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Home Environmental Consequences of Commute Travel Impedance[1]

Raymond W. Novaco,[2] Wendy Kliewer, and Alexander Broquet
University of California, Irvine

The physical and perceptual dimensions of commuting travel impedance were again found to have stressful consequences in a study of 99 employees of two companies. This quasi-experimental replication study, which focuses here on home environment consequences, investigated the effects of physical impedance and subjective impedance on multivariate measures of residential satisfaction and personal affect in the home. Both sets of residential outcome measures were significantly related to the two impedance dimensions. As predicted, gender was a significant moderator of physical impedance effects. Women commuting on high physical impedance routes were most negatively affected. Previously found subjective impedance effects on negative home mood, regardless of gender, were strongly replicated with several methods and were buttressed by convergent results with objective indices. The theoretical conjecture that subjective impedance mediates the stress effects of physical impedance was supported by the personal affect cluster but only for one variable in the residential satisfaction cluster. Traffic congestion has increased in metropolitan areas nationwide, and commuters, families, and organizations are absorbing associated hidden costs. The results are reviewed in terms of our ecological model, and the moderating effects of gender are discussed in terms of choice and role constraints.

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[2]All correspondence should be sent to Raymond W. Novaco, University of California, Irvine, California 92717.

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National trends in commuting patterns show that increases in the workforce, the greater availability of automobiles, and the shift in jobs to suburban locations have significantly increased commuting by private automobile (Pisarski, 1987).[3] A report of the General Accounting Office (1989) stated that the metropolitan-wide problem of traffic congestion has become more severe, showing major increases in average daily traffic volume for United States urban Interstate roads from 1980 to 1987, calculated in terms of volume/capacity ratios. Between 1960 and 1987, the number of vehicle miles traveled increased by 168%, while the number of new highway miles increased by 9%. This impairment to mobility has a widely acknowledged impact on the economic vitality of our communities, but it also has adverse public health consequences. Automobile commuting on congested roadways has costs not only in terms of time and work but also with regard to physical and psychological well-being. These "externalities" of the marketplace are receiving increased attention as social costs in the transportation field.

The stressful aspects of chronic exposure to traffic congestion and other demands of long-distance driving have been demonstrated in a series of studies (most recently, Novaco, Stokols, & Milanesi, 1990). In these studies, traffic congestion is understood to be stressful by virtue of its *impedance* properties. That is, it operates as a behavioral constraint on movement and goal attainment, thus constituting an aversive, frustrating condition. Our research has found that high-impedance commuting has adverse effects on blood pressure, mood, frustration tolerance, illness occasions, work absences, job stability, and overall life satisfaction. Corroboration of some of our propositions and hypotheses has been obtained by Schaeffer, Street, Singer, and Baum (1988), who found that high-impedance driving was related to elevated blood pressure and cognitive performance impairments.[4]

The impedance characteristics of commuting have both physical and perceived dimensions. Subjective impedance and physical impedance are overlapping but not isomorphic, and these two dimensions have differential effects on health and well-being outcomes (Novaco et al., 1990). The relationship between travel impedance and stress outcomes was conceptualized in terms of an ecological model, which incorporates the transportation environment, the home and work domains, and coping behaviors.

[3]From 1960 to 1980, travel to work by private automobile increased from 70 to 80% nationally, while use of public transit declined from 12.6 to 6.2%. In southern California, solo driving by private automobile has been the predominant mode of commuting. For example, in Orange County, 82% of resident workers in 1983 commuted to work by driving alone; this increased to 86% in 1987, and was 84% in 1989 (Baldassare, 1987; Baldassare & Katz, 1989).
[4]Schaeffer et al. (1988) used average speed to operationalize impedance, which we have found to be problematic (see Footnote 5 in Novaco et al., 1990).

Among the themes of our ecological perspective is an emphasis upon the reciprocal links between life domains. In this regard, a concept generated within the commuting stress theoretical model is that of *interdomain transfer effects*, whereby the psychological consequences of environmental conditions in one life domain (home, commuting, work, or recreational) transfer to another, either positively or negatively. Novaco et al. (1990) found stress transfer effects as a function of travel impedance in both the job and residential domains.

Negative interdomain transfer effects from commuting to the residential domain are examined more fully in the present study which focuses on home environment consequences of commuting impedance. The larger project was designed as an expanded replication of the previous investigations, involving more elaborate outcome measures. Once again, a quasi-experimental design was used, including field-site testings with physiological and task measures at the work site; however, the focus of the present study is on the home environment, which received little attention in the previous research on commuting stress. We here investigate the theoretically conjectured mediational role of subjective impedance and the newly hypothesized moderating role of gender for physical impedance.

Stress-oriented researchers and family researchers have examined the interplay between work and home with regard to both the demands and supports of one domain impacting the other. Reviews of this research can be found in the book by Eckenrode and Gore (1990) and also in the work of Greenberger, Goldberg, and their colleagues (Greenberger & Goldberg, 1989; Greenberger, Goldberg, Hamill, O'Neil, & Payne, 1989; Greenberger & O'Neil, in press). In their research on work and *parenting,* Greenberger and Goldberg found that physical health symptoms were inversely related to job satisfaction and directly related to role strain, especially for single women (Greenberger et al., 1989). Among the studies in this field is that of Crouter (1984), who studied spillover (from family to work) as both a positive and negative phenomenon. This fluid overflow metaphor is similar to the interdomain transfer effects idea.

The spillover concept appears in several chapters in the Eckenrode and Gore (1990) volume, particularly one by Bromet, Dew, and Parkinson (1990), who report a study of blue-collar women. The Bromet et al. study pursued the ideas of Crouter (1984) and the findings of Pleck, Staines, and Lang (1980) regarding work-family conflict among women.[5] Bromet et al. found that the jobs of assembly-line workers generated fatigue and negative

[5]Staines' (1980) review article on "spillover" is misleading in that its use of the concept seems arbitrary and pertains to matching of work versus nonwork activities, rather than to carryover of effects.

affect, thus interfering with duties at home. They reported spillover effects in hierarchical multiple regression analyses on depression, anxiety-related symptoms, and physical health,[6] although the job strain and spillover effects seem to be clearest for depression.

The work and family life literature has ignored commuting as a source of stress, only giving scant attention to business travel as a potential stressor (e.g., Culbert & Renshaw, 1972). Similarly, environmental psychological research on the home (e.g., Altman & Werner, 1985) has neglected to study commuting. In the absence of research on home environment impacts of commuting, we therefore examined several commuting stress hypotheses and sought to replicate previous findings regarding subjective impedance effects on evening home mood.

