UC Davis

Recent Work

Title

Modeling Employees' Perceptions and Proportional Preferences of Work Locations: The Regular Workplace and Telecommuting Alternatives

Permalink

<https://escholarship.org/uc/item/52v5c9wr>

Authors

Mokhtarian, Patricia
Bagley, Michael

Publication Date

2000-05-01

PERGAMON

Transportation Research Part A 34 (2000) 223–242

TRANSPORTATION
RESEARCH
PART A

www.elsevier.com/locate/tra

Modeling employees' perceptions and proportional preferences of work locations: the regular workplace and telecommuting alternatives

Patricia L. Mokhtarian *, Michael N. Bagley

*Department of Civil and Environmental Engineering and Institute of Transportation Studies, One Shields Avenue,
University of California, Davis, Davis, CA 95616, USA*

Received 10 August 1998; received in revised form 10 December 1998; accepted 22 December 1998

Abstract

This paper develops measures of job and workplace perceptions, and examines the importance of those and other measures to the desired proportions of work time at each of three locations: regular workplace, home, and telecommuting center. Using data from 188 participants in the Neighborhood Telecenters Project, four job context perception factors were identified: productivity, job satisfaction, supervisor relationship, and co-worker interaction. Four generic workplace perception factors were identified (with measures for each of the work locations of interest): personal benefits, work effectiveness, autonomy, and supervisor comfort. A multinomial logit model of the desired work time allocation found the generic variables job suitability, personal benefits, and work effectiveness to be significant and positively related to greater desired proportions of time at the associated location. These variables capture the major elements previously hypothesized to influence telecommuting preference (including work, family, independence, and commute stress reduction drives as well as manager and job suitability constraints) in a parsimonious fashion. The model explained 55% of the theoretical maximum amount of information in the data, and did not violate the Independence of Irrelevant Alternatives (IIA) assumption. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Telecommuting; Telecommuting center; Proportions logit model; Factor analysis

* Corresponding author. Tel.: +1-530-752-7062; fax: +1-530-752-7872; <http://www.engr.ucdavis.edu/~its/telecom/>
E-mail address: plmokhtarian@ucdavis.edu (P.L. Mokhtarian).

1. Introduction

In recent years, telecommuting¹ has become firmly established in the US as a workplace alternative, promoted by the public sector as a transportation demand management strategy (as well as serving other public goals), adopted by employers for business reasons such as reduced real estate costs and improved customer service, and embraced by employees as offering a way to balance the conflicting demands of work and personal life. This is not to imply that telecommuting adoption has reached saturation: it appears that many more people want to telecommute than are able to do so at this point (Mokhtarian and Salomon, 1996), and that even those who begin to telecommute are often not able to sustain it for very long (Varma et al., 1998). But awareness of telecommuting is relatively pervasive at this point, and net adoption continues to grow.

Currently, most telecommuting is home-based. But as has been pointed out elsewhere, home is not a suitable place to work for everyone. Some employees may prefer the structure, spatial separation from home, opportunities for human interaction, and potentially superior facilities or equipment offered by an out-of-home office – while not wanting (at least on a daily basis) the lengthy commute to their regular workplace. Further, some employers may feel more comfortable with the employee's productivity, the security, and the professional image associated with a traditional office environment (even if remote from direct supervision). In these situations, telecommuting from a local center (a conventionally-equipped office generally operated by a public or private agency and shared by multiple employers leasing space for their employees) may be the solution.

Considerable experimentation with telecommuting centers has taken place in the US, Japan, and Europe (Aichholzer, 1996; Buckinger et al., 1997; Mokhtarian et al., 1997; Sato, 1997; Spinks, 1997). The state of California alone has seen more than 40 such facilities established since 1991, and the US federal government is participating in the operation of more than two dozen telecenters under its Flexible Workplace Initiatives program. To date, most of these centers cannot be considered successful in terms of achieving economic self-sustainability; indeed many of them have closed due to insufficient revenues at the conclusion of the demonstration period. However, it is possible that the telecenter concept is either ahead of its time (given that even the simpler home-based form of telecommuting still faces institutional barriers to wider adoption) or being implemented in a flawed way (for example, perhaps with an undue emphasis on a multi-employer facility, primarily dedicated to telecommuting), for the advantages of telecenters described above appear to have merit at least for a segment of the potential market.

Further, the transportation and even air quality impacts of the center-based form of telecommuting seem to be positive (Mokhtarian and Varma, 1998). Telecenters appear to have a small trip generation effect (interestingly, mainly commute trips generated by going home for

¹ In this paper, telecommuting refers to a salaried employee working from home or from another location, with the result that commuting to the regular workplace is eliminated, reduced, or shifted in time (generally out of the peak). As such, telecommuting is a subset of telework or remote work (Mokhtarian, 1991), where the latter terms may also include self-employment, overtime work at home, and mobile work (working from a variety of locations and/or while traveling).

lunch and returning to the center in the afternoon), but the reduction in distance traveled is so large that all criteria pollutants studied decrease for telecommuters on their telecommuting days. Thus, from a public policy standpoint it is important to learn more about the demand for center-based telecommuting compared to the home-based form, to help determine what allocation of support will yield optimal results in terms of transportation (and other desirable) impacts. Putting all our public policy “eggs” into the home-based telecommuting “basket”, for example, would not be optimal if there is a large segment of the market for which only center-based telecommuting is acceptable. Pushing center-based telecommuting, on the other hand, would not be cost-effective if it will ultimately appeal only to a small niche market.

2. Previous work and motivation for this research

At least two studies have investigated employees’ preference between center-based and home-based telecommuting, using discrete choice (logit) models. Bagley and Mokhtarian (1997) analyzed the responses of nearly 600 employees of the City of San Diego, whereas Stanek and Mokhtarian (1998) dealt with 97 participants (from a variety of employers) in the California Neighborhood Telecenters Project. In both cases, explanatory variables included attitudinal factors, other drives and constraints, and demographic characteristics. The two studies used very different surveys, however, and for Bagley and Mokhtarian (1997), the attitudinal factors were generic to telecommuting per se, not specific to each form of telecommuting.

