Gender, the Home-Work Link, and Space-Time Patterns of Nonemployment Activities*

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Abstract: Building upon recent theoretical work on the reconceptualized home-work link, this study identifies out-of-home, nonemployment activities as another crucial component of the dynamic dependencies between home and work. Using travel diary data from Columbus, Ohio, and GIS-based three-dimensional visualization techniques, I compare the space-time patterns of these activities for three population subgroups. I examine the complex interrelations among women's daytime fixity constraint, nonemployment activities, household responsibilities, and employment status using a nonrecursive structural equation model. The results show that women encounter higher levels of daytime fixity constraint than men regardless of their employment status. Such constraint is reduced when there are other adults in the household to share some of the domestic responsibilities. Women who face higher levels of fixity constraint are more likely to work part time. An important implication is that redressing the domestic division of labor and gender relations within the household will not only reduce women's fixity constraint, but will also improve their labor market position (especially for women currently working part time). One unexpected result is that full-time employed women travel longer distances to work than do men even though they encounter higher levels of fixity constraint. This suggests that, contrary to what past studies often assumed, the journey to work may not reflect the magnitude of the fixity constraint women face in their everyday lives.

Key words: gender, home-work link, fixity constraint, activity patterns.

Recent research on gender differences in the journey to work and access to employment opportunities has shed light on many important issues pertaining to the complex relationships between gender, race, commuting behavior, and local labor market dynamics (e.g., Blumen and Kellerman 1990; England 1993; Fagnani 1983; Gilbert 1998; Hanson and Pratt 1990, 1995; Johnston-Anumonwo 1995, 1997; McLafferty and Preston 1992, 1997; Rutherford and Wekerle 1988; Singell and Lillydahl 1986; Wyly 1996, 1998). Especially important in this literature is the critique of the view that treats home and work as separate spheres of reproduction and production, and the emphasis on the need to examine their dynamic dependencies (Hanson and Pratt 1988, 1992). It is recognized that work and home are not only important nodes in individuals' everyday lives, but are also inseparably linked by a multitude of activities and processes.

While several elements of this reconceptualized home-work link have been extensively studied in recent research, others have not been reexamined in this particular context. One area that has received relatively little attention in recent years is out-of-home, nonemployment activities and their space-time relations to home and work. Because many out-of-home activities are undertaken as household responsibilities, their performance is part of the gen-

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der division of labor within the household and their space-time patterns reflect women's and men's gender roles. Past studies also tend to emphasize the location of jobs relative to home and to ignore the effect of space-time constraints arising from other essential activities (e.g., childcare drop-off) on job choice and location.

In this paper, I investigate the importance of out-of-home, nonemployment activities in the home-work link and argue that they provide the critical links for understanding gender differences in the journey to work and employment status. Using a travel diary data set collected in 1995 in Columbus, Ohio, I compare the space-time activity patterns of three European-American population subgroups using GIS-based three-dimensional visualization techniques. I examine the effect of the fixity constraint on these patterns and women's adaptive strategies for coping with their constraints. I also investigate the relationships among women's daytime fixity constraint, household responsibilities, commuting distance, and employment status.

The results indicate that the level of the daytime fixity constraint depends more on one's gender and the extent to which household responsibilities are shared with other adults in the household than on some conventional variables used to represent the amount of household responsibilities, such as the presence or number of children in the household. The daytime fixity constraint women face has a significant impact on their employment status, where a higher level of fixity leads to a higher likelihood of being employed part time. Unexpected results of this study are the longer commutes of full-time employed women when compared to those of men.

The Home-Work Link and Nonemployment Activities

Home and work have long been conceptualized not only as separate spheres of reproduction and production, but also as gendered spheres, where the home epitomizes the female realm while the workplace is associated with the male (Hanson 1992; Hanson and Pratt 1988; Hayden 1984; Klausner 1986; Markusen 1981; McDowell 1983; Rose 1993; Saegert 1981). With a few exceptions, this view has led to studies that ignore out-of-home, nonemployment activities and travel, which are critical for understanding the complex relationships between gender, race, employment, and the journey to work. As recent work has critiqued this conventional notion and emphasized the need to examine the dynamic dependencies between home and work, it is now recognized that home and work are not discrete points in urban space joined by the journey to work, but are inseparable spheres of everyday life connected by a multitude of activities and processes (Hanson and Pratt 1988, 1992).

These activities and processes consist of webs of localized networks of social relations and interactions, social supports and services, as well as daily activities and trips (Cope 1998; Gilbert 1998). Together, they weave the home-work nexus that constitutes a significant part of everyday life. This is the arena where women and men negotiate in space-time the tension introduced by the interconnectedness and physical separation of home and work (Dyck 1989, 1990; England 1993, 1996). Although most of these activities are directly related to household and personal needs, their social and space-time arrangements are often made in relation to the conditions and requirements of work. For instance, many out-of-home activities involve coping with the space-time constraints imposed by work (e.g., chauffeuring young children to childcare facilities on the way to work), while choices pertaining to job location and occupation often have to be made in light of the need to undertake obligatory out-of-home activities (Gilbert 1997a; Michelson 1988; Myers-Jones and Brooker-Gross 1996; Pickup 1985; Tivers 1985). The inseparable spheres of home and work are therefore not only connected by the journey to work, but are also intricately medi-

ated by a web of daily out-of-home, nonemployment activities in space-time.

Studies have documented the increasing importance of these nonemployment activities in everyday life (Levinson and Kumar 1995; Pisarski 1992). Because people often link other activities and trips on their way to and from work, travel between home and work is more complex than the direct home-work trip often assumed (Bianco and Lawson 1996; Davidson 1991; Fox 1983; Hanson 1980; Kitamura, Nishii, and Goulias 1990; Nishii and Kondo 1992; Rosenbloom 1987, 1993). Women perform more nonemployment activities and make more out-of-home trips (e.g., serve passengers, shopping) than do men (Fox 1983; Hanson and Johnston 1985). Such activities constitute an important dimension of gender differences in everyday life. For women in particular, driving children to visit friends and to various afternoon activities affects their subjective experience of travel mobility (Pazy, Salomon, and Pintzov 1996). Michelson (1985) and Neal et al. (1993) found that the childcare drop-off can add considerable extra travel to the commute trip, and the amount of extra distance is significantly related to women's travel stress over the day. Others concluded that space-time constraints are more binding among women than men (Pickup 1985; Salomon and Tacken 1993). As the structure and organization of women's daily lives are dictated by the obligatory nature and space-time fixity of certain out-of-home activities, we need to situate the home-work link in the context of an individual's overall activity-travel pattern (Burnett 1980; Droogleever Fortuijn and Karsten 1989; Forer and Kivell 1981; Gilbert 1997a; Palm 1981; Pickup 1984; Pratt and Hanson 1991; Tivers 1985).

Further, people mediate the physical separation of home and work via a multiplicity of adaptive strategies, which may render the relationships between home and work less determinate than what is often assumed (Brooker-Gross and Maraffa 1985; England 1993). Examples of such strategies include (1) social means, through historically constituted localized social networks, or sharing of domestic responsibilities within the household; (2) temporal strategies, through shifting the time of activities, for example, from weekdays to the weekend; and (3) spatial strategies, through changing the location of activities, residence, or workplace (Christensen 1993; Dyck 1989, 1990; England 1993; Gilbert 1998; Fox 1983; Hanson and Hanson 1981). To cope with the space-time tension arising from the physical separation and interconnectedness of home, work, and nonemployment activities, women often have to adopt one or more of these adaptive strategies.

The conceptual framework of this study is based in the time-geographic perspective on women's everyday lives (England 1993, 1996; Hanson and Pratt 1990; Kwan 1998, 1999a, 1999b; Miller 1982, 1983; Palm and Pred 1974; Tivers 1985, 1988).[1] It conceives of home, work, and nonemployment activities as distinct but interconnected spheres woven together through a web of localized social interactions, activities, and trips. Spatially and/or temporally fixed activities constitute fixity constraints, many of which are associated with women's gender role in the household and can be referred to collectively as gender-role constraints (Pickup 1985; Pratt and Hanson 1991). Because they play a crucial role in determining which activities are feasible in space-time, they structure the organization of women's daily activities.