Both physical impedance (a three-level, quasi-experimental variable) and subjective impedance (a continuous, aggregate index variable) are hypothesized to have adverse effects on a number of home environment measures. Mood at home in the evening, conflict at home, various residential satisfaction measures, and personal dysphoria are expected to be adversely affected by commuting impedance. We sought to replicate the previously found effects for *subjective* impedance on evening home mood, particularly with regard to evening commute impedance.[7] Hence, the replication effort regarding subjective impedance examined daily commuting log ratings for the AM and PM trips, as well as improved scaling on the new main project questionnaire, which now segmented the various travel constraint items according to AM and PM commutes. Although *physical* impedance effects previously were not found for home mood, they are again predicted here.

Several lines of research suggest that commuting stress effects in the residential domain will be greater for women than for men. This hypothesis is based on a convergence of findings in three areas: transportation research on travel behavior, experimental research on worker's stress physiology, and studies on work and family life. First, there are gender differences in commuting patterns. Working women tend to have more complex travel patterns because they must juggle household duties and child care along with their employment, and they are very much dependent on the automobile (Rosenbloom, 1988). Whether married or

[6]Bromet et al. (1990) do not disentangle the multiple regression effects of their job strain and marital strain variables, which they enter as a block after the covariates and do not report separate changes in R^2 effects.

[7]Subjective impedance (SI) was operationalized by Novaco et al. (1990) as an index that combined two factor-based subscales, Evening Congestion and Aversiveness of Travel. It was decided a priori on empirical grounds to exclude the Morning Congestion subscale from the SI index, and indeed subsequent analyses showed this subscale and AM commuting to have lesser effects than PM commuting dimensions.

unmarried, mothers are much more likely to have child-chauffeuring duties than are fathers and must therefore link trips as part of work commutes or have other postcommute travel demands. Other domestic responsibilities assumed by women (shopping and other errands) that require trip-chaining might also make automobile driving on congested roads more aversive. Travel behavior data from U.S. and European studies indicate that women feel more constrained in their travel choices than do men in comparable situations (Raux & Rosenbloom, 1986). In this regard, we have found that perceived constraints on choice in commuting route, residence, and car purchase each add significantly to subjective impedance (Novaco et al., 1990).

Psychophysiological research by Frankenhauser and her colleagues (Frankenhauser, 1986; Frankenhauser et al., 1989) has found that female managers have greater difficulty "unwinding." Intensive physiological measurements over the course of 12 consecutive hours during a work day and a nonwork day found that after work, while the blood pressures of male managers dropped, the blood pressures of females remained the same as during their work levels. Female managers also had a smaller decrease in cortisol after work than did males, and they also had a significant increase in norepinephrine excretion.

The Frankenhauser et al. (1989) study included assessments of "negative mood" after work in their many measurements but did not find gender differences. However, their study, conducted in Sweden, did not involve transportation variables. They attributed the inability of female managers to unwind after work to conflicting demands at home pertaining to household duties, quite unrelated to child care.[8] This research with white-collar workers is thus complemented by the Bromet et al. (1990) study of blue-collar women, who "described their jobs as making them exhausted and irritable and hence unable to get the housework and cooking done, or done well" (p. 137). Summarizing the findings regarding gender in their volume on stress between work and family, Eckenrode and Gore (1990) stated that women are more reactive than men to stress across roles.

In view of these findings on travel constraints, physiological delays in unwinding, and role strain, we expected women in the high physical impedance condition to show the highest commuting-stress effects and to be significantly more stressed than men in that condition, particularly because our dependent variables involve residential domain and psychological well-being measures. Thus, gender is hypothesized to moderate

[8]Female managers who were single did not differ from their married female colleagues. Only one third of the female managers had children under 16 living at home, compared to two thirds for the female nonmanagers and the male groups.

physical impedance effects on the criterion measures. Subjective impedance effects, however, are expected to be independent of gender. In accordance with our theoretical model, subjective impedance is expected to mediate the effects of physical impedance on stress outcomes; therefore, gender differences in the high physical impedance condition should be explained by differences in subjective impedance. Put succinctly, we hypothesized that the effects of physical impedance (PI) would be moderated by gender and predominantly mediated by subjective impedance (SI).

METHOD

Participants

Participants were 99 solo drivers (51.5% women) recruited from two large industrial firms in Irvine, CA. One is an aerospace company, and the other is a pharmaceutical company. The employees of these companies were contacted by letter (approximately 2,000 were distributed) and asked to complete a one-page screening survey and to indicate their willingness to participate in a study of "Commuting and Well-Being." Sixty-two percent (n = 635) of the employees who returned questionnaires volunteered for the study; of these, 30% (n = 193) met our criteria for participation. Slightly over half of these volunteers who met our criteria participated in the study.

The participants had a mean age of 41.49 years (SD = 11.88 years), and most (58.6%) were married. They were middle to upper-middle class, with median family incomes of \$50–55,000 (range: \$20–75,000+).[9] Eighty-four percent of the sample had completed some education beyond high school. Median time with their company was 6 years. As was found in the previous research with these companies, participants from the aerospace firm were older (46.0 vs. 37.2 years), t (97) = 3.89, $p < .001$, had a higher proportion of men, χ^2 (1, N = 99) = 9.67, $p < .002$, and had been with the company longer (127.2 vs. 68.1 months), t (97) = 3.48 $p < .001$. They did not differ in length of time in home residence. Those from the pharmaceutical firm did have higher family incomes, $t(97) = 2.52$, $p < .02$, and were more educated, $t(97) = 2.56$, $p < .02$. Hence, we routinely incorporated age, income, and education as covariates.

[9]The income level for our sample is highly comparable to that of those who participated in the research by Greenberger and her colleagues conducted in four southern California cities (Greenberger & Goldberg, 1988; Greenberger et al., 1989).

Selection Criteria and Study Design

Selection was based on information provided in the screening questionnaire. Volunteers were selected according to the following criteria: (a) solo drivers; (b) not having recently returned from vacation or about to embark on one; (c) having been on their commuting routes at least 1 year; and (d) did not drive regularly on the job. The distance and duration of commute parameters below were also used to select subjects for the physical impedance quasi-experimental conditions. Information from all employees returning screening questionnaires was used to create the boundary criteria for three physical impedance groups, although actual commuting log data were used for group assignment. *Low-impedance* subjects were those falling within the bottom 20% of the distributions of commuting distance and time. This group comprised 25 persons (12 females) who traveled 7 miles or less between home and work and spent 20 minutes or less returning home from work. *Medium-impedance* subjects fell into the middle 25% of the time and distance distributions and consisted of 22 persons (8 females) traveling between 11 and 15 miles and spending 30 to 40 minutes to get home. *High-impedance* subjects fell into the top 25% of the distance and time distributions and consisted of 24 persons (15 females) traveling 20 to 64 miles and spending 50 minutes or more to get home.