As discussed at greater length in those two papers, defining the dependent variable in this context is somewhat problematic. The standard discrete choice modeling framework assumes that the decision-maker selects one and only one alternative from her choice set. But if we view the current context as a workplace preference decision, the fundamental alternatives – regular workplace, home, and telecommuting center – are not mutually exclusive. Most telecommuting is part-time – 1 or 2 days a week on average (Mokhtarian, 1998) – and hence telecommuting will generally be mixed with working at the regular workplace during the course of a given week. Indeed, if the “most preferred” alternative is taken to be the one that is desired to be used for the greatest amount of time during the week, then the regular workplace would be the “most preferred” alternative for a sizable majority of telecommuters – a situation that would not provide much insight into the choice of telecommuting. Further, as seen below and in Mokhtarian et al. (1997), a number of respondents express a desire to engage in both forms of telecommuting, so that even the preference between telecommuting alternatives is not mutually exclusive.

The two studies cited took a simplified approach to defining the dependent variable. First, they focused on the two telecommuting alternatives. Given that, various preference measures were formulated, based on responses to the following question (virtually identically-worded in both surveys): “Assuming there are no work-related constraints, how much would you like to telecommute from (a) a telecommuting center? (b) home?” The possible response categories were not at all, less than once a month, about 1–3 days a month, 1–2 days a week, 3–4 days a week, 5 days a week, and occasional partial days (which was eventually combined with the “less than once a month” category). An important feature of this question wording is that individuals could respond to the two forms of telecommuting independently rather than partitioning a certain amount of desired telecommuting time between the two. Hence, their responses to both questions might

add to more than 5 days a week, and it is likely that they at least tended to respond to each form as a maximum desired amount if the other form were not available.

Different models in these two studies defined “preference” in different ways. One set of models analyzed the preference between telecommuting from a center and not telecommuting from a center, where respondents were defined as preferring telecommuting from a center if they expressed the desire to do so any non-negligible amount [Bagley and Mokhtarian (1997) counted “less than once a month” as still indicating a preference for telecommuting, whereas Stanek and Mokhtarian (1998) did not].² Although this was a conventional and natural definition of a binary dependent variable, it created some problems with interpretation. First, the “not center-based telecommuting” alternative confounded the “home-based” and “neither” alternatives, and second, a respondent classified as “preferring” center-based telecommuting under this definition might actually prefer to telecommute from home even more frequently.

To partially avoid these problems, a second set of models analyzed the preference between home and center only, where respondents were defined as preferring alternative x if they wanted to telecommute from x more frequently than from the other location. However, these models necessarily excluded those who preferred neither form of telecommuting, and those who preferred to engage in both forms at equal frequency. Thus, although they could offer some insight into the preference between forms of telecommuting, they could not identify variables important to both forms of telecommuting, i.e. those that distinguished the desire to telecommute (generically) from the desire not to do so. Further, even with this definition of preferring alternative x , respondents could still want to engage in the other alternative at some (albeit a lesser) frequency. Although this situation is not very different from conventional discrete choice models in which a preference for one alternative does not absolutely preclude a lesser preference for another alternative, it still weakens the ability of a model to distinguish between two discrete alternatives on the basis of observed explanatory variables – which are likely legitimately to favor both alternatives to some extent.

Bagley and Mokhtarian (1997) estimated one more type of model: a nested logit model containing the four alternatives neither, home, center, and either. With home and center preference defined as in the second set of models just described, the “neither” respondents were those answering “not at all” to both questions about desired frequency of telecommuting, and the “either” or indifferent respondents were those who gave the same frequency category for both forms of telecommuting. Although this model was conceptually the strongest of those developed in these studies, it suffered both from the same blurring of the telecommuting alternatives in the definition of the dependent variable, and from a lack of explanatory variables which differed in value by form of telecommuting.

Of course, it is theoretically possible to define discrete (mutually exclusive and collectively exhaustive) alternatives in terms of bundles or combinations of the elemental alternatives regular workplace, home, and center. In practice, however, this approach is not very appealing. First, there are an infinite number of possible bundles if desired proportion of time at each location is

² Stanek and Mokhtarian (1998) also modeled the preference between telecommuting from home and not, using a similar definition; the comparable model on the other data set was previously reported in Mokhtarian and Salomon (1997).

taken into account (e.g. differentiating 60%-RW/30%-HM/10%-TC from 55%-RW/35%-HM/10%-TC). At the opposite extreme, as few as seven bundles could be defined (RW–HM–TC, RW–HM, RW–TC, HM–TC, RW, HM, TC) if no regard were paid to the relative proportions of time desired at each location, but that approach has all the disadvantages of the binary definitions used in the earlier work, and more. These two extremes, as well as cases in between (e.g. for each of the first four of the seven bundles described above, distinguishing which member of the bundle was “most preferred”) – in other words, all approaches involving bundles of elemental alternatives – also suffer from the difficulty of defining generic independent variables that vary by each alternative. As described below, our data (based on generic factors for each workplace) are better suited to doing so than is usually the case (e.g. for a particular variable such as work effectiveness, one could devise a composite “score” for the bundle, weighting each individual workplace score by the proportional weight that the workplace has in the bundle), but it still represents rather a contrived method compared to the more natural approach taken here.

The present research is an attempt to remedy both shortcomings of the “best” Bagley and Mokhtarian (1997) model, that is, it improves both on the definition of the dependent variable and on the measurement of explanatory variables. It is in some ways a successor to the Stanek and Mokhtarian (1998) study, since it is based on the final sample from the Neighborhood Telecenters Project (at $N=188$, more than double the size of the interim sample available to the earlier study). An important feature of the questionnaire used in that project is that participants were asked to respond on a Likert-type scale to 30 attitude statements about each of the three locations: regular workplace, telecenter, and home. As discussed further in Section 4, this allowed the development of generic explanatory variables which could take on different values for each workplace alternative. This aspect distinguishes the current study [together with the earlier Stanek and Mokhtarian (1998) study] from other telecommuting models, in which few or no explanatory variables are available that differ by telecommuting location.

The definition of the dependent variable used here also differs from that used in any previous model of telecommuting adoption. It is still a preference indicator, but is derived from a different question on the survey. The question asks, “Given your current circumstances, what would be the ideal distribution of your work time among each of the following locations?...”, with responses expected to add to 100% across the provided alternatives of regular workplace, telecommuting center, home, and other. The response to this question represents a desired partition of one’s time among workplace alternatives. It is this partition which is the indicator most appropriate to model (given preference and not choice per se as the dependent variable of interest). To understand the adoption of telecommuting, it is important not just to know how one form is preferred relative to the other, but how both are viewed relative to the regular workplace alternative. For example, two respondents could both be classified as “indifferent” between both forms of telecommuting under the previous model, but one wants to telecommute (from either location) once a month while the other wants to do so 4 days a week. It is critical to know what variables distinguish one such respondent from the other, and (to forecast transportation impacts, for example) the relative incidence of each type of respondent in the population.