Using this perspective and a travel diary data set collected in Columbus, Ohio, this study examines gender differences in the space-time patterns of nonemployment

[1] Despite Rose's (1993) feminist critique of time-geography, others have shown the continued usefulness of the perspective for studying women's everyday lives and spatiality (e.g., Dyck 1996; England 1996; Kwan 1999a; Laws 1997; Myers-Jones and Brooker-Gross 1996; Truelove 1996). See Gregory (1994) and Laws (1997) for the possibility of a post-structuralist/feminist time-geographic perspective.

activities of three European-American population subgroups: women employed full time, women employed part time, and men employed full time. Specifically, I seek to answer the following questions: Is there any gender difference in the space-time patterns of nonemployment activities? What kind of adaptive strategies do women adopt to cope with their gender-role constraints? What individual and household attributes are associated with a high level of space-time constraints? What are the relationships among women's fixity constraint, household responsibilities, commuting distance, and employment status?

Study Area and Data

The study area is Franklin County, located at the center of the seven-county Columbus Metropolitan Statistical Area (MSA) in central Ohio. Its main urban area consists of the city of Columbus and several smaller cities. The county will have a projected population of one million in 2000 (Columbus 1993). It is about 42 kilometers (26 miles) in an east-west direction and 37 kilometers (23 miles) in a north-south direction. With the suburbanization of population and firms over the last three decades (England 1993; Smith and Selwood 1983), establishments are now more spatially scattered but are still found largely within and around the Outerbelt Freeway (I-270). This means that most establishments are located within an area smaller than what is delimited by the county boundary, making them quite accessible to car users (Kwan 1998). As decentralization continued, the importance of downtown Columbus as the economic center of the region has declined. According to the Mid-Ohio Regional Planning Commission, only about 15.5 percent of the residents in Franklin County commute to work downtown, while 25 percent of the jobs in the county are on the northern corridor ("Region's Heart Vulnerable" 1996).

In 1995 I collected a two-weekday travel diary data set in the study area for adults (over 18 years of age) in a sample of family households with one or more working members. The travel diary recorded details of all activities and trips made by respondents in the two-day period, including street address, travel mode used, car availability, routes taken, the primary purpose of activity, and other individuals present when performing each activity. A total of 109 travel diaries from 60 households were finally received. Despite the original goal to generate a representative sample and some targeted sample enrichment effort, many gender/ethnic groups are underrepresented in the final sample. For instance, less than 2 percent of the respondents are African Americans, whereas this group accounts for 16 percent of the county's population in 1990. Since relatively homogeneous subgroups of considerable size are required for meaningful comparative analysis, I created a subsample by selecting all gender/ethnic subgroups with more than 10 working (full-time or part-time employed) persons. This process generated a subsample of 72 European-Americans consisting of 28 full-time employed women, 13 part-time employed women (who work less than 35 hours a week), and 31 full-time employed men. Households in this subsample, consisting of dual-earner married couples, are spatially scattered in largely suburban areas of the study area. The analysis in this paper uses this subsample of 72 individuals.

Understandably, this subsample is small and does not represent the population of Franklin County. As shown in Table 1, sample individuals are rather affluent and have good access to automobiles. Median household income is about $75,000 a year. Average number of vehicles per household is 2.3 and vehicle per adult is 1.2. Further, all persons in the subsample have a driver's license and normally use their own cars for traveling to work and other out-of-home activities. Over three-quarters (76.4 percent) of these individuals hold managerial, professional, and technical occupations. In terms of the industries in which they are employed, 62.5 percent work in profes-

Table 1

Characteristics of the Subsample Compared with Franklin County, Ohio, and U.S. Metropolitan Areas (MSA)

	1990 Census		
	U.S. Metropolitan Areas	Franklin County	Subsample (N = 72)
Socioeconomic characteristics			
Black (%)	13.0	15.9	0
White (%)	78.3	81.5	100.0
Persons per family	3.17	3.07	2.93
Average vehicles per household	1.8[a]	1.6	2.3
Median household income (dollars)	43,680	30,375	74,659
Journey-to-work characteristics			
Mean travel time (minutes)	23.2	21.2	19.3
Using private vehicle (%)	73.0	79.5	100.0
Using car pools (%)	12.9	11.4	0
Using public transit (%)	6.5	2.7	0
Occupation			
Managerial and professional (%)	28.1	30.5	68.1
Service occupations (%)	13.0	12.0	11.1
Clerical and administrative support (%)	17.1	20.2	11.1
Industry			
Professional services (%)	23.8	25.8	48.6
Finance, insurance and real estate (%)	7.6	10.2	13.9
Transportation and communications (%)	7.3	7.0	9.7
Manufacturing (%)	16.8	12.9	1.4

Sources: U.S. Department of Transportation (1996); U.S. Bureau of the Census (1990); Travel diary survey conducted in Columbus, Ohio, 1995.

[a] Data are for the entire United States.

sional services (e.g., medical services and education) and FIRE (finance, insurance, and real estate). The subsample consists largely of individuals with upper-middle socioeconomic status.

Although the subsample is small and not representative, it has several advantages for the analysis of gender differences in activity-travel patterns. First, all individuals in the subsample have a similar level of access to automobiles. Gender differences in activity patterns or commuting distance observed are not due to differences in travel mobility. Second, as women and men in the subsample are wives and husbands from the same households (that is, with the same residential locations), the effect of residential location on commuting distance is eliminated. Any difference in home-work distance observed in this study is therefore the result of differences in job locations of the three groups of individuals. Third, the homogeneous nature of the subsample makes it representative of one segment of the larger population (in this case, the white upper-middle-class residents of the study area).

Methods

The activity-travel data were processed through several steps using ARC/INFO and ArcView GIS. First, all locations recorded in the diaries were geocoded based on a digital street network, Dynamap/2000. All subsequent geoprocessing was based on the geographic coordinates of each location generated at this stage. Second, because numerous rivers cut through the study area in a north-south direction, the straight line distance

between two locations may deviate from the travel distance using the transportation network. In fact, a statistically significant difference of 1.6 kilometers (1 mile) was found between these two measures of distance for the locations recorded in the travel diaries. In view of this, all distances in this study were measured in terms of the network distance of the shortest path between two particular locations using the digital network and point-based GIS (Geographic Information Systems) procedures (as used in Talen 1997; Kwan and Hong 1998).

For the representation of space-time paths and the analysis of activity-travel patterns, this study uses three GIS-based visualization techniques to complement quantitative methods. The first technique is the familiar space-time aquarium conceived by Hägerstrand (1970). In a schematic representation of the aquarium, the vertical axis is the time of day and the boundary of the horizontal plane represents the spatial scope of the study area. Individual space-time paths are portrayed as trajectories in this three-dimensional aquarium.

Although the aquarium is a valuable representational device, interpretation of patterns becomes difficult as the number of paths increases with the number of individuals being examined. Further, since the home-work axes have different locations and are oriented in different directions for different individuals, it is difficult to detect patterns through visualization. One way to overcome this problem is to plot space-time paths using a standardized coordinate system, where the coordinates of the activity locations for an individual are transformed using the home site as the origin (0,0) and the home-work axis as the positive x-axis. Using these transformed space-time paths, many distinctive features of the activity patterns of a particular group of individuals are identifiable even when many space-time paths are plotted.

Further, this study uses the kernel estimation method to generate space-time activity density surfaces for the three population subgroups (Gatrell 1994). Implementation of the method begins with the specification of a space-time coordinate system where one axis represents the time of activity, while the other records the distance of an activity site from home.[2] Following Bailey and Gatrell's (1995) formulation, the quartic kernel function described in Silverman (1986) and a bandwidth of 1.5 are used to generate activity density surfaces. Since these surfaces are capable of revealing the intensity of activities in space and time simultaneously, they facilitate the examination of the interaction between these two dimensions and the identification of the space-time strategies adopted by individuals for coping with their constraints.

Space-Time Patterns of Out-of-Home, Nonemployment Activities

In this section, I describe and compare the space-time patterns of the out-of-home, nonemployment activities of the three groups of European-Americans in the subsample using three-dimensional visualization techniques. As subsequent discussions involve different notions of constraints, their meaning needs to be clarified at this point. The time-budget constraint refers to the limited time available to a person after allowing for the essential and/or obligatory activities of a day, such as work. The fixity constraint arises from the rigid locational and/or temporal requirements of those activities that allow little flexibility as to when and where they may be performed (e.g., chauffeuring a child to daycare or school; Kitamura 1983). The gender-role constraint refers to that part of the fixity constraint associated with the

[2] The time axis covers a 24-hour day starting at 3 a.m. and the space axis extends to 38.4 kilometers (24 miles) from home. A fine grid structure of 96 x 96 space-time grids (with 9,216 cells) is then created by dividing a day into 96 15-minute time slices and distance from home into 96 0.4-kilometer (quarter-mile) blocks.

space-time fixity of household-serving, gender-role-related activities women often perform in their everyday lives (Tivers 1985; see Kwan (1999b) for details about how these notions of constraints are operationalized).