The above impedance groups included only those persons having correspondent positions along the distance and time distributions (i.e., low/low, medium/medium, high/high). A subset of the experimental sample ($n = 28$) displayed noncorrespondent rankings with regard to the time and distance distributions. (These 28 participants were originally selected into one of the three physical impedance conditions. However, their duration and distance data from the daily commuting logs were not consistent with information obtained on the screening questionnaire.) These persons were excluded from the statistical analyses involving the three-level physical impedance factor, but they were included in all other analyses. That is, they were excluded from the quasi-experimental group design, but they were included in analyses of the physical impedance auxiliary measures, which are continuous, and in all analyses of subjective impedance.

Testing Procedure

Each employee participated in the study for 1 week, which was conducted in multiple waves from August 1988 to May of 1989. Several days prior to the start of the week, participants received a packet of information

to complete including a commuting log for their Monday morning commute and a Background Questionnaire. The Background Questionnaire included sections on (a) demographics; (b) the commuting experience; (c) physical health and health-related behaviors; (d) work satisfaction, work performance, and work-related experiences; (e) residential satisfaction and experiences at home; and (f) attitudes regarding environmental problems and transportation management strategies. The focal measures derived from the Background Questionnaire are discussed below. Data obtained on daily commuting logs supplemented the various Background Questionnaire measures.

A synopsis of the remaining procedural context of the study is as follows: On each day of the study participants had their blood pressure and heart rate assessed. They also completed a daily commuting log, a short mood questionnaire, and one other measure of personality or behavior. As part of the commuting log, participants recorded their actual distance and times to and from work, and subjective impressions of congestion. Logs were completed on arrival at work and at home for the morning and evening commutes, respectively. Upon arrival at work on Monday, Wednesday, and Friday, the employees drove to a testing station located in the parking lot where blood pressure and heart rate were recorded. Mood forms were completed and commuting logs were turned in at this time. On Tuesday and Thursday of the testing week, the participants reported to a company conference room approximately $1^1/_2$ hours after arriving at work. Measures of blood pressure, heart rate, and mood were again obtained, and brief tasks were administered to assess memory, psychomotor performance, and tolerance for frustration. At the end of the week, all participants were provided with a summary of their daily blood pressure and heart rate readings, as well as a detailed explanation of the research procedures and previous research findings.

Physical Impedance Auxiliary Indices

In addition to the quasi-experimental conditions, PI effects were also evaluated by auxiliary indices, as in the previous research. The number of road exchanges, number of freeways, percentage of time and miles on freeways, commuting distance, and commuting duration (AM and PM) were examined in various regression analyses for all participants. The commuting duration (travel time) measures were averaged for the week from daily logs.

Subjective Impedance Measures

Important differences between AM and PM commutes were found by Novaco et al. (1990) regarding SI and its effects on stress outcomes. Consequently, the SI measures were modified in the present research to separately index perceived constraints in AM and PM commuting. As before, we conducted a factor analysis of the perceived constraint items, and the orthogonal rotation (Varimax) produced four factors: Evening Congestion, Morning Congestion, General Congestion Aversiveness, and Surface Street Constraints. The factor analysis replicated that of the previous research, and the component items used for the SI index in this study are equivalent to those in the initial operationalization.

For purposes of replication, the SI index is again constructed using the combination of the Evening Congestion subscale and the General Congestion Aversiveness subscale, which involve the same 11 items as used in the previous research. (Details about the construction of our indices can be obtained from us in an elaborated report.) As before, it was decided a priori to index subjective impedance by the combination of the Evening Congestion and the General Congestion Aversiveness subscales. This SI index has an internal reliability of .91.

The separate subscales for Evening Congestion (.92) and for Morning Congestion (.91) are also highly consistent internally. The three-item General Congestion Aversiveness subscale has an alpha of .70. The intercorrelation of the AM and PM congestion subscales is .47, and the General Congestion Aversiveness subscale correlates .62 with Evening Congestion and .69 with Morning Congestion. As previously found, the Surface Street Constraints subscale is uncorrelated (average $r = .03$) with the other subscales and is therefore dropped from analyses of subjective impedance. The travel log ratings of traffic congestion mentioned above were also used as additional measures of subjective impedance that have particular value in our comparison of PM versus AM effects. For our analyses, the travel log ratings of congestion (9-point scale) were averaged over the 5 days of the week.

Dependent Measures

Mood. Mood upon arrival at home was obtained from the Background Questionnaire administered at the start of the study. The mood index consisted of seven bipolar scales (tense–relaxed; friendly–irritable; happy–sad;

tired–energetic; carefree–burdened; intolerant–tolerant; contented–frustrated), and had a Cronbach alpha of .86. The contented–frustrated dimension was added to the set used in the previous studies. Scores could range from 7 to 49, with higher scores indicating a more *negative* mood upon arrival at home.

Residential Environment and Satisfaction. Residential satisfaction was indexed by three 7-point scales which separately assessed satisfaction with the dwelling, satisfaction with the neighborhood, and satisfaction with the general location. Desire to relocate was also assessed on a 7-point scale. The home physical environment was measured by seven bipolar scales (e.g., unpleasant–pleasant; noisy–quiet), which were combined into one index, with a range of 7 to 49, with higher scores indicating more positive rating of the home. Cronbach alpha on this home physical environment index was .87.

Family Conflict. The 9-item conflict subscale of Moos' (1975) Family Environment Scale was used to measure aversive social interactions in the residential domain. Respondents indicated whether each of nine statements was mostly true or false for their family or cohabitants. Cronbach alpha was .78 for this measure. Persons living alone (n = 13) did not complete this scale.

Cocooning. The degree to which individuals personalized their home to insulate themselves from the outside world and to enhance their quality of life within the home was assessed by a set of 5-point scales. Respondents reported the extent to which they invested in eight features (e.g., specialized music/video systems; home fitness centers; gourmet food preparation devices) suggested by the popular literature as indicators of cocooning. Scales were summed to create a total cocooning index. Possible scale range was 8 to 40, with higher scores indicating more cocooning. Cronbach alpha was .76 on the measure.

Dysphoria. A 9-item dysphoria measure was derived from the Global Stress Scale of S. Cohen, Kamarck, and Mermelstein (1983). Respondents rated on a five-point scale (*never* to *very often*) how often in the past month that they experienced difficulties, could not cope, felt "nervous and stressed," felt "downhearted and blue," were satisfied with life, and so forth. The alpha coefficient on this scale was .84 for our participants. In addition, we incorporated an item that asked the respondents to rate their spirits generally in the past 3 months on a 5-point scale, from *very low* to *very good*. This "general spirits" measure correlated −.66 with the dysphoria measure, −.53 with negative mood, and −.31 with family/cohabitant conflict.