Thus, the model developed here is one of desired (relative) frequency for each workplace location type. The presumption of the model is that a preference for each workplace location is a function of the perceived utility of that location, and that different partitions of time among locations should be explainable by different attribute ratings for each location (among other

variables). Someone wanting to work at the regular workplace 80% of the time should find something more valuable about the regular workplace than the person wanting to work there only 10% of the time. This study attempts to identify what generates those differences.

Accordingly, discrete choice modeling is still employed here, but using proportions data rather than a zero-one indicator of preference. The three alternatives analyzed are regular workplace, telecenter, and home. Twenty respondents who indicated wanting to spend a considerable amount of time at “other” locations – such as at client offices – were removed from the sample for the purposes of this study. For three other individuals who indicated wanting to spend a small amount of time at “other” locations (e.g. at conferences), their responses for the three alternatives of interest were proportionally increased to total 100% as required by the LIMDEP estimation software (Green, 1995) used in this study. The explanatory variables include perceptions and other measures that vary across workplace, as well as variables that do not vary by workplace.

The organization of the remainder of this paper is as follows: Section 3 describes the empirical context of this research, including a description of the sample. Section 4 presents the measurement of attitudinal factors relating to job satisfaction and generic workplace perceptions, and Section 5 discusses possible model structures and provides the final model results. Section 6 summarizes and interprets the findings and suggests directions for future research.

3. Empirical context

The Residential Area-Based Offices Project, informally known as the Neighborhood Telecenters Project (NTP), provides the empirical context for the models developed here. The NTP was a multi-year project funded by the Federal Highway Administration and the California Department of Transportation, to open a number of telecommuting centers around the state of California and evaluate their effectiveness as a work arrangement and as a transportation demand management strategy. Fifteen telecenters were opened under the NTP, and an additional five centers participated to some extent in the evaluation process. The data usable for this portion of the analysis came from respondents associated with 18 of the 20 centers.

Four different instruments were used in the evaluation of the telecenters: attitudinal surveys, travel diaries, exit interviews, and attendance logs. Attitudinal surveys were completed by telecommuters shortly before beginning to use the center, and again about six months later. Similar surveys were completed at roughly the same times by home-based telecommuters and non-telecommuters in comparable occupations at the same organizations. Parallel surveys were completed by managers of each of these respondents. Despite providing response incentives, however, the sizes of the comparison groups are much smaller than that of the telecenter user group.

The present study uses the 188 responses having relatively complete data on the before-wave employee attitudinal survey: 133 (prospective) telecenter users, 20 home-based telecommuters, and 35 non-telecommuters. Although the after-wave data would have provided information on preferences tempered by actual experience with center-based telecommuting, the sample size would have been considerably smaller, since many respondents either had not been telecommuting long enough to receive an after survey at the time data collection was concluded, had quit telecommuting before enough time had elapsed to receive the after survey, or simply failed to complete the after survey. Analysis of telecommuting duration, assessment of impacts on trans-

portation and emissions, and other aspects of the evaluation are reported in references cited earlier.

Table 1 summarizes some key characteristics of the sample. The respondents are largely well-educated, relatively affluent, mid-career professionals. Slightly more than half are women, and slightly fewer than half have children less than 16 years old living at home. In keeping with previous studies of telecommuters (Mokhtarian, 1998), the sample includes a disproportionate number of long-distance commuters: the average one-way commute length is 34 miles, taking 46 min. The respondents' jobs appear to be well-suited to telecommuting: nearly 70% of their work time, on average, is spent working independently or with others remotely, and only a quarter of their time is spent face to face with others or in location-dependent work.

Table 2 presents the respondents' ideal distribution of work time among the three workplaces of interest, disaggregated by workplace combination. Clearly the proportions of the sample falling into each workplace combination are not representative of the population as a whole, given the selection bias (in particular, the pro-telecenter bias) of the sample. However, it is still useful to understand the variety in preference across respondents. And the relationship of these preferences to explanatory variables can be estimated consistently (in the statistical sense of the word), even with a sample that is non-random (Ben-Akiva and Lerman, 1985).

Table 1
Sample characteristics ($N = 188$)

<i>Occupation</i>		<i>Gender</i>	
Manager/administration	34 (18.1%)	Female	102 (54.3%)
Professional/technical	106 (56.4%)	Male	86 (45.7%)
Services/repair	1 (0.5%)	<i>Average one-way commute</i>	
Administrative support	28 (14.9%)	Length (miles)	33.8 (s.d. 23.2)
Sales/marketing	19 (10.1%)	Time (min)	46.1 (s.d. 27.3)
<i>Annual HH pretax income</i>		<i>Age</i>	
Less than \$15,000	1 (0.5%)	24 or younger	3 (1.6%)
\$15,000–\$34,999	20 (10.8%)	25–34	46 (24.7%)
\$35,000–\$54,999	53 (28.5%)	35–44	80 (43.0%)
\$55,000–\$74,999	47 (25.3%)	45–54	47 (25.3%)
\$75,000–\$94,999	32 (17.2%)	55–64	9 (4.8%)
\$95,000 or more	33 (17.7%)	65 or older	1 (0.5%)
<i>Average years with:</i>		<i>Average % time spent:</i>	
Employer	7.3 (s.d. 6.3)	Working independently	46.9 (s.d. 24.7)
Occupation	8.7 (s.d. 7.3)	Working with others remotely	20.7 (s.d. 17.2)
<i>Education</i>		Face to face with others	19.7 (s.d. 12.3)
High school graduate	8 (4.3%)	Working in a specific location	5.7 (s.d. 8.6)
Some college or tech school	41 (21.9%)	In work-related travel	6.5 (s.d. 9.9)
4-year degree	61 (32.6%)	<i>Household size</i>	
Some graduate school	19 (10.2%)	Average no. of people	2.9 (s.d. 1.3)
Completed graduate degree	58 (31.0%)	No. with children under 16	87 (46.3%)
		No. with children under 6	53 (28.2%)

Table 2

Desired work time allocation by workplace combination

Workplace combination ^a	Average ideal percent work time at:			Respondent classification (%)			
	Regular workplace	Telecommuting center	Home	Center-based telecommuter	Home-based telecommuter	Non-telecommuter	Total
RW	100.0	–	–	2 (1.5)	0	5 (14.3)	7 (3.7)
TC	–	100.0	–	4 (3.0)	0	0	4 (2.1)
RW and TC	60.5	39.5	–	62 (46.6)	0	0	62 (33.0)
RW and HM	57.7	–	42.3	6 (4.5)	18 (90.0)	22 (62.9)	46 (24.5)
TC and HM	–	72.9	27.1	7 (5.3)	0	0	7 (3.7)
RW, TC, and HM	44.8	32.4	22.8	52 (39.1)	2 (10.0)	8 (22.9)	62 (33.0)
Total	52.6	28.6	18.9	133 (100.0)	20 (100.0)	35 (100.0)	188 (100.0)

^a RW, regular workplace; TC, telecommuting center; HM, home.