Space-Time Aquariums of the Three Groups

The time-budget constraint that work imposes on the nonemployment activities of full-time employed women is evident (Fig. 1). Their long work hours (8.2 hours a day) are revealed by the long activity duration at the workplace, as indicated by the length of the vertical segments of their space-time paths during the day. This constraint allows for only a few nonemployment activities to be undertaken, besides a meal or some short personal business stops near the workplace at lunch time.

From the travel diary data, part-time employed women have shorter work hours (3.9 hours a day), which are indicated by the short vertical daytime segments of their space-time paths shown in Figure 2. Further, as they tend to perform more

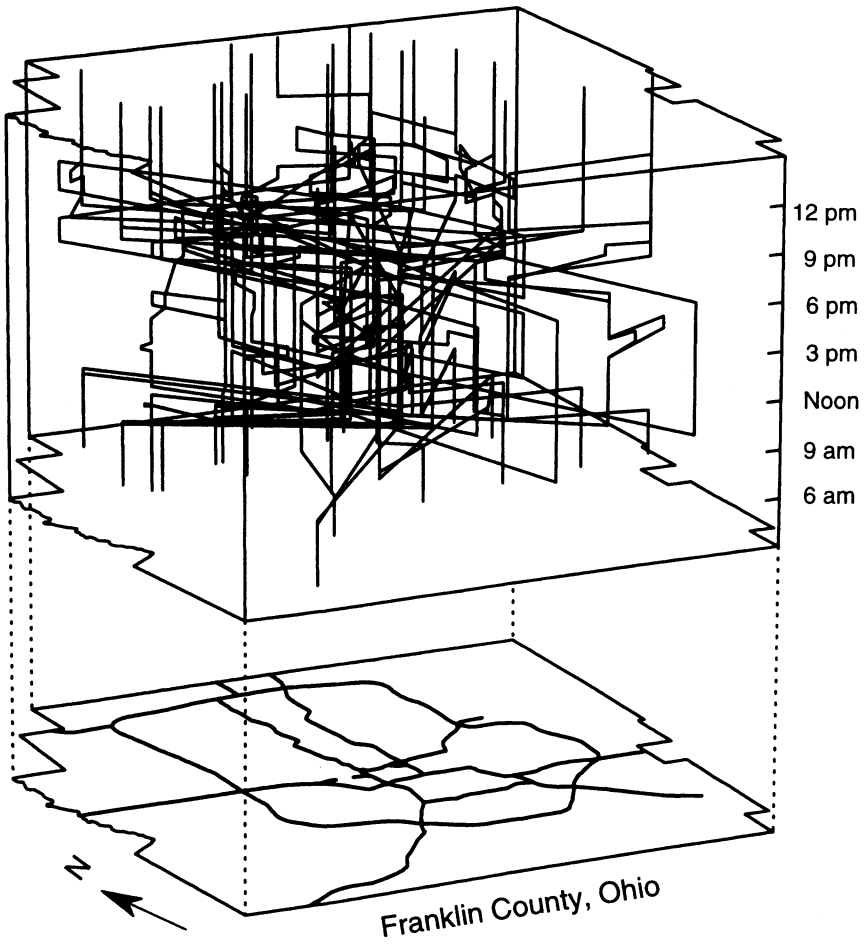

Figure 1. Space-time aquarium for women employed full time.

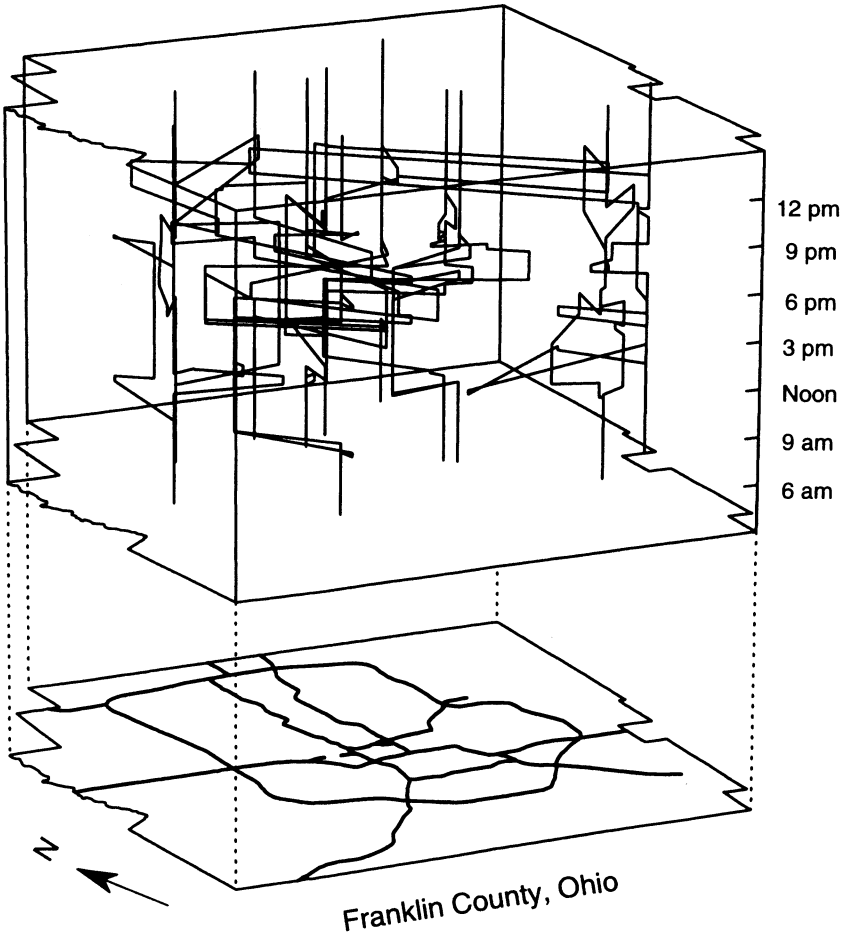

Figure 2. Space-time aquarium for women employed part time.

nonemployment activities during the day (many of these are likely to be gender-role-related fixed activities), given their less restrictive time-budget constraint, their space-time paths appear to be more fragmented during the day than those of the women employed full time.

The space-time paths in the aquarium for the men in the subsample (not shown) have many similarities with the paths for full-time employed women, except that these men seem to have more flexibility in terms of the duration, timing, and location of their daytime nonemployment activities. This is perhaps due to the fact that, besides the time-budget constraint imposed by their work hours (8.2 hours a day), they undertake fewer fixed nonemployment activities when compared to both groups of women. They may therefore have more discretion regarding when and where to carry out these activities.

Standardized Space-Time Paths and Activity Density Surfaces

To identify intergroup differences in activity patterns more clearly, "standardized" space-time paths and space-time activity density surfaces of the three groups

are constructed and shown in Figures 3 to 8. In each of the space-time path diagrams, the home site of an individual is the origin (0,0) and the home-work axis is the positive x-axis. Two views of these paths are given in Figures 3, 4, and 7: an oblique view, in which the home-work plane and all stops are visible; and a view produced by passing the view line through the home-work plane, thus hiding all work stops and highlighting the space-time distribution of nonemployment activities.

As shown in Figures 3 and 4, nonemployment activities for women and men working full time are strongly oriented along and constrained by the home-work axis. Because of the time-budget constraint imposed by their work hours, a considerable proportion of their nonemployment activities are undertaken in the evening hours, after 6:00 p.m. (47.8 percent for women employed full time and 39.2 percent for men). During the day, not only are there few nonemployment activities, but the distance of these activities from the home-work axis is also highly constrained. In contrast, the spatial range of nonemployment activities undertaken in the evening hours is greater than those performed during the day.

The space-time activity density surfaces in Figures 5 and 6 reveal that the intensity of nonemployment activities for full-time employed women and to a lesser degree men is highest at the daily commuting peaks (at about 7:30 a.m. and 5:00 p.m.), lunch break at noon, and in the evening hours. There are some important differences, however, between the density patterns for the full-time employed women and men in the subsample.