RESULTS

Subsample Comparisons

There were no significant differences between the two companies for the dependent measures, with the exception of satisfaction with dwelling, which became nonsignificant when participants' age was controlled. There were no company differences in the SI operational variables, in the PI auxiliary measures, nor in distance or in time to work. However, time home from work, computed from the commuting logs, did differ between companies. Those from the aerospace firm took longer to get home (44.9 vs. 32.6 minutes), t (97) = 2.89, $p < .01$, than did those from the pharmaceutical firm. Given the general absence of significant differences between companies on dependent and independent variables, they were combined in the analyses, as had been done in the previous research.

Physical Impedance Conditions: Internal Validity

The three-level physical impedance factor (PI), operationalized by our quasi-experimental conditions, is intended to represent increasing levels of travel constraint. Table I presents the means, standard deviations, and ANOVA results for the seven constraint measures used with regard to both the morning and evening commutes. These perceived constraint measures serve as internal validity indices for the PI three-level factor. Although there are highly significant ANOVA effects for every variable for both AM and PM commutes, the medium and high conditions are generally not different on these constraint ratings. This suggests that there are some threshold effects. Indeed, the expected linear increase pattern does occur on some variables, but gender operates as a very significant moderator of impedance effects on nearly all of the constraint measures. There is a significant linear trend $F(2, 68) = 59.8, p < .001$, for the unavoidability of heavy traffic AM (Table I) and for all of the other constraint measures presented in Table II: route choice ($M = 4.0, 2.5, 2.3$), $F(2, 68) = 10.12, p < .002$; traffic jams ($M = 3.6, 5.1, 5.3$), $F(2, 68) = 11.42, p < .002$; slowed by traffic accidents ($M = 1.6, 3.0, 3.9$), $F(2, 68) = 27.46, p < .001$; traffic as an inconvenience ($M = 4.3, 6.1, 6.4$), $F(2, 68) = 23.76, p < .001$; and for both commuting satisfaction AM ($M = 1.8, 4.5, 4.9$), $F(2, 68) = 57.76, p < .001$, and PM ($M = 2.9, 5.2, 5.6$), $F(2, 68) = 36.93, p < .001$. However, the means and ANOVA results presented in Table II show that women in the high PI

Table I. Perceived Travel Constraints According to Physical Impedance Condition

Measure of travel constraint	Physical impedance condition[a]			F	p
	Low	Medium	High		
Heavy traffic unavoidable					
AM	2.0 (1.3)	4.4 (1.7)	5.3 (1.6)	31.55	.000
PM	3.1 (2.0)	5.3 (1.4)	5.4 (1.6)	15.18	.000
Speed reduced by heavy traffic					
AM	2.5 (1.5)	5.0 (1.4)	4.9 (1.9)	17.79	.000
PM	4.3 (1.8)	5.9 (1.2)	5.6 (1.5)	7.41	.001
Necessity for braking					
AM	3.6 (1.3)	5.0 (1.4)	5.0 (1.9)	6.58	.002
PM	4.5 (1.3)	6.1 (1.0)	6.0 (1.4)	11.89	.000

Commute "congested"					
AM	2.3 (1.1)	4.6 (1.1)	4.7 (1.8)	24.77	.000
PM	4.2 (1.7)	5.8 (0.9)	5.8 (1.4)	11.05	.000
Commute "slow"					
AM	3.4 (1.5)	4.4 (1.0)	4.6 (1.5)	5.56	.006
PM	4.3 (1.3)	5.5 (1.3)	5.3 (1.6)	4.83	.01
Commute "interrupted"					
AM	3.6 (1.2)	4.7 (1.3)	5.0 (1.5)	6.99	.002
PM	4.6 (1.3)	5.9 (1.0)	5.6 (1.6)	6.02	.004
Commute "unpleasant"					
AM	3.0 (0.9)	4.4 (1.3)	3.8 (1.4)	8.29	.001
PM	3.5 (1.3)	5.0 (1.3)	4.7 (1.3)	9.29	.000

[a] Standard deviations are in parentheses.

condition consistently rate their commutes as more constrained than do the men in that condition.

The top section of Table II contains the means for objective route characteristics (No. of freeways, No. of road exchanges, and % time and % miles on freeways) grouped according to physical impedance condition and gender. It can be seen that there are highly significant PI main effects and linear trend effects for each of these objective characteristics of the route, with no main effects or interactions concerning gender. *Females do not differ from males on these objective, physical route variables, but they do vary significantly in their constraint ratings.* As indicated in Table II, there are significant gender main effects for ratings of traffic jams and traffic as a frequent inconvenience, as well as commuting satisfaction regarding both AM and PM commutes. Women give higher constraint ratings and are less satisfied. There are also significant interactions of gender with impedance for rating of traffic jams and both commuting satisfaction variables. The interactions result from male/female differences between the medium and high impedance conditions—while the ratings by women indicate much greater aversiveness in the high PI condition, those of men in that condition reflect less aversiveness than for medium PI men. These findings confirm the need to examine gender as a moderating variable for the main dependent measures.

Physical Impedance: Relationship to Subjective Impedance Index

The "overlapping but not isomorphic" relationship between PI and SI (dichotomized with a median split) was replicated. The overlap is reflected in a highly significant cross-tabulation, χ^2 (2, N = 71) = 23.4, $p < .0001$. However, there are 3 high SI commuters in the low PI condition and 6 low SI commuters in the high PI condition. Performing this analysis separately for men and women reveals a moderating effect for gender. In the low PI condition, the three high SI participants are all women. In the high PI condition, 4 of the 6 low SI participants are men—the 9 men in the high PI condition are distributed on SI as 4 (low) and 5 (high), whereas the SI distribution for the 15 women in that condition is 2 (low) and 13 (high).