It can be seen that 4% of the sample did not want to telecommute at all (most of whom were already non-telecommuters, but two of whom, interestingly, were among the prospective telecenter users). About a quarter wanted to telecommute exclusively from home, on average 42% of the time or about two days a week. All but two of the existing home-based telecommuters fell into this group, indicating that for the most part home-based telecommuters were not interested in center-based telecommuting. But this group also included a majority (63%) of the non-telecommuters in the sample (indicating an unsatisfied demand for telecommuting) as well as a few (5%) of the prospective center users (suggesting that they would be telecommuting from a center only because the home-based option was not available to them).

About a third of the sample wanted to telecommute exclusively from a center, similarly about 2 days a week or 40% of the time on average. Thus, early hypotheses that employees may want to telecommute more often from a center than from home because it is less isolated and better equipped (e.g. Bagley et al., 1994) have not been borne out empirically – neither in this study of preference nor in a study of actual telecommuting frequency (Varma et al., 1998), which found center usage to be very similar to typical home-based telecommuting frequencies at 1.1 days per week on average.

A third of the sample wanted some mixture of both forms of telecommuting and the regular workplace. This group was dominated by prospective telecenter users, who wanted, on average, to spend somewhat more work time at the telecenter than at home – and more at both locations combined than at the regular workplace.

4. Job and workplace perceptions

In discrete choice models, the utility for a particular alternative is assumed to be a function of characteristics of the decision-maker (e.g. socio-demographic variables) and characteristics of the alternative. This section focuses on the measurement of work-related perceptions hypothesized to affect the preference for alternative work locations. Data were collected on two sets of attitudes. One set relates to characteristics of the job context in general. As measured, these variables

represent decision-maker characteristics that do not vary by workplace location. The second set of attitudes relates to characteristics of the specific workplace alternative.

A number of previous studies of the adoption of telecommuting have included explanatory variables related to the relative advantages and disadvantages of the regular workplace compared to a telecommuting location which is either specified to be home, or is unspecified. For example, it is common to compare telecommuting to the regular workplace on characteristics such as perceived productivity, motivation to work, social/professional interaction, prospects for career advancement, commute characteristics, and so on. The current study builds on and extends this earlier work by carefully considering the characteristics that are likely to distinguish not only between telecommuting and the regular workplace, but between home-based and center-based telecommuting. Based on the literature presenting conceptual models of telecommuting adoption as a function of various drives and constraints, and on the authors' informed judgement, 30 such characteristics were identified.

Although congruence with the industrial psychology literature on job satisfaction was not the originating motivation for the characteristics identified, it develops that those characteristics (both of the workplace and of the job context) are consistent with that literature. It is natural to suggest that, in a broad sense, job satisfaction may vary by workplace, and that the preference for various workplaces may be partly a function of the job satisfaction at each location.

A modern treatment of components of job satisfaction may be found, for example, in Clark (1998), who identifies six distinct elements: pay, hours of work, future prospects, job difficulty, job content, and interpersonal relationships. Perhaps the closest fit to our work, however, is found in the classic work by Locke's (1976). He identified nine components of job satisfaction: work, recognition, promotion, supervision, co-workers, working conditions, management, pay, and benefits. In our present context, the last two components were assumed to be constant regardless of preferred work location, and not to affect the desire to telecommute. This assumption is consistent with the most common practice in the US for salaried employees who telecommute, and in particular with the conditions pertaining to the respondents in this study. The remaining seven components were measured through responses on a five-point scale to the two sets of attitudinal statements mentioned above. The first set of statements, related to the job and its context, associated primarily with the first five of Locke's (1976) components. The second set contained 30 statements for each of the three work locations, and related primarily to Locke's working conditions and management components. Responses to both sets of statements were factor-analyzed separately, using oblique rotation (see, e.g. Rummel, 1970).

4.1. Job context perceptions

Table 3 presents the strongest pattern matrix loadings for the first set of attitudinal statements. Based on the eigenvalue-one cutoff rule modified by an interpretability criterion, the four-factor solution was adopted, which accounted for 58% of the total variance in the data. The highest correlation between any two factors was 0.27 (between factors 1 and 4, with factors 2 and 3 having a 0.26 correlation). The factors are highly interpretable, and may be described as follows:

1. *Productivity*. The eight statements loading most heavily on this factor represent various aspects of productivity – the quantity, quality, and timeliness of work completed, and an overall perception of productivity, each from both the respondent's perspective and the respondent's view

Table 3

Strongest pattern matrix loadings for job context attitudes

Statement	Loading
<i>Factor 1: Productivity</i>	
How supervisor would rate employee's ability to meet deadlines	0.85
How supervisor would rate employee's overall productivity	0.85
How supervisor would rate the amount of work completed by the employee	0.76
How employee rates his/her overall productivity	0.75
How employee rates his/her ability to meet deadlines	0.73
How supervisor would rate the quality of the employee's work	0.69
How employee rates his/her quality of work	0.65
How employee rates his/her amount of work completed	0.64
<i>Factor 2: Job satisfaction</i>	
Working at my job gives me a sense of accomplishment	0.89
Overall, I am satisfied with my job	0.85
I am likely to look for a new job in the near future	−0.55
My job is tedious and boring	−0.46
My supervisor doesn't appreciate my work effort enough	−0.28
<i>Factor 3: Supervisor relationship</i>	
My supervisor doesn't appreciate my work effort enough	−0.70
My supervisor and I work well together	0.69
My supervisor and I don't communicate effectively	−0.67
I have the same opportunity for promotion as anyone who is similarly qualified	0.61
My work team is effective	0.39
<i>Factor 4: Co-worker interaction</i>	
I don't get along well with my co-workers	−0.81
I am confident in my ability to do what is expected of me at work	0.64
My work team is effective	0.43
I am frustrated by a lack of adequate resources to do my job	−0.31

of the supervisor's perspective. These eight statements were rated on a five-point semantic differential scale whose endpoints were "terrible" and "excellent"; all other statements discussed in this section were measured on the "strongly disagree" to "strongly agree" Likert-type scale.