As indicated by the three strong peaks of nonemployment activities after 5:00 p.m. shown in Figure 5, the space-time flexibility for nonemployment activities for women employed full time seems to be particularly limited when compared to that of men (Fig. 6). Besides these peaks, other areas of the surface are characterized by moderate or minor undulations, suggesting low levels of involvement in nonemployment activities from about 9:00 a.m. to 4:00 p.m. (except with some activities associated with the morning journey to work and during the lunch hour). Especially noteworthy is that few nonemployment activities are performed close to home during the day. While facing the similar time-budget constraint of long hours, men employed full time seem to have more space-time flexibility for pursuing nonemployment activities during the day, as indicated by several moderate peaks in activity intensity at various locations on the surface (Fig. 6). Compared to the surface for women employed full time, the surface for men has less contrast in activity intensity between the day and the evening, and the peaks are in general less pronounced.

The effect of the time-budget constraint due to full-time employment on the space-time patterns of nonemployment activities is thus different for women and men. This observation corroborates Hanson and Hanson's (1981) finding that the activity-travel patterns of women differ from those of men even when they have the same employment status. Using travel diary data for a 35-day period, they also observed a shifting of weekday activities to the weekend for full-time employed women in the face of a more stringent time-budget constraint. In our case, women employed full time adopt a "diurnal" temporal strategy to cope with their time-budget constraint by shifting a considerable proportion of their nonemployment activities to the evening. Exactly why their daytime activities are more restricted than those of men is not clear from the present data. This may be due to a higher tendency for the men to have occupations that involve more work-related travel, as indicated by several cases where men's work involves traveling to clients' places or other temporary work sites. As nonemployment activities may be undertaken along with work-related trips, the daytime activity patterns of these men tend to be spatially and/or temporally more flexible.

For women employed part time, nonemployment activities are only weakly

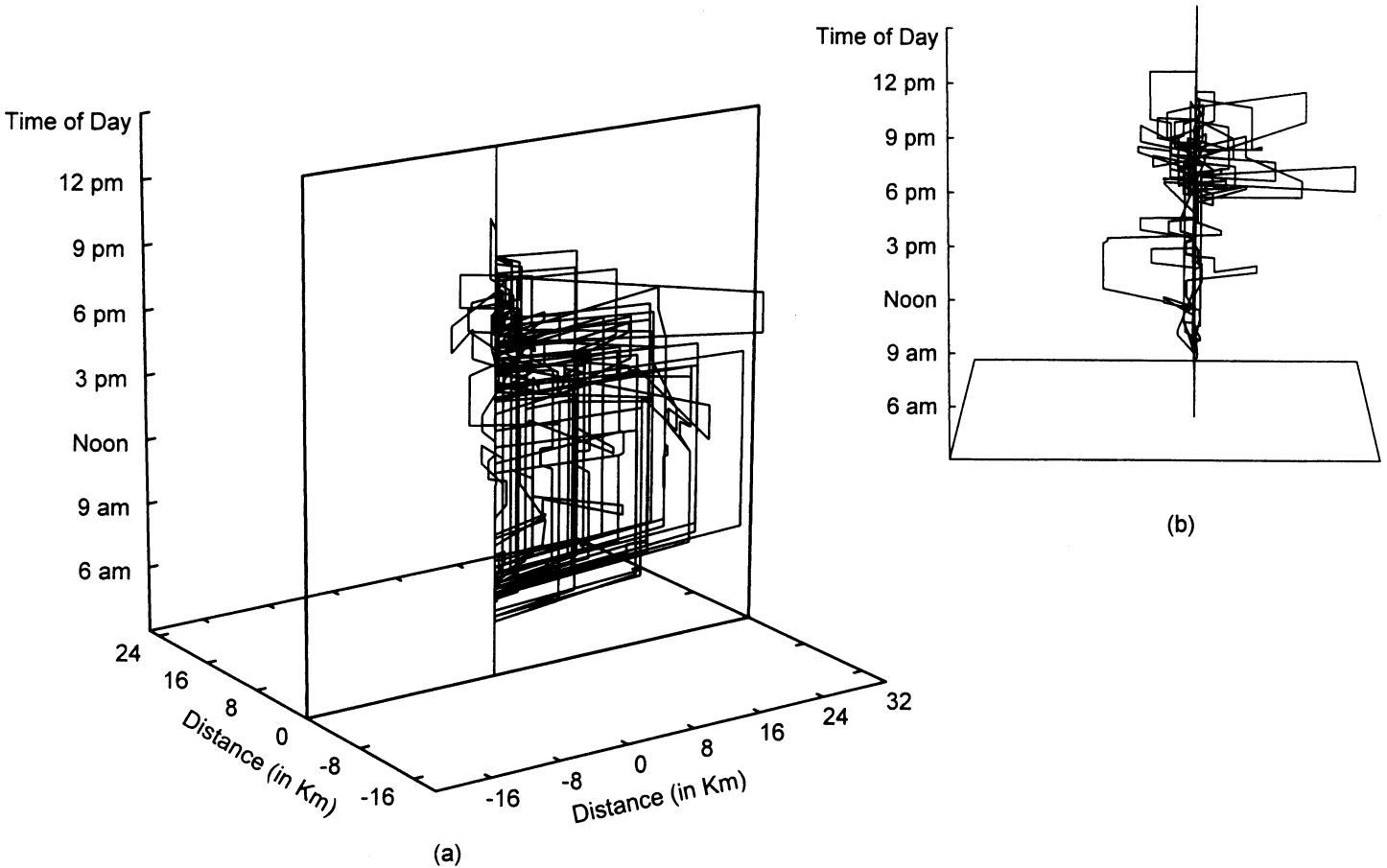

Figure 3. Standardized space-time paths for women employed full time. Location (0,0) on the x–y plane is the home site, and the vertical plane along x-axis is the home-work plane. (a) With the home-work plane shown, all stops are visible. (b) With the view line passing through the home-work plane, all work stops are "hidden."

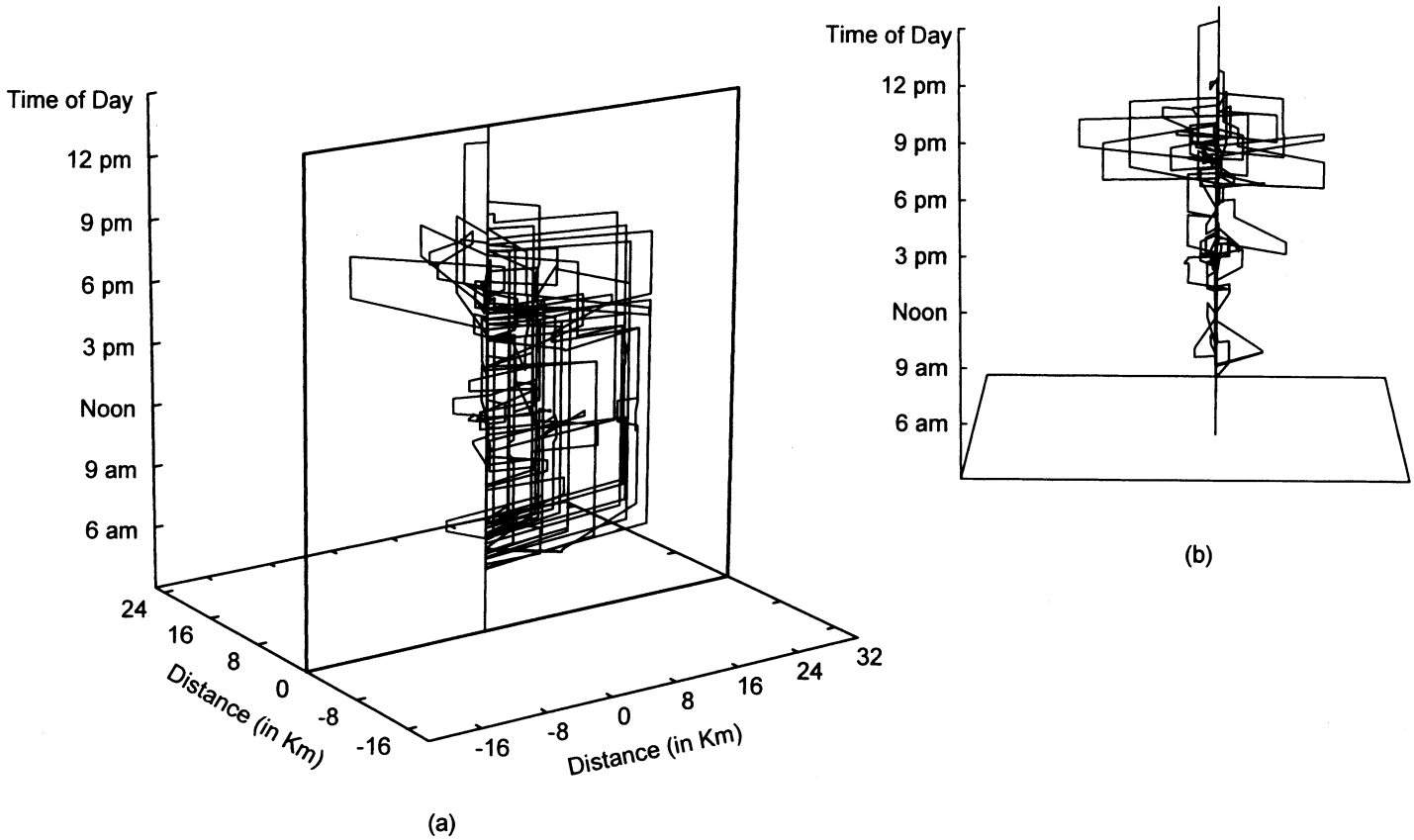

Figure 4. Standardized space-time paths for men employed full time. Location (0,0) on the x–y plane is the home site, and the vertical plane along x-axis is the home-work plane. (a) With the home-work plane shown, all stops are visible. (b) With the view line passing through the home-work plane, all work stops are "hidden."