The moderating effect of gender for PI effects on subjective impedance is especially strong for the morning commute. When the SI index, as a continuous measure, was examined in a PI × Gender ANOVA, the main effects for PI ($p < .0001$) and gender ($p < .03$) were both significant, and the interaction approached significance ($p < .09$). However, when the Morning Congestion subscale was similarly analyzed, the interaction was

Table II. Gender Comparisons Across Impedance Conditions Regarding Route Characteristics and Perceived Constraints

	Physical impedance condition								
	Low		Medium		High				
	M	F	M	F	M	F	F_I	F_G	$F_{I\times G}$
Route characteristics[a]									
No. of freeways									
AM	0.7	0.5	1.9	1.4	2.4	2.3	21.38[d]	ns	ns
PM	0.7	0.4	2.0	1.3	2.1	2.3	16.43[d]	ns	ns
No. of road exchanges	1.1	0.9	2.9	2.4	3.3	3.4	26.83[d]	ns	ns
% miles on freeways	23.5	16.0	68.9	65.0	75.7	76.5	30.01[d]	ns	ns
% time on freeways	15.7	14.3	64.8	67.0	73.4	76.4	37.37[d]	ns	ns
Constraint measure[a]									
Route choice	3.9	4.1	2.7	2.1	2.2	2.3	5.70[c]	ns	ns
Traffic jams	3.2	4.1	5.1	5.0	3.7	6.3	7.62[d]	8.79[c]	4.02[b]
Traffic accidents (slowed by)	1.5	1.8	3.4	2.3	3.4	4.2	14.13[d]	ns	ns
Traffic as frequent inconvenience	3.6	5.0	6.1	6.3	5.9	6.7	14.28[d]	5.39[b]	ns
Commuting satisfaction									
AM	6.6	5.7	3.4	3.7	4.1	2.5	36.87[d]	5.21[b]	3.01[b]
PM	6.0	4.2	2.6	3.0	2.9	2.1	23.60[d]	5.08[b]	3.10[b]

[a] There are also significant linear trend effects across the PI conditions for all route characteristic variables ($p < .001$) and all constraint variables ($p < .002$).

[b] $p < .05$.

[c] $p < .01$.

[d] $p < .001$.

significant, $F(2, 65) = 5.27$, $p < .01$, as there is a crossover for men and women between the medium PI and high PI conditions. For the AM commute, high PI men perceive less impedance ($M = 30.7$) than do either medium PI men ($M = 37.7$) or women ($M = 35.5$), whereas high PI women ($M = 42.7$) perceive greater impedance. Regarding our hypothesis specific to gender differences in the high PI condition, men and women in that condition were compared on all subjective impedance items in t-test analyses. The women are significantly higher (mostly $p < .01$) on six of the eight Morning Congestion items, on one of the three general items (Traffic Jams, $p < .001$), but on none of the Evening Congestion items. This suggests that the morning commute should be examined for its relevance to gender effects related to the PI conditions.

Residential Domain Measures

Physical Impedance Effects

The relationships between PI and residential domain satisfaction measures, as well as measures of the home physical environment, were examined in multivariate analyses of covariance, along with gender as a moderator. The means and standard deviations for the PI by gender conditions are given in Table III regarding satisfaction with dwelling, neighborhood, and location; desire to move; home physical environment; and cocooning. Two sets of analyses were conducted. The first analyses of PI were conducted with the main covariates, which included months in residence, family income, education, job satisfaction, work physical environment, and work social environment. These were incorporated into a MANCOVA performed on the six residential domain measures. For the second set of analyses, *subjective impedance was added as a covariate* in order to test the mediational hypothesis.

In the first set of analyses, neither PI nor gender have significant multivariate effects. There are no univariate main effects for gender on any of the six measures. The PI main effect is significant only for satisfaction with location, $F(2, 59) = 3.38$, $p < .04$; however, the multivariate test of the interaction is highly significant, $F(12, 106) = 2.90$, $p < .005$. There are significant univariate interactions on five of the six measures, and the sixth effect is nearly significant. The significant PI × Gender interactions are satisfaction with dwelling, $F(2, 59) = 3.34$, $p < .04$; satisfaction with neighborhood, $F(2, 59) = 7.82$, $p < .01$; satisfaction with location, $F(2, 59) = 5.03$, $p < .01$; desire to move, $F(2, 59) = 8.26$, $p < .001$; and home physical environment, $F(2, 59) = 6.19$, $p < .005$. The effect for cocooning

Table III. Residential Domain Measures According to Physical Impedance and Gender

	Physical impedance (PI)[a]					
	Low		Medium		High	
Residential domain measure	Male (n = 13)	Female (n = 12)	Male (n = 14)	Female (n = 8)	Male (n = 9)	Female (n = 15)
Residence satisfaction						
Home	5.8 (1.3)	5.7 (1.4)	5.3 (1.1)	6.5 (0.9)	6.2 (0.8)	5.4 (1.5)
Neighborhood	5.5 (1.4)	5.8 (1.0)	4.9 (1.5)	6.4 (0.9)	5.8 (1.2)	5.0 (1.6)
Location	6.3 (0.9)	6.3 (0.6)	5.6 (1.2)	6.4 (0.9)	6.2 (1.0)	4.9 (1.8)
Desire to move	3.6 (2.1)	3.2 (1.6)	4.1 (1.9)	1.6 (0.9)	1.9 (1.3)	4.5 (2.6)
Home physical environment	38.6 (7.8)	41.3 (5.0)	35.4 (6.8)	43.4 (6.1)	44.7 (3.1)	38.3 (6.2)
Cocooning	18.3 (6.1)	17.3 (3.7)	19.9 (4.8)	18.0 (4.2)	16.3 (3.8)	19.5 (8.5)

[a] The MANCOVA test of the PI × Gender interaction is significant ($p < .005$). There are no multivariate main effects. Standard deviations are given in parentheses.

is marginal ($p < .07$). When SI was controlled in the second set of analyses, the overall PI × Gender interaction remained significant, as did the five univariate interactions. The PI main effect for satisfaction with location disappears. These analyses indicate that SI does not mediate PI effects on residential satisfaction, except satisfaction with location and that gender is a significant moderator.

The interactions for the three satisfaction measures and for desire to move result from a crossover between the medium and high impedance conditions. In the medium PI condition, men are less content, while in the high PI condition, it is women who are less content. In this regard, it is also the medium impedance men and the high impedance women who produce the PI main effect for satisfaction with location ($M_L = 6.3$, $M_M = 5.9$, $M_H = 5.4$). Regarding the home physical environment index, the crossover occurs from both the low and medium PI conditions to the high PI condition where the women give significantly lower ratings than do the men (who curiously have done the least cocooning). The comparison of men and women in the high PI condition by t tests performed on the residential domain measures found that the women were significantly less satisfied with their location, had a greater desire to relocate, and rated their home physical environment more negatively (all $p < .05$).

It should be noted that family income was used as a covariate in our analyses. There are no PI group differences or interactions with gender regarding income, and, in the full sample, income is not significantly correlated with distance, time, or any of the PI auxiliary measures. These correlations for men are near zero, but for women, income is significantly related to distance ($r = .43$, $p < .001$) and to time to work ($r = .34$, $p < .01$). Women living further from work have higher incomes; therefore, the residential domain measure effects for high impedance women are in no way a function of income constraints.