2. *Job satisfaction.* Statements relating to a sense of accomplishment and overall satisfaction loaded positively on this factor, whereas statements relating to the tedium of the job, an interest in changing jobs, and lack of appreciation by the supervisor loaded negatively.
3. *Supervisor relationship.* Positively-worded statements about working well with one's supervisor and having a fair opportunity for promotion loaded positively on this factor, whereas statements about not being appreciated by the supervisor and not communicating well with him/her loaded negatively. A secondary loading about the effectiveness of the work team also appears here (split between this factor and the next one), probably here reflecting the influence of the supervisor on the work team.
4. *Co-worker interaction.* The first and third highest-magnitude loadings on this factor relate to getting along with one's co-workers and having an effective work team, so this appears to be

predominately a co-worker interaction dimension. However, two additional statements relate to being confident in one's ability to do what is expected, and being frustrated by a lack of adequate resources (loading negatively). Hence, this might be more broadly labeled a "work context" factor, but the "co-worker interaction" label was adopted as being more descriptive and capturing the primary content of the dimension.

Each of these factors could be hypothesized to affect workplace location preferences, although as it happens, in most cases, effects in both directions are potentially plausible. For example, if I am productive, I may want to telecommute because it will allow me to be even more productive; on the other hand if I am not productive, I may want to telecommute to allow me to get away with even more laxity. If I am satisfied with my job, I may want to telecommute – again, to derive even more satisfaction by accomplishing more; on the other hand, if a lot of my satisfaction is derived from the physical and/or social environment of the regular workplace, I may not want to telecommute. If my relationship with my supervisor is good, that increases the likelihood that I will be allowed to telecommute and hence [as found by other studies, e.g. Bagley and Mokhtarian (1997)] that I will want to (that is, in practice our preferences tend to take external constraints into account to some extent, even though conceptually there is no need for them to do so – we could prefer an alternative even though we know it is impossible for us). On the other hand, if my relationship is bad, I may want to telecommute to reduce contact and possibly tension.

4.2. *Workplace perceptions*

As mentioned earlier, the before-wave survey contained a section with 30 statements relating to environment, ease of working, personal impacts, and supervisory conditions associated with the workplace. Individuals responded on a 5-point Likert-type scale to each statement for each of the three workplaces. Two of the statements, related to family life (flexibility to handle dependent care and potential household conflicts), were discarded from the factor analysis since they were not applicable to everyone. Responses to the remaining statements were analyzed as $188 \times 3 = 564$ cases with 28 variables each, rather than as 188 cases with $28 \times 3 = 84$ variables each. This ensured that a statement was associated with the same factor for all three workplaces.

Table 4 presents the strongest pattern matrix loadings for this set of attitudinal statements. A four-factor solution was also adopted here, accounting for 52% of the variance in the data. The highest correlation between factors was 0.38 (between factors 3 and 4); factors 1 and 2 had a correlation of 0.34. Both of those outcomes are consistent with the nature of the factors, as described below: factors 1 and 2 can be considered measures of the independence/leisure drive identified by Mokhtarian and Salomon (1994) (although factor 1 also contains elements relating to travel, family, and work drives as well), and factors 3 and 4 are both indicators of a work drive. For ease of interpretation, in each case, the factor was (re-)oriented (if necessary) so that a higher score on that factor is more favorable to the workplace in question.

1. *Personal benefits*. Statements loading heavily on this factor relate to a variety of potential benefits of a given workplace, including the ability to dress as one likes and to control one's work environment, to have a low-stress commute, to help the environment and not involve a high cost, to minimize distractions from others and effectively balance work and household responsibilities.

Table 4
Strongest pattern matrix loadings for workplace perceptions

Statement	Loading
<i>Factor 1: Personal benefits</i>	
My commute would be a hassle when I work from...	−0.81
It would be beneficial to the environment to work from...	0.76
It would save me money to work from...	0.72
I would be able to dress the way I like at...	0.64
I wouldn't have a lot of free time to be with my family and/or friends when I work from...	−0.64
It would cost me too much money to work from...	−0.62
When sick or disabled, I would be able to work at...	0.59
I would have control over my work environment (noise, etc.) when I work from...	0.55
Distractions from other people would be a problem when I work at...	−0.54
I could effectively balance work and household responsibilities when I work at...	0.51
<i>Factor 2: Autonomy</i>	
I would have relative independence in my day-to-day activities when I work from...	0.60
I would have the freedom to adjust my work schedule when I work from...	0.59
The merit of my work would be judged primarily by results if I worked from...	0.58
It would be convenient to run errands when I work from...	0.56
I would have control over my work environment (noise, etc.) when I work from...	0.28
<i>Factor 3: Work effectiveness</i>	
It would be easy for me to be motivated when I work from...	0.75
I would have difficulty keeping my home and work activities separate when working at...	−0.72
The workplace would have a professional appearance at...	0.71
I would work effectively at...	0.71
It would be stressful to work from...	−0.60
I would probably overeat or indulge in other ways when I work from...	−0.58
I wouldn't have the needed equipment and services to be effective at...	−0.56
It would take a lot of self-discipline to work from...	−0.47
Distractions from other people would be a problem when I work at...	−0.46
I wouldn't have enough space to work at...	−0.36
<i>Factor 4: Supervisor comfort</i>	
Communication with my supervisor would be a problem when I work from...	−0.78
I wouldn't be visible enough to management if I worked at...	−0.69
I wouldn't have enough opportunities for professional interaction at...	−0.55
My supervisor would be uncomfortable when I work from...	−0.54
I would have enough opportunities for social interaction with fellow employees and others when I work from...	−0.60
The merit of my work would be judged primarily by results if I worked from...	0.34

2. *Autonomy*. Statements loading on this factor relate to independence from supervision, freedom to adjust one's schedule and run errands, and having one's work judged by results.
3. *Work effectiveness*. Statements loading positively on this factor relate to being motivated and working effectively at a given workplace. Statements loading negatively include concerns about keeping home and work separate, stress, lack of self-discipline, needed equipment or space, and distractions from others.

4. *Supervisor comfort*. Statements loading negatively on this factor relate to concerns about communicating with the supervisor, the supervisor's level of comfort with the employee working at this particular workplace, visibility to management, and professional and social interaction.