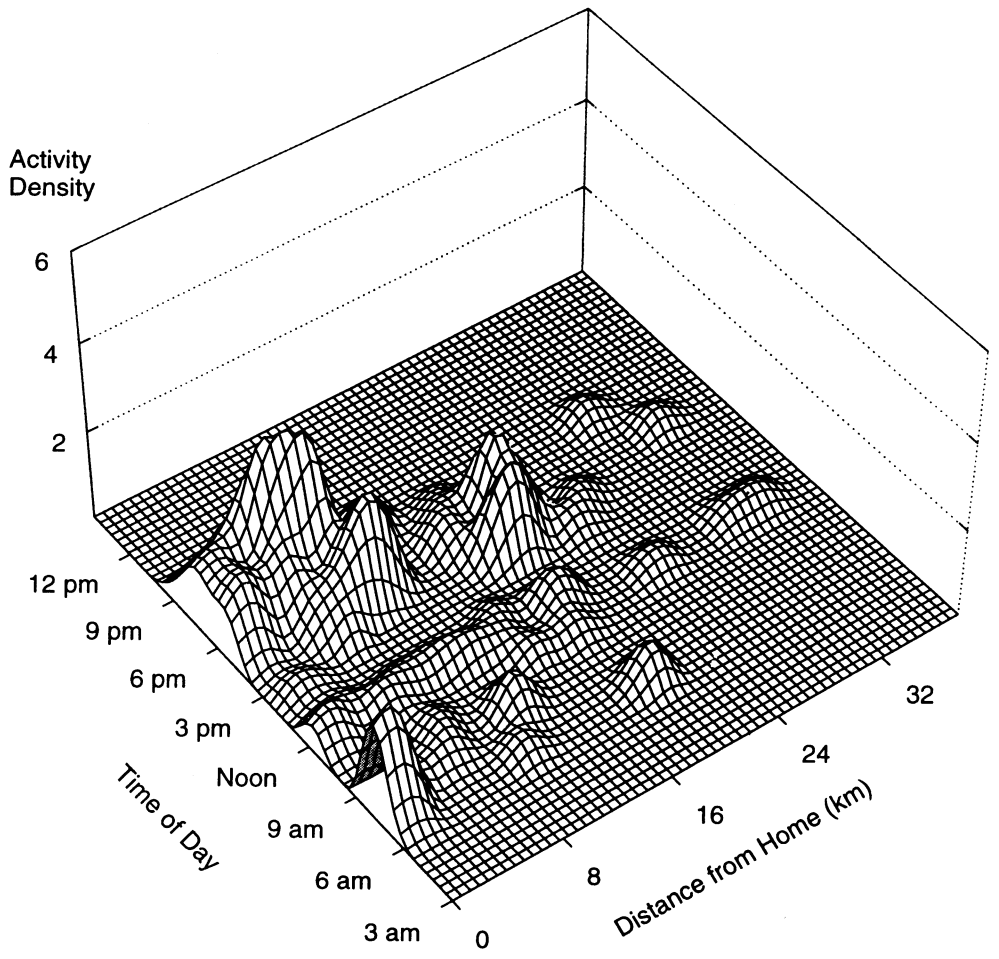

Figure 5. Space-time activity density surface of nonemployment activities for women employed full time.

oriented along and constrained by the home-work axis when compared to women and men working full time (Fig. 7). There is also less contrast in the temporal distribution and spatial range of nonemployment activities between day and evening. Only 29.1 percent of their nonemployment activities are performed after 6:00 p.m., suggesting that a considerable proportion of their nonemployment activities are undertaken during the day. Relatively few of their nonemployment activities are located far from home, as compared to the other two groups. Further, their space-time paths tend to be temporally more fragmented during the day than those of the other two groups.

As indicated by the location of the two sharp peaks of high activity intensity in Figure 8, many of these activities are performed as late as 10:00 a.m. in the morning and as early as 3:00 p.m. in the afternoon at locations close to home (within 4.8 kilometers, or 5 miles) (peaks of high activity intensity for full-time employed women and men are found earlier in the morning (about 7:30 a.m.) and later in the afternoon (about 5:00 p.m.); see Figs. 5 and 6). Given

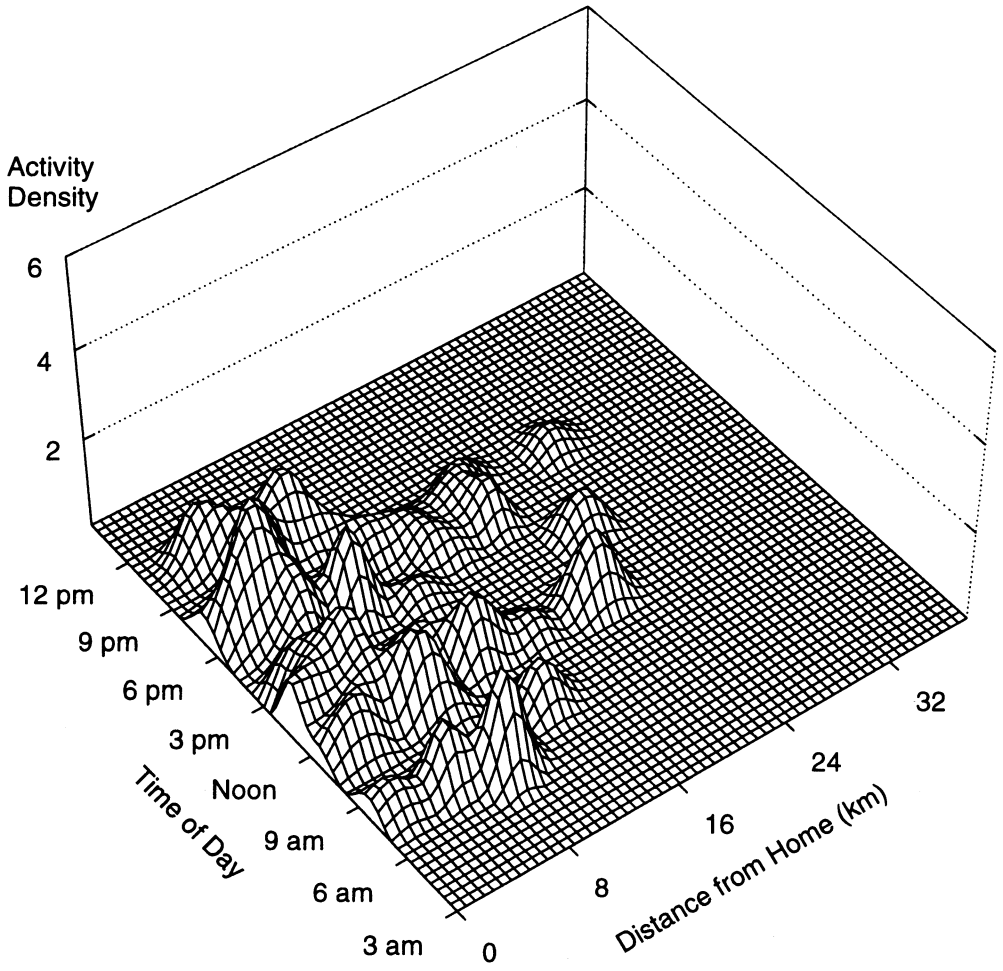

Figure 6. Space-time activity density surface of nonemployment activities for men employed full time.

that these part-time employed women have more time to perform nonemployment activities during the day than do full-time employed women and men, their activity patterns should have more space-time flexibility than the "concentrated" pattern revealed in Figure 8. As Villoria's (1989) study shows, individuals with a less restrictive time-budget constraint (e.g., full-time "housewives") can potentially reach more activity sites farther from home than those with more restrictive time-budget constraints (e.g., full-time workers). The apparent restriction in the activity patterns of the part-time employed women in the subsample hints at factors that limit the space-time flexibility and spatial range of their nonemployment activities.