Subjective Impedance Effects

Although we examined SI as a mediator in the above analyses of PI where it was used as a covariate, we here examine this effect directly, using the full sample (including the 28 commuters not in the PI conditions). There were no significant zero-order correlations of the SI index with the residential domain measures, either for the full sample or separately by gender. However, the Morning Congestion subscale was significantly correlated, $r = -.26$, $n = 99$, $p < .005$, with satisfaction with location, and this inverse relationship was similar for men and women. Therefore, a multiple regression was performed on satisfaction with location, controlling for the

six covariates used above in the PI ANCOVAs. The regression effect of the Morning Congestion subscale is significant above that for the set of covariates, R^2 change = .05, $F(7, 90) = 5.18$, $p < .03$.

Personal Affect in the Home

This set of analyses constitutes the attempt to constructively replicate the findings of Novaco et al. (1990) regarding impedance effects on mood at home in the evening, which had been found only for SI. We investigate PI and SI effects, do so in conjunction with gender, and incorporate additional affect measures (dysphoria, family conflict, and general spirits). Moreover, the SI analyses also involve commuting log measures, as well as the SI index, so as to examine whether personal affect at home is more strongly linked to PM commuting (rather than AM commuting), as previously found. The analyses were conducted for both PI and SI with the same covariates used in the previous study, which were based on the theoretical model. The replicated controls include three job variables (job satisfaction, work physical environment, and work social environment) and three residential variables (residential satisfaction, residential choice, and desire to move). Income, education, and months in residence were incorporated as added covariates. To test the SI mediational hypothesis, SI was added to the covariates in a subsequent MANCOVA, as was done with the residential satisfaction measures.

Physical Impedance Effects

The means and standard deviations for the measures of personal affect in the home are given in Table IV according to PI and gender. Because the family conflict measure was completed only by those with a cohabitant, its inclusion in the MANCOVA cluster would delete 12 PI condition subjects from the analyses, and so this measure was dropped from the multivariate cluster.[10] This MANCOVA results in a PI main effect, $F(6, 108) = 3.56$, $p < .003$, with the six replicated covariates as well as with the augmented covariate set ($p < .005$). These results for PI constitute strong confirmation of the previous effects that had only been found for SI.

Examination of the univariate tests (with all covariates) reveals that there is a highly significant PI effect for negative mood, $F(2, 54) = 8.76$, $p < .001$, and a significant PI effect for dysphoria, $F(2, 54) = 3.34$,

[10]The PI main effect in the MANCOVA remains significant ($p < .03$), if the family conflict measure is included in the multivariate cluster.

Table IV. Personal Affect in the Home by Physical Impedance and Gender[a]

	Physical impedance (PI)					
	Low		Medium		High	
Affect measure	Male (n = 13)	Female (n = 12)	Male (n = 14)	Female (n = 8)	Male (n = 9)	Female (n = 15)
Negative home mood	29.9 (6.7)	24.5 (4.5)	29.0 (7.5)	33.2 (7.3)	27.6 (9.6)	32.5 (6.6)
Conflict among family members	1.5 (1.8)	1.1 (1.0)	2.0 (2.3)	2.3 (2.3)	1.8 (2.5)	2.3 (1.9)
Dysphoria	19.9 (4.7)	19.2 (4.1)	22.9 (4.9)	24.4 (4.4)	19.2 (5.9)	26.7 (8.3)
General spirits	3.8 (0.7)	4.0 (0.6)	3.5 (1.0)	3.3 (1.2)	4.4 (0.5)	3.0 (1.4)

[a] The conflict measure was not completed by persons living alone. There is a significant MANCOVA main effect for PI ($p < .005$). Standard deviations are given in parentheses.

$p < .05$. This main effect is not significant for conflict or general spirits. These effects for negative mood and dysphoria can be seen in Table IV to result from the higher scores on both measures for women in the medium PI and high PI conditions. The main effect for gender indeed approaches significance on negative mood ($p < .08$), dysphoria ($p < .09$), and general spirits ($p < .08$). There are no significant ANCOVA effects for the family conflict measure, which has a skewed distribution (analyses were performed on square root scores), as relatively little conflict was reported (71% have scores of 2 or less on a scale of 9; 23% have scores of 4 or above). Regarding our hypothesis about gender differences in the high PI condition, women had more negative affect on all four measures, but mean differences were significant only for dysphoria, $t(22) = 2.37, p < .03$, and spirits, $t(22) = 3.67, p < .005$.

The mediational role of SI was again examined in a second MANCOVA that added SI to the covariates in testing for PI effects. With SI controlled, the PI main effect on the multivariate affect measures becomes nonsignificant, as do all the previously significant univariate effects. These results suggest that SI mediates PI effects in the personal affect outcomes and that gender does not moderate this process. (The SI mediation effect for the affect measures was also found in partial correlation analyses concerning the PI auxiliary indices. Significant correlations on all affect measures, primarily due to females, become nonsignificant with SI as a covariate.)

Significant correlations for home mood in the full sample were obtained with regard to distance and time. Negative home mood was significantly related ($p < .01$) to average time to work ($r = .26$), and to average time home ($r = .36$), while distance approached significance ($r = .22$, $p < .02$). Given the hypothesis that the previously obtained subjective *evening* congestion effects would replicate (i.e., that negative home mood is most strongly related to PM commuting), multiple regressions were performed separately for distance, time to work, and time home. In accordance with the analytic procedures outlined by J. Cohen and Cohen (1983), covariates and predictors were centered prior to entry into the regression equation. Centering (subtracting the mean from each observation) reduces problems with multicollinearity regarding interaction effects in regression analyses. We used this procedure in all of our regression analyses, as some of them examined interaction effects.

Regressions on negative home mood controlled for the nine covariates on Step 1, then entered gender on Step 2, testing for its effect, and then examined the distance or time variable. The covariates do not produce a significant regression. The effect of gender is significant, producing a change in $R^2 = .04$, $F(1, 85) = 4.20$, $p < .05$. Beyond the regression of

the covariates and gender, the effects for distance, time to work, and time home are all significant and are strongest for time home. The changes in R^2 are as follows: for distance, R^2 change = .06, $F(1, 84) = 6.05$, $p < .02$; for time to work, R^2 change = .07, $F(1, 84) = 6.97$, $p < .01$; and for time home, R^2 change = .15, $F(1, 84) = 16.90$, $p < .0001$. For the regression containing the time home, the multiple R was .53. These results confirm our expectations regarding the PM commute, using physical, objective measures. They strongly complement the analyses for PM versus AM subjective impedance reported below.