Computation of factor scores resulted in each respondent having a score on each factor for each workplace. Across all three workplaces and the sample as a whole, the scores for each factor are automatically standardized to have mean zero and variance one. Examination of mean factor scores by workplace, as shown in Fig. 1, indicates how each workplace is perceived relative to the others on the four identified dimensions; the results are consistent with expectations.

Home-based telecommuting is viewed as offering the most personal benefits and autonomy, but arouses concern about work effectiveness and supervisor reaction. Center-based telecommuting does not offer as many personal benefits (due to the requirement to dress, make a commute, and share an office environment with others), but rates the highest of the three locations on work effectiveness (perhaps successfully avoiding the different distractions of both home and the regular workplace). Autonomy when working from a center is perceived to be superior to that at the regular workplace, but not as high as when telecommuting from home (perhaps the center is to some extent viewed as an administrative extension of the regular workplace). On the other hand, not surprisingly, supervisors are expected to be somewhat more comfortable with their employees telecommuting from a center than from home, although not as comfortable as when they are at the regular workplace. The regular workplace is clearly viewed as inferior on the personal benefits and autonomy dimensions, while offering moderate work effectiveness and, of course, the highest

Fig. 1. Mean factor scores by workplace ($N = 188$).

level of supervisor comfort. Collectively, these perceptions tend to reinforce the idea that center-based telecommuting can in many cases provide a mutually acceptable compromise between employee and employer desires and concerns.

5. Workplace preference

5.1. *Testing the validity of the Independence of Irrelevant Alternatives (IIA)*

As indicated in Section 2, the dependent variable for this study was the stated ideal percent of work time at each of the three locations: regular workplace, telecommuting center, and home. In estimating logit models on these alternatives, it is essential to test whether the Independence of Irrelevant Alternatives assumption holds. If the error terms in the utility equations are correlated across alternatives (that is, if the utilities for two of the alternatives share significant unobserved variables not shared by the third), then the IIA assumption is violated and multinomial logit (MNL) estimation results are not valid.

Fry and Harris (1996) point out that the tests for IIA can be classified into two types: comparing MNL with an alternative model form that does not involve the IIA assumption, and “partitioning the choice set”, or statistically comparing model parameters estimated from the full choice set to those estimated from a restricted choice set. To estimate parameters on the restricted choice set, cases choosing the excluded alternative(s) must be dropped from the sample, and variables specific to excluded alternative(s) must be dropped from the model specification. It is important to realize, then, that in cases (such as ours) involving proportions data rather than 0–1 choices, IIA tests involving partitioning the choice set (e.g. Hausman and McFadden, 1984, Small and Hsiao, 1985) are likely not to be practical. This is because a large proportion of the sample is likely to have some degree of preference (in our case, or “choice” in general) across multiple alternatives, and excluding all such cases would decimate the sample. For example, from Table 2 it may be seen that dropping everyone expressing any preference for home-based telecommuting would eliminate 61% of the sample. The comparable proportions for excluding the center-based telecommuting and regular workplace alternatives are 72 and 94%, respectively.

Accordingly, in this context, the most straightforward test of whether IIA holds is to estimate a more general nested logit (NL) model (Ben-Akiva and Lerman, 1985), in which alternatives that are suspected of being similar are placed together in one branch and distinct alternative(s) placed in a different branch(es). If the inclusive value coefficient associated with the branch is not significantly different from one, the NL model is not significantly better than the corresponding MNL model, and the case for IIA being valid is strengthened.

When there are three alternatives, three different nested structures are possible, as shown in Fig. 2 for the current context. Conceptually, it may seem that the most natural structure is the one shown in Fig. 2(a), in which the two telecommuting alternatives are grouped together. Clearly, it is quite possible that some variables significant to the preference for either form of telecommuting, but not relevant to the preference for the regular workplace, are unobserved, which would result in the error terms for the utilities of the two telecommuting alternatives being correlated. However, for completeness it is advisable to check each nested logit structure (Gensch and Ghose, 1997), since unsuspected correlations between alternatives may be present empirically. And in

a: Telecommuting versus Non-telecommuting

b: Out-of-home versus In-home

c: Anchor Location versus Telecenter

Fig. 2. Alternative nested logit structures.

fact, a conceptual case can be made for each of the other two nested structures as well. The regular workplace and the telecommuting center [Fig. 2(b)] have in common that they are both out-of-home locations. As such, they may share unobserved variables related to the (dis)utility of having to get dressed to go out, the necessity of making a trip, and so on. The regular workplace and the home [Fig. 2(c)] have in common that they are important “fixed points” in an individual’s activity space – locations whose surroundings and inhabitants are familiar, that are relatively “comfortable”, and visited frequently. By contrast, the telecommuting center is an unfamiliar location (especially evaluated in the abstract, as would have been the case for many respondents) with an unknown atmosphere.

Each of these NL structures was tested, and in each case the null hypothesis of equivalence to the MNL specification could not be rejected. As McFadden et al. (1977, p. 45) point out, the validity of IIA “depends on the specification of the model for a particular choice situation, not on the choice situation itself”. Evidently, the model specification used here is sufficiently robust that

IIA is not violated despite the conceptual grounds for suspecting that it would be. Hence, in this paper we present and discuss only the MNL model results.

5.2. Multinomial logit results

More than 40 measures were considered as candidate explanatory variables in the multinomial logit model of workplace proportions preference, including the two sets of factor scores described in Section 4, other indicators of job suitability and manager willingness, and socio-demographic variables. Each variable was tested singly and in combination with others, in various forms of specification (generic where possible, as well as alternative-specific with the coefficients respectively constrained to be equal or allowed to vary across two or all three of the alternatives). After a tentative final model was identified, selected variables that were excluded at an earlier stage were tested again for inclusion, to minimize the possibility of omitting a significant variable.