Complexities may render this suggestion questionable, as the causal link it implies may also be in the reverse direction: that is, part-time employed women perform more nonemployment activities close to home during the day simply because they work fewer hours a day and have jobs close to home. They therefore have the flexibility to undertake, or are more likely to accept, a larger number of spatially or temporally

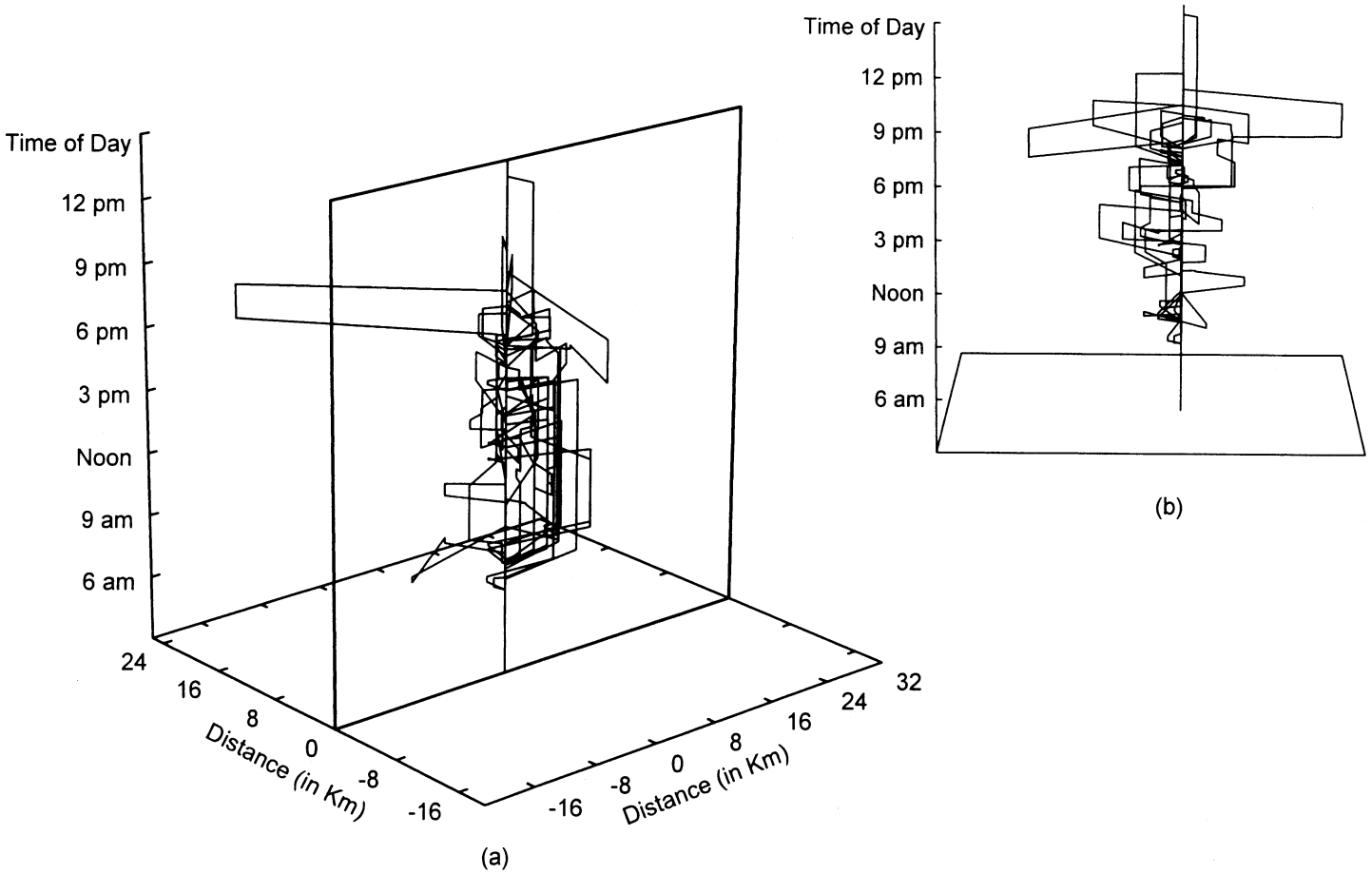

Figure 7. Standardized space-time paths for women employed part time. Location (0,0) on the x–y plane is the home site, and the vertical plane along x-axis is the home-work plane. (a) With the home-work plane shown, all stops are visible. (b) With the view line passing through the home-work plane, all work stops are "hidden."

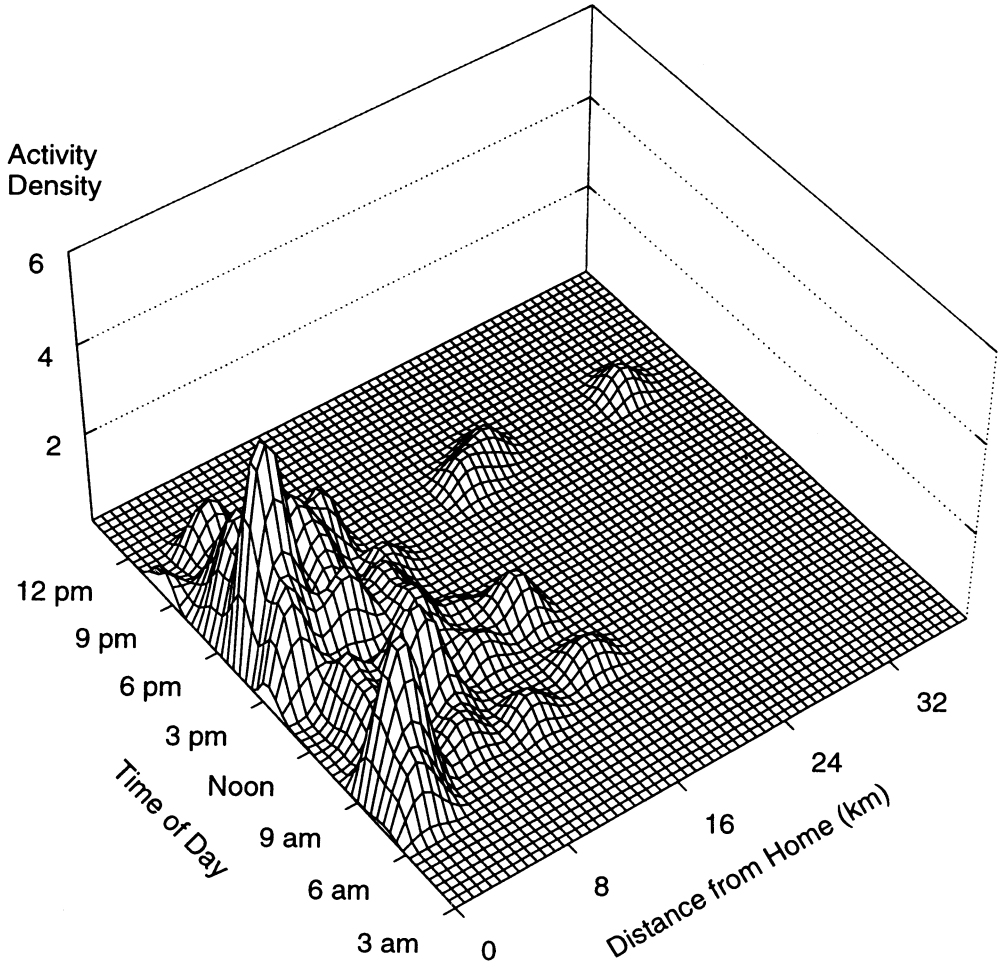

Figure 8. Space-time activity density surface of nonemployment activities for women employed part time.

fixed activities during the day than the full-time employed women and men in the subsample. This is undoubtedly a complex, two-way relationship that is difficult to disentangle without a contextualized ethnographic understanding of the particular life situations of the respondents. Further, the social and spatial context (such as the geographic distribution of job opportunities), as well as variations in the coping strategies adopted by these women, may also mediate the effect of the fixity constraint they face and make the activity outcomes less determinate than what is supposed above (Johnston-Anumonwo 1995; Gilbert 1997a, 1998; Preston and McLafferty 1993). Without this kind of qualitative information, I explore these complex interrelations in the next section using largely quantitative methods and the travel diary data.