Last, the SI mediation hypothesis was examined in conjunction with the results found for evening commute trip time. This was done by including both SI and evening commute time in the regression after the covariates and alternating their order of entry. When evening commute time is entered before SI, the R^2 change (.11) for SI remains highly significant, $F(1, 83) = 13.82$, $p < .0001$; whereas when SI is entered before evening commute time, the latter objective variable only produces a change in $R^2 = .04$, $F(1, 83) = 5.44$, $p < .03$, which suggests a partial mediation. More strongly, for travel time to work and for distance, SI reduces their effect each to 1% of the variance (which is not significant), while the prior entry of these objective variables leaves the effect of SI strongly significant, accounting for 15% of the variance.

Subjective Impedance Effects

As before, SI effects were examined in multiple regression analyses with the covariates, gender, and the interaction term for the full sample (including the 28 commuters not in the PI conditions). Regressions were conducted only when zero-order correlations were significant. Multiple regressions on dysphoria and general spirits with the nine covariates, however, did not find moderating effects for gender. For dysphoria, the overall regression is significant, $R = .46$, $F(11, 85) = 2.02$, $p < .04$, but the R^2 change effects for SI ($p < .10$) and gender ($p < .06$) are marginal, and their interaction has no effect. Similarly, the overall regression for general spirits is significant, $R = .52$, $F(11, 85) = 2.81$, $p < .005$, but the effects for SI ($p < .06$) and for gender ($p < .11$) only approach significance, and there is no effect for their interaction.

Regarding negative home mood, the SI effects are very clear and strongly replicate the findings of Novaco et al. (1990). The strength of the replication, moreover, is demonstrated by a triangulated set of measures and analyses. Replicating the regression of SI on negative home mood using the same six covariates produced a highly significant effect for SI

($p < .0001$). More fully, performing the multiple regression with the nine covariates and then also controlling for gender, the effect for SI remains highly robust. The results are presented in Table V. The multiple R is .585 after SI enters the equation, and it produces a very significant change in R^2 of .21, $F(1, 84) = 26.15$, $p < .0001$. There is also a significant effect for gender ($p < .05$) and no interaction. The effects for gender and SI are independent, as reversing their order of entry in the equation produced the virtually same effect for each variable.

Table V also contains the results of other subjective impedance variables that confirm other aspects of the replication pertaining to the PM commute and confirm the SI findings with a different methodology. First, across all participants, ratings of PM commute congestion are significantly higher than the AM congestion ratings both on the main questionnaire measures, $t(98) = 5.19$, $p < .001$, and on the daily travel logs, $t(98) = 4.52$, $p < .001$. Section B of Table V gives the negative home mood regression statistics for the Evening Congestion (SI PM) and the Morning Congestion (SI AM) subscales, when those variables alternatively enter on Step 3 of the equation (after the covariates and gender). It can be seen that the PM subscale has a much stronger effect than does the AM subscale (and less strong than the SI index). This confirms the previous findings for the evening commute and supports the construction of the SI index. The stronger effect on negative home mood for evening commute subjective impedance can also be seen in Section C of Table V, which presents the results for subjective ratings of traffic congestion on the daily travel logs, separately for the PM and AM commutes. When these variables are alternatively entered on Step 3 of the regression, the PM log ratings produce a highly significant change in R^2, and, whereas the AM log ratings also have a significant effect, the PM ratings account for 7% more of the variance. Taken in conjunction with the results on the objective, physical impedance dimension of trip time, which found that evening commute time had a stronger regression on negative home mood than did morning commute time, this set of findings is a strong replication with convergent measures.

DISCUSSION

The stressful consequences of commuting travel impedance have again been demonstrated for both the physical and perceptual dimensions of commuting constraints. The hypothesized effects of physical impedance (PI) and subjective impedance (SI) were studied in multivariate analyses with regard to two clusters of home environment variables: residential domain satisfaction and personal affect in the home. This constructive replication of pre-

Table V. Negative Home Mood Regressed on Subjective Impedance Indices Controlling for Residential Domain, Job Domain, Income, and Education Covariates[a]

Predictor	Step	Multiple R	Cumulative R^2	R^2 change	Beta	Test of R^2 change	p
A							
Education	1				.035		
Satisfaction with home	1				-.085		
Work social relationships	1				-.190		
Residential months	1				-.039		
Residential choice	1				-.132		
Job satisfaction	1				-.028		
Family income	1				.191		
Work physical environment	1				.116		
Desire to move	1	.309	.096	.096	-.083	$F(9, 86) = 1.01$	ns
Gender	2	.372	.138	.043	-.221	$F(1, 85) = 4.20$	<.05
SI index	3	.585	.343	.205	.491	$F(1, 84) = 26.15$	<.0001
SI × Gender	4	.587	.344	.002	.067	$F(1, 83) = 0.28$	ns
B							
SI PM scale	3	.550	.303	.164	.445	$F(1, 84) = 19.80$	<.0001
SI AM scale	3	.451	.203	.065	.281	$F(1, 84) = 6.86$	<.01
C							
SI travel logs PM	3	.506	.256	.118	.371	$F(1, 84) = 13.26$	<.001
SI travel logs AM	3	.428	.183	.045	.229	$F(1, 84) = 4.66$	<.04

[a] The negative home mood measure is a summary index on seven bipolar scales. The SI index in Section A is the replicated measure, composed of the Evening Congestion and General Congestion Aversiveness subscales. Sections B and C show the effects for the other subjective impedance measures when alternatively entered after the 9 covariates and gender.

vious research used an elaborated set of measures in a new study having the same quasi-experimental design. Additionally, we conducted more refined analyses of empirical and theoretical relationships. Gender was examined as an hypothesized moderator of PI effects, and the theoretically specified mediational role of SI for the effect of PI was also investigated in multivariate analyses of covariance and in multiple regressions.

The PI conditions were revalidated, although the present data suggest that there is a threshold for perceived constraints in the medium PI condition, as well as a gender moderation effect on high PI outcomes. Analyses of the residential domain satisfaction measures found highly significant PI effects as moderated by gender, but there were virtually no significant SI effects on these criterion variables. We did find strong PI and SI effects on the personal affect measures, robustly replicating the findings of Novaco et al. (1990) with additional outcome and predictor variables. Although PI effects had not been found previously for negative home mood, they were here obtained for the multivariate affect cluster, as well as for that univariate measure. Moreover, whereas the previous study had found that SI accounted for 16% of the variance in negative home mood, we found here that it accounted for 20% of the variance after the inclusion of three additional covariates and gender. This is a strong confirmation of the effects of SI, the index of which was generated from a replicated factor analysis.