The final model specification is shown in Table 5. Collectively, the significant variables capture the key drives and constraints suggested to be important to workplace preference. Individually, each variable is significant (with the marginal exception of the home ASC) and for the most part has a reasonable sign. The positive signs and similar magnitudes of the two ASCs indicate that important variables not included in the model favor telecommuting on average (although these parameters, unlike the rest, are not statistically consistent estimates of the true values due to the non-representativeness of the sample). The negative sign of the education coefficient means that the more highly educated the respondent, the lower the reported ideal percent of time spent telecommuting. Although this is counter to a previous finding on a different data set [Bagley and

Table 5
Multinomial logit workplace proportions model

Variable	Variable type	Coefficient	<i>t</i> -Statistic
Alternative-specific constant, telecenter	Constant	1.38	1.96
Alternative-specific constant, home	Constant	1.17	1.56
Education	Demographic (specific to telecenter and home)	−0.26	−1.96
Job suitability	Facilitator (generic)	0.68	4.19
Personal benefits	Travel, independence/leisure, family, and work drives (generic to telecenter and home, zero for regular workplace)	0.69	2.55
Work effectiveness	Work drive (generic)	0.34	1.96
Number of observations		185	
Log-likelihood at zero		−203.24	
Log-likelihood at convergence		−157.73	
ρ^2		0.22	
Adjusted ρ^2		0.21	
χ^2		93.34	
Theoretical maximum log-likelihood		−120.56	
Proportion of distance between equally-likely and theoretical maximum log-likelihoods explained by the model		0.55	

Mokhtarian (1997) found education level to be positively associated with a preference for home-based telecommuting], it is possible that education is serving as a proxy for another variable such as age (and therefore inertia with respect to change).

The remaining three variables are generic, that is, capable of taking on different values for each workplace. Job suitability is an ordinal variable indicating the (categorical) frequency with which the respondent's job permitted working from each location (the question was only asked with respect to the two telecommuting alternatives; it was assumed that each job could be conducted from the regular workplace with maximum frequency). It is significant and positive, in keeping with previous studies finding that the constraint/facilitator job suitability actually affects preference as well as choice. Personal benefits is one of the workplace perception factors described in Section 4.2; in the final model it is significantly (and positively) associated only with the two telecommuting alternatives. The work effectiveness variable is another one of the workplace perception factors, and is significant to all three alternatives.

It is of interest to discuss variables that are not significant in the final model as well as those that are. None of the job context perception factors mentioned in Section 4.1 were significant – which is not necessarily surprising in view of the potential counteracting effects described there. Two of the four workplace perception factors, autonomy and supervisor comfort, were not significant – but as mentioned earlier, they are correlated conceptually and empirically with the two factors that were significant. Objective characteristics such as commute length and presence of children were also not significant, but these variables are captured by the multi-faceted personal benefits factor score, which is based on responses to statements relating to the hassle of commuting and to the ability to have time for family and balance work and household responsibilities, among others. Notably, many of these variables that were not significant in the final model, *were* significant when entered by themselves. Hence, the final model can be viewed as a reasonably parsimonious representation of the major aspects important to workplace preference.

Turning to the goodness-of-fit statistics, the ρ^2 for the model is 0.22 (adjusted ρ^2 of 0.21), compared to 0.08 for the market share model containing only the two alternative-specific constants (ASCs). Thus, the variables in the full model add substantial explanatory power, and a χ^2 test rejects null hypotheses of equivalence both to the equally-likely and to the market share models.

A ρ^2 of 0.22 is relatively modest, although not out of line with typical results for a three-alternative choice context. However, that index is based on unity being the upper bound for ρ^2 . In fact, as Hauser (1978, p. 409) points out, “ $\rho^2 = 1$ may not be the appropriate upper bound. If individuals make repeated choices and do not always select the same alternative [given the same observed explanatory variables], then $\rho^2 = 1$ is not possible, even in theory. (Perfect prediction would require different probabilities for different occasions. Such predictions are not possible without situational variables.)” A similar observation is made by Stopher and Ergün (1982). In these types of situations, including the present one, Hauser notes that the perfect model is one in which each predicted probability $P_n(i)$ exactly equals the observed relative frequency f_{in} of choice for individual n of alternative i . Hence, the theoretical maximum log-likelihood is given by

$$\sum_n \sum_i f_{in} \ln(f_{in}).$$

As shown in Table 5, the theoretical maximum log-likelihood for this sample is -120.56 , and the final model explains 55% of the distance between the minimum log-likelihood (for the equally-likely model in which all coefficients equal zero) and the maximum.

6. Conclusions

This paper develops measures of job and workplace perceptions, and examines the importance of those and other measures to the desired proportions of work time at each of three locations: regular workplace, home, and telecommuting center. This research, together with Stanek and Mokhtarian (1998), represents the first effort known to the authors to characterize workplace perceptions in terms of generic attitudinal factors taking on different values for each of the three relevant work locations. The current paper also constitutes a first use of the continuous proportion of time desired to be spent at each workplace as the dependent variable. This approach seems conceptually to be a more natural specification (and one more suited to the ultimate aim of translating forecasts of telecommuting frequency into transportation impacts) than the more common binary variables indicating the presence or absence of telecommuting, or the categorical telecommuting frequency variables that have been used in previous models.

The model specification appears to be relatively powerful, explaining 55% of the difference in log-likelihoods between the no-information (equally likely) and perfect-information (predicted probabilities equal observed relative frequencies for each individual) models. The variables that are in the model capture the major elements previously hypothesized to influence telecommuting preference (including work, family, independence, and commute stress reduction drives as well as manager and job suitability constraints) in a parsimonious fashion. The fact that IIA is not violated by the final multinomial logit model specification is further evidence of the appropriateness of the model. Taken together, these outcomes provide support for the value of characterizing the utility for different alternatives in terms of generic variables that can be measured for each alternative.

In further applications of this approach, it would be desirable to model actual choice as well as preference. Another extension is to explore the existence of different segments of the telecommuting market. It is quite possible that people who prefer telecommuting, or a particular form of telecommuting, value or weight certain characteristics differently from those who prefer a different arrangement. For example, two people may both consider that working from a telecenter is less isolating than working from home. *Ceteris paribus*, the conventional model could not predict a different outcome for these two people. But one person may view the isolation of working from home as a major constraint, while the other is not concerned about it at all, in which case different outcomes should be predicted, and would be predicted by a model allowing coefficients to vary across different market segments.

Finally, it would be useful to begin to model a broader work location choice context. With advances in information/computing technologies, an increasingly globally linked economy, and other forces, the workforce is becoming more mobile. In more and more cases, workers (and/or their employers) will be dynamically selecting among a variety of work locations to suit the needs of the time. Alternative locations include the regular workplace, the home, a telecenter, a non-territorial drop-in office provided by the employer, an executive office suite, a vehicle (auto, train, airplane), a client's office, a hotel room, and so on. Understanding more about how choices are made among this large variety of possibilities – including the extent to which those choices are constrained or dictated by the changing nature of work – will be important to monitoring and forecasting changes in commuting and work-related travel patterns, as well as changes in land use in urban and rural areas.