Space-Time Constraints and Everyday Life

Association with Individual and Household Characteristics

To identify the individuals who experi-

ence higher levels of daytime fixity constraint, I perform a canonical correlation analysis with two sets of variables (Table 2). The first set represents a person's daytime fixity constraint, which is measured by the number of spatially and/or temporally fixed activities performed before 6 p.m.[3] The second set of variables includes 12 personal and household attributes. This latter set of variables represents a person's socioeconomic characteristics, family life cycle, and presence and age of children in the household. Three variables in this set are used to represent the possibility of sharing household responsibilities with others in the household: number of adults, child/adult ratio, and child/employed-person ratio in the household.

As indicated by the canonical loadings of the two sets of variables shown in Table 2, the daytime fixity constraint is significantly related ($p < .05$) to the set of individual attributes. The analysis reveals that women encounter more fixed activities than men during the day regardless of their employment status. Perhaps more surprising is that women who work part time experience higher levels of daytime fixity constraint than do the full-time employed women and men in the subsample. Further, higher personal income is associated with a lower level of daytime fixity constraint. Although no causal structure is hypothesized for the present analysis, these results are consistent with the findings of earlier studies which observed similar interrelations among gender, fixity constraint, employment status, and personal income (e.g., Hanson and Pratt 1995).

Several important observations pertaining to household responsibilities and child-serving activities deserve emphasis here. Although the variables often used to represent household responsibilities (e.g., the number of children and the presence of children at preschool age) have a positive association with the level of fixity constraint, their correlation is only moderate when compared to gender and those variables representing the possibility of sharing household responsibilities (e.g., the number of adults and child/adult ratio). This means that the level of daytime fixity constraint one experiences depends more on one's gender and whether there is someone in the household who can and is willing to take up some of the household-serving activities in the day than the number of children in the household. If there is someone to share the household- and child-serving activities within the household, the burden of fixity constraint a woman faces in her daily life will be greatly reduced. The most significant implication of this is that redressing the domestic division of labor and gender relations within the household would substantially reduce women's fixity constraint, which might also improve women's labor market position and income-earning potential.

Effect on Commuting Distance

The above analysis shows the association between women's fixity constraint and gender relations in the household. This section explores the effect of the fixity constraint on women's commuting distance. Most studies of the journey to work have observed that women's work trips are shorter than men's, whether measured in terms of distance or time (see studies reviewed in Hanson and Johnston 1985; Blumen 1994; Gilbert 1997b; and McLafferty and Preston 1997). Various factors have been identified as important reasons for women's shorter work trips: women's household and childcare responsibilities, the space-time constraints they face, their lack of access to the automobile, their lower income levels, and their labor market positions due to occupational segregation. These results from previous

[3] To determine which activities are spatially fixed or temporally fixed, four questions were included in the travel diary, following Cullen, Godson, and Major's (1972) approach. Answers to these questions indicate the possibility and ease of changing the location and/or time of an activity (see Kwan 1999b for details).

Table 2

Canonical Correlation Analysis of the Relationships between Daytime Fixity Constraint and Personal and Household Attributes

	Canonical Component[a]	
	1	2
Eigenvalue	0.48	0.27
Canonical correlation	0.70	0.52
Wilk's Λ	0.33	0.63
χ^2	55.52*	22.77
Degrees of freedom	39	24
Daytime fixity constraint variables		
Number of spatially fixed activities before 6:00 p.m.	0.63	0.47
Number of temporally fixed activities before 6:00 p.m.	0.50	0.84
Number of spatially and temporally fixed activities before 6:00 p.m.	0.77	0.57
Personal attributes		
Age	–0.26	0.18
Gender (male = 0, female = 1)	0.32	0.37
Employment status (full time = 0, part time = 1)	0.17	0.62
Personal income below $20,000 a year (0–1)[b]	0.20	0.51
Personal income above $40,000 a year (0–1)	–0.48	0.07
Number of adults in household	–0.59	0.42
Child/adult ratio in household	0.29	–0.12
Child/employed persons ratio in household	0.05	–0.01
Number of children in household	0.17	–0.42
Presence of children at age < 6 (0–1)	0.21	0.40
Presence of children at age 6 to 15 (0–1)	–0.06	–0.08
Presence of children in household (0–1)	0.23	0.36

Note: Number of cases entered into the analysis is 59.

[a] Only two of the three canonical components computed are shown.

[b] (0–1) indicates that the variable is a 0–1 indicator variable.

* Significant at $p < .05$.

research lead to the expectation that women in the current subsample, whether employed full time or part time, will have a shorter commuting distance than men.

As shown in Table 3, part-time employed women have a shorter commuting distance than men, as expected. What is unexpected is that the workplaces of women employed full time are located significantly farther away from home (15.8 kilometers or 9.8 miles on average) than are men's (11.9 kilometers or 7.4 miles) ($p < .05$). This result is unexpected in view of past studies that have observed shorter commutes for women than men. Some recent studies found that, in some particular subpopulations, women travel as far as men from home to work (England 1993; McLafferty and Preston 1991, 1996; Hanson and Pratt 1992, 1995); that women work farther away from home than men in a homogeneous subpopulation has not yet been observed.[4]

[4] Women's longer commuting distance than men's observed in some past studies was due to the distinctive characteristics of the women and men in the sample. For example, in Brooker-Gross and Maraffa's (1985) study of university employees, two-thirds of the male respondents were holding faculty jobs, while women in the sample were predominantly clerical personnel, food service workers, and housekeepers.

Table 3

Average Distance of the Workplace and Nonemployment Activities from Home for Each Group

	Distance from Home (in km)[a]		
	Women, Employed Full Time	Women, Employed Part Time	Men, Employed Full Time
Workplace	15.84	8.63*	11.92*
Nonemployment activities	9.69	6.32*	11.52

Source: Travel diary survey conducted in Columbus, Ohio, 1995.

[a] All distances are average network distance in kilometers measured by a digital network for a particular group.

* Difference from women employed full time is statistically significant ($p < .05$).

Several factors identified as important in past studies are unlikely to be the main reason for this result. For instance, since all individuals in the subsample have and regularly use their own cars, differences in travel mode or access to means of transportation cannot explain women's longer commuting distance. Similarly, the relatively short home-work distance for women employed part time cannot be explained by their lack of access to the automobile. Further, as women and men in the subsample are from the same households, which are spatially scattered in the study area, differences in commuting distance between the three groups are not likely to be due to differences in residential location. The spatial distribution of employment opportunities in the study area also does not explain the longer commutes of full-time employed women in terms of their disadvantaged residential location relative to jobs compared to their husbands (as observed in Fox 1983; Madden 1981; Singell and Lillydahl 1986). Although past studies observed that suburban women may have long journeys to work if they need to commute from suburban residences to downtown work sites, employment opportunities, including professional jobs, in Columbus are now available in many spatially scattered suburban centers. In fact, downtown Columbus now has only 13 percent of the jobs in Franklin County ("Regions's Heart Vulnerable" 1996), and most women in the subsample do not commute to work downtown, even if their commute is longer than that of their husbands.

The finding that full-time employed women in the subsample travel longer to work than full-time employed men is more likely due to the specific personal attributes of this particular group of women, who have high travel mobility and occupational status. On average, they travel 48 kilometers (30 miles) a day, while the men in the subsample travel 37 kilometers (23 miles) and women employed part time travel 34 kilometers (21 miles) a day respectively. As the survey data indicate, 82.1 percent of these full-time employed women hold managerial and professional occupations, while 71.0 percent of men and 30.8 percent of part-time employed women have these occupations. Thus, occupational status could be the factor leading to the longer home-work distance for this group of women. As past studies observed, occupational status is positively related to work-trip length: individuals with high occupational status travel longer distances to work than those with low occupational status (Fagnani 1983; Singell and Lillydahl 1986; Hanson and Pratt 1995). The longer journeys to work of the full-time employed women may be due to their willingness to travel longer in response to personal career aspirations (Pazy, Salomon, and Pintzov 1996).