The *interdomain transfer effects* predicted by the ecological model of commuting stress were substantially demonstrated for negative impacts on the home environment. However, we generally failed to find effects for family conflict. We had a "floor" effect with the Moos (1975) scale for this variable, and participants also reported some confusion in responding to the items, in that their responses might vary for different family members. Other investigators (e.g., Repetti, 1987) have not reported such difficulties with this measure. The absence of SI effects on the residential satisfaction cluster is also theoretically disconfirming, and there were mixed results for the hypothesized SI mediation process.

The mediational role of SI for PI effects was indeed found for the personal affect variables but not for the residential satisfaction variables. Our conjecture about SI mediation was that it would predominantly account for PI effects. We did not rule out direct effects of PI, nor did we preclude the operation of other travel stressors encompassed by the ecological model, such as exposure to air pollution while commuting, attentional and performance demands on drivers, economic strain associated with commuting costs, or responsibility for passengers when ride-sharing. A full review of travel stressors can be found in Stokols and Novaco (1981). We did not assume that the impedance concept accounts for all stress as-

sociated with commuting. However, our results suggest that the SI mediation hypothesis be modified to give greater weight to direct effects of PI which may occur through a wear-and-tear process. Moreover, it is also possible that SI mediational effects may be masked by subjective denial of impedance.

The disconfirming results for SI mediation in the residential satisfaction measures also suggest a greater complexity in the relationship between commuting stressors and residential domain stress indices that we stipulated. Although our various analyses sought to control for potential confoundings, other possibilities remain for differential selection into long commutes and the interactive effects of such variables. It is even possible that psychological resources that provide resistance to travel impedance stress are associated with selection into long commutes, and our results could thereby underestimate impedance effects.

The moderating effects of gender are intriguing but remain a puzzle. We predicted that women in the high PI commutes, relative to their male counterparts, would be most negatively affected. Indeed, this was the case for satisfaction with location, desire to move, ratings of the (interior) home physical environment, dysphoria, and general spirits. Although not statistically significant, the means were also in the expected direction for negative home mood, satisfaction with dwelling and neighborhood, and cocooning. The explanation for these effects is not entirely clear, as there are a number of possible determinants beyond subjective impedance mediation, which itself needs to be explained for its higher levels among women.

Women in the high PI commutes *appraised* their commutes more negatively than did men in the same condition—bear in mind that these women had higher family incomes and did not differ in education, marital status, or home ownership nor in the objective characteristics of their commutes. However, these high PI women indicated that they felt more constrained than men regarding their commute (particularly in the AM), were delayed more often by traffic jams, felt less able to avoid traffic, and in general felt less satisfied with their commutes.

Why might women in long commutes subjectively experience their commutes more negatively than men? We, of course, speculated that they might have more things to do on route. In this regard, we gathered information on what people did between their commuting destinations, and we also obtained ratings on the extent to which "interim activities" were done on the PM commute as a way to avoid traffic exposure. Unfortunately, because most participants drove directly between their destinations, we had too little variation of these measures to have explanatory power. Women in the high PI condition did not have significantly more interim activities on route home, neither to avoid traffic, nor of necessity. For example, in

the latter regard, four (27%) of the long-distance female commuters dropped off and/or picked up children before and after work, whereas only one (11%) of the long-distance male commuters did so, but this difference is not significant. In view of the reports of other investigators that women have more complex travel plans than men, largely because of greater household and family responsibilities (Raux & Rosenbloom, 1986; Rosenbloom, 1988) and our findings that gender differences in SI (for the high PI commuters) occurred in the AM but not the PM commute (there are no gender differences overall), we examined an indirect index of such responsibilities in the morning. Each day at the morning testing, participants rated the degree to which they felt "rushed" to get to work on a 7-point scale. An analysis of covariance on the 5-day summed rating for the PI and gender groups found a significant interaction ($p < .005$) and no main effects. Comparing the high PI men and women, the women ($M = 21.5$) are indeed significantly higher than the men ($M = 12.5$) in feeling rushed to get to work, $t(22) = 3.17$, $p < .005$. And while feeling rushed is related to commuting during the morning traffic peak period, there are neither gender nor PI condition differences in peak period commuting. Hence, the "rushed" data suggest that the high PI women may have more household responsibilities that predispose them to be more reactive to commuting constraints.

The finding that women who commute long distances reported more dysphoria and lower spirits than did men in long commutes mirrors evidence that women are more reactive than men across roles (Eckenrode & Gore, 1990) although a recent study with married couples suggests that this might not be the case (Bolger, DeLongis, Kessler, & Wethington, 1989). As reviewed earlier, studies of both white- and blue-collar workers indicate that women) whether or not they have children, do have household responsibilities that make them exhausted, irritable, and unable to unwind after a long day on the job. Consistent with such findings, our female commuters driving long distances expressed a greater desire to move, were less positive about their home physical environment, and felt more dysphoric than did male long-distance commuters. Pursuing this differential reactivity theme post hoc, we analyzed daily commuting log reports of "unusual incidents" on route (recall the absence of gender differences in objective route characteristics), summing the reported incidents (e.g., accidents, road construction, debris, rain) for the week. Indeed, for the morning commute, high PI women ($M = 1.40$) reported significantly more unusual incidents than did men ($M = 0.22$), $t(22) = 3.63$, $p < .002$; and, although not significant for the evening commute, the women reported nearly three times the number of PM incidents as did men. This further suggests that high PI women were more sensitized to commute disruptions.

Another reason why women might appraise their commute more negatively than men is because they perceive themselves as having less choice about where to live. When asked how much choice they had in selecting their residence, women with long commutes said they had significantly less choice, $t(22) = 2.98$, $p < .01$, than their male counterparts (a 2-point difference on a 7-point scale). Although they did not differ in their satisfaction with their dwelling or neighborhood, the women were much less satisfied with their residential location, and we have also found them to have significantly higher levels of job involvement. These data suggest that female long-distance drivers may have compromised in selecting their residence and its location—perhaps because of the needs of other family members. In fact, three high PI women (20%) reported that they had chosen their residence as an intermediate point between two job locations. No high PI men reported this reason for residential selection.

In this program of research on commuting stress, the degree of residential choice has often been found to be relevant to well-being. We need to examine this variable more fully in subsequent work, as well as to properly understand the moderating effects of gender. The present study provides further evidence of interdomain transfer effects from the commuting domain to the residential domain. The processes by which this transfer or spillover occurs remain to be elucidated. Repetti (1987) has suggested a number of hypothetical processes linking work and family roles, and our findings would seem to fit within her "competition for personal resources" category, which is an overload concept. Further research on commuting stress needs to examine residential domain responsibilities as a relevant variable.

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