Acknowledgements

The data analyzed in this article were collected under contract no. 60T381 with the California Department of Transportation (Caltrans) and the Federal Highway Administration. Many people participated in the Neighborhood Telecenters Project and thereby directly or indirectly contributed to this work, including David Stanek, Michelle Derr, Carol Buckinger, David Fleming, Sally Ho, Krishna Varma, Prashant Balepur, and Ilan Salomon. The comments of anonymous referees on an earlier draft resulted in several improvements.

References

- Aichholzer, G., 1996. Telework centres: a desirable social innovation without future? In: Jackson, P.J., van der Wielen, J.M. (Eds.), *Proceedings, New International Perspectives on Telework: From Telecommuting to the Virtual Organization*, 31 July–2 August, Brunel University, UK. Department of Management Studies and Centre for Culture and Technology, Brunel University and the Work and Organization Research Centre of Tilburg University, The Netherlands, pp. 483–498.
- Bagley, M.N., Mannering, J.S., Mokhtarian, P.L., 1994. Telecommuting centers and related concepts: A review of practice. Research Report No.UCD-ITS-RR-94-4. Institute of Transportation Studies, University of California, Davis, CA (<http://www.engr.ucdavis.edu/~its/telecom/>).
- Bagley, M.N., Mokhtarian, P.L., 1997. Analyzing the preference for non-exclusive forms of telecommuting: modeling and policy implications. *Transportation* 24 (3), 203–226.
- Ben-Akiva, M., Lerman, S.R., 1985. *Discrete Choice Analysis: Theory and Application to Travel Demand*. MIT Press, Cambridge, MA.
- Buckinger, C., Mar, F., Mokhtarian, P., Wright, J., 1997. Telecommuting Centers in California: 1991–1997. Prepared for the Federal Highway Administration and the California Department of Transportation Office of Traffic Improvement. Research Report UCD-ITS-RR-97-16. Institute of Transportation Studies, University of California, Davis, CA.
- Clark, A.E., 1998. Measures of job satisfaction: what makes a good job? Evidence from OECD Countries. Labour Market and Social Policy Occasional Papers no. 34, DEELS/ELSA/WD (98) 5, Directorate for Education, Employment, Labour and Social Affairs, Employment, Labour and Social Affairs Committee, Organisation for Economic Co-operation and Development, Paris.
- Fry, T.R.L., Harris, M.N., 1996. A Monte Carlo study of tests for the independence of irrelevant alternatives property. *Transportation Research B* 30 (1), 19–30.
- Gensch, D., Ghose, S., 1997. Differences in independence of irrelevant alternatives at individual versus aggregate levels, and at single pair versus full choice set. *Omega* 25 (2), 201–214.
- Green, W.H., 1995. *LIMDEP Version 7.0 User's Manual*. Econometric Software, Bellport, NY.
- Hauser, J.R., 1978. Testing the accuracy, usefulness, and significance of probabilistic choice models: an information-theoretic approach. *Operations Research* 26 (3), 406–421.
- Hausman, J., McFadden, D., 1984. Specification tests for the multinomial logit model. *Econometrica* 52 (5), 1219–1240.
- Krishna, V., Ho, C.-I., Stanek, D.M., Mokhtarian, P.L., 1998. Duration and frequency of telecenter use: once a telecommuter, always a telecommuter? *Transportation Research C* 6 (1/2), 47–68.
- Locke, E.A., 1976. The nature and causes of job satisfaction. In: Dunnette, M.D. (Ed.), *Handbook of Industrial and Organizational Psychology*. Rand McNally, Chicago, IL.
- McFadden, D., Train, K., Tye, W., 1977. An application of diagnostic tests for the independence of irrelevant alternatives property of the multinomial logit model. *Transportation Research Record* 637, 39–46.
- Mokhtarian, P.L., 1991. Defining telecommuting. *Transportation Research Record* 1305, 273–281.
- Mokhtarian, P.L., 1998. A synthetic approach to estimating the impacts of telecommuting on travel. *Urban Studies* 35 (2), 215–241.

- Mokhtarian, P.L., Ho, C.-I., Hung, S., Lam, T., Raney, E., Redmond, L., Stanek, D.M., Varma, K.V., 1997. Residential Area-Based Offices Project: Final Report on the Evaluation of Impacts. Prepared for the Federal Highway Administration and the California Department of Transportation Office of Traffic Improvement. Research Report UCD-ITS-RR-97-17, Institute of Transportation Studies, University of California, Davis, CA.
- Mokhtarian, P.L., Salomon, I., 1994. Modeling the choice of telecommuting: setting the context. *Environment and Planning A* 26 (5), 749–766.
- Mokhtarian, P.L., Salomon, I., 1996. Modeling the choice of telecommuting 2: a case of the preferred impossible alternative. *Environment and Planning A* 28, 1859–1876.
- Mokhtarian, P.L., Salomon, I., 1997. Modeling the desire to telecommute: the importance of attitudinal factors in behavioral models. *Transportation Research A* 31 (1), 35–50.
- Mokhtarian, P.L., Varma, K.V., 1998. The tradeoff between trips and distance traveled in analyzing the emissions impacts of center-based telecommuting. *Transportation Research D* 3 (6), 419–428.
- Rummel, R.J., 1970. *Applied Factor Analysis*. Northwestern University Press, Evanston, IL.
- Sato, K., 1997. Telework center developments for the socially mobility less groups: significance for social policy. In: Jackson, P.J., van der Wielen, J.M. (Eds.), *Proceedings, Second International Workshop on Telework: 'Building Actions on Ideas'*, 2–5 September, Amsterdam, pp. 130–142.
- Small, K.A., Hsiao, C., 1985. Multinomial logit specification tests. *International Economic Review* 26 (3), 619–627.
- Spinks, W., 1997. Two regional cases of telework in Japan. In: Jackson, P.J., van der Wielen, J.M. (Eds.), *Proceedings, Second International Workshop on Telework: 'Building Actions on Ideas'* 2–5 September, Amsterdam, pp. 143–151.
- Stanek, D.M., Mokhtarian, P.L., 1998. Developing models of preference for home-based and center-based telecommuting: findings and forecasts. *Technological Forecasting and Social Change* 57 (1/2), 53–74.
- Stopher, P.R., Ergün, G., 1982. The effect of location on demand for urban recreation trips. *Transportation Research A* 16 (1), 25–34.