The case of women employed part time, on the other hand, is in stark contrast with the case of women employed full time. These women work only 20.8 hours per week on average (as compared to the 46.2 hours for full-time employed women). Over half of them hold service and clerical jobs, and none of them works more than 10

Further, women and men in their sample had different residential locations.

kilometers (6 miles) from home. The number of children (1.85) and the child/adult ratio (0.85) in the household for these part-time women are higher than those of the full-time employed women (0.75 child and 0.39 child per adult in the household). These data suggest that household responsibilities may be a major source of the fixity and/or gender-role constraint these women encounter in their everyday lives. Such responsibilities in turn may have exerted a rather strong limiting effect on the spatial range of their workplace and nonemployment activities (Table 3). These results are in line with previous findings that part-time employed women tend to work closer to home than do full-time employed women, and that the spatial entrapment of women pertains particularly to white lower- and middle-class women (Hanson and Pratt 1994).

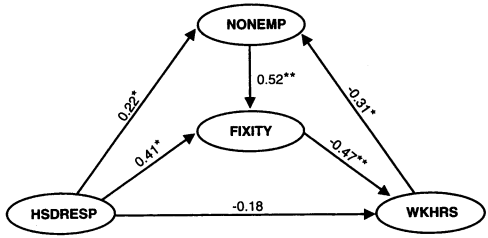

Figure 9. Path diagram and standardized coefficients for the structural equation model. Numbers on arrows are standardized path coefficients. Statistically significant relations are indicated by * ($p < .05$) and ** ($p < .01$).

Impact on Women's Employment Status

To disentangle the complex interrelations among women's daytime fixity constraint, nonemployment activities, household responsibilities, and employment status, I estimate a nonrecursive structural equation model with latent variables for the women in the subsample (Fig. 9) (Bollen 1989; Jöreskog and Sörbom/SPSS 1989). The model takes household responsibilities (HSDRESP) as the exogenous latent variable, which is measured by two observed variables: the number of children and the child/adult ratio in the household. Three endogenous variables in the model represent the daytime fixity constraint (FIXITY), employment status (WKHRS), and the number of out-of-home, nonemployment activities undertaken before 6:00 p.m. (NONEMP) respectively. The fixity constraint variable (FIXITY) is measured by two observed variables: the number of spatially fixed activities before 6:00 p.m., and the number of temporally fixed activities before 6:00 p.m. To avoid the use of categorical variables so that standardized coefficients can be computed, employment status is represented by the number of work hours in a typical work week (WKHRS) instead of the dichotomous categories of full-time and part-time employment.

With this model, I evaluate several sets of hypotheses that focus on the direct and indirect effects of household responsibilities and the fixity constraint on women's employment status. The first hypothesis is that women's daytime fixity constraint has a significant impact on their employment status. As I argued earlier, women's daytime fixity constraint is associated with their need to undertake household-serving fixed activities during the day, and the need to perform these activities may make it difficult for them to work full time. This causal path is modeled by the HSDRESP-FIXITY-WKHRS link in the middle of Figure 9. Its purpose is to examine whether the fixity constraint has a significant direct effect on women's employment status, and whether household responsibilities contribute significantly to such fixity constraint.

Testing these hypotheses, however, involves several complications and requires the introduction of other causal links into the model. On the one hand, women employed part time may perform more fixed activities simply because they work fewer hours a day and have the flexibility to undertake, or are more likely to accept, more nonemployment activities (many of which are fixed activities) during the day.

The feedback loop on the upper right (WKHRS-NONEMP-FIXITY-WKHRS) incorporates this reciprocal causation between women's fixity constraint and employment status into the model. On the other hand, household responsibilities, by virtue of their demand for time and effort, may exert their own direct effect on women's employment status without the mediation of the fixity constraint. In other words, the role of a daytime fixity constraint as an intervening link between household responsibilities and women's employment status as hypothesized above may be spurious. To examine this hypothesis, the direct link (HSDRESP-WKHRS) at the bottom of Figure 9 is incorporated into the model. It tests whether household responsibilities have a direct effect on employment status independent of the fixity constraint. In addition, the link in the upper left (HSDRESP-NONEMP-FIXITY) of Figure 9 assesses whether household responsibilities have an indirect effect on fixity through increasing the number of out-of-home, nonemployment activities (NONEMP).

The results shown in Figure 9 are consistent with the notion that higher levels of women's daytime fixity constraint (FIXITY) lead to fewer work hours per week (WKHRS). As an intermediate variable, however, an increase in FIXITY itself can be attributed to two different sources: (1) increase in the amount of household responsibilities (HSDRESP), and (2) increase in the number of out-of-home nonemployment activities (NONEMP) due to fewer work hours (WKHRS) or more household responsibilities (HSDRESP). This suggests that household responsibilities, besides exerting a direct effect on women's employment status (which is not statistically significant in this case), also has an indirect impact on employment through the mediating effect of the daytime fixity constraint (FIXITY) and the number of out-of-home nonemployment activities (NONEMP). Further, an increase in women's daytime nonemployment activities due to part-time employment tends to increase the level of fixity constraint as measured in this study, as part-time employed women have the time and flexibility to undertake more fixed activities during the day. These results confirm the existence of reciprocal causation between women's daytime fixity constraint and employment status.

Two observations need to be emphasized here. First, five statistically significant links identified in the model involve the FIXITY variable, and this indicates that daytime fixity is an important intermediate variable, as hypothesized. These links are found in the feedback loop WKHRS-NONEMP-FIXITY-WKHRS and the links HSDRESP-FIXITY-WKHRS and HSDRESP-NONEMP-FIXITY-WKHRS. Second, although the direct effect of household responsibilities (HSDRESP) on the number of work hours (WKHRS) is not statistically significant, its indirect effect through FIXITY is exerted through two intermediate but statistically significant links. This suggests that in cases where household responsibilities are observed to be unimportant (as observed in some past studies), introducing the fixity constraint as an intermediate variable may provide the missing link for unraveling the indirect but significant effect of household responsibilities on employment status.

Summary and Conclusions

Emphasizing the importance of out-of-home, nonemployment activities in the reconceptualized home-work link, this study provides an alternative and yet fruitful way to examine the gendered nature of social life: through unraveling the complex relationships between women's gender roles in the household (domestic responsibilities) and the local labor market (employment status) through the mediating links between home and work (nonemployment activities). It confirms the significance of the fixity constraint as a mediating factor in the complex interrelations among these three spheres of women's everyday lives.

The travel diary data for the three European-American population subgroups reveal that the level of daytime fixity constraint depends more on one's gender and the extent to which household responsibilities can be shared with other adults in the household than on some conventional variables of household responsibilities, such as the presence or number of children in the household. As an intervening variable mediating the interrelations among women's household responsibilities, nonemployment activities, and employment status, the fixity constraint has a significant impact on women's employment status (where women with higher levels of fixity constraint are more likely to work part time). The most important implication of this finding is that redressing the domestic division of labor and gender relations within the household will not only substantially reduce women's fixity constraint, but will also improve their labor market position and income-earning potential (especially for women currently working part time).

One of the most unexpected results of this study is that women employed full time travel longer distances to work than do men. This is perhaps due to their high occupational status. Further, these full-time employed women adopt a diurnal temporal strategy involving shifting a considerable proportion of their nonemployment activities to the evening to cope with their time-budget constraint. As far as these activities allow for such temporal adjustments, the fixity constraint of these women may not be manifested in terms of more restrictive job locations or shorter journeys to work. This suggests that, contrary to what was assumed in the past, the journey to work may not reflect the magnitude of the space-time constraints women face in their everyday lives. As England (1993, 235–37) argued, a long journey to work does not necessarily imply the absence of a woman's negotiation of her multiple roles or the need to overcome the space-time tension arising from the physical separation and interconnectedness of home and work. The journey to work is indeed only one aspect of a much larger space-time budgeting problem in which various adaptive strategies can be deployed to meet specific needs.

Whether a short journey to work is always the result of a woman's juggling of multiple roles, however, is less straightforward. The fact that no woman employed part time in the subsample works farther than 10 kilometers (6 miles) from home (Fig. 7) seems to suggest the restrictive effect of their daytime fixed activities. On the other hand, even though women employed full time do not need to perform many daytime fixed activities close to home, some of them still work relatively close to home (as shown by a cluster of paths at about 8 kilometers, or 5 miles, from home in Figure 4). To understand the diverse experiences of women even within an apparently homogeneous population subgroup will require ethnographic research with a focus on gender relations and "difference" (e.g., Aitken 1998; Gregson and Lowe 1993).

Several limitations of the study should be addressed in future research. First, due to the specific subsample and context of the study, its results cannot be generalized to other gender/ethnic subgroups or sociospatial contexts. For instance, in view of the high scoioeconomic status and travel mobility of the individuals in the subsample, results reported in this study may seriously understate the fixity constraint and mobility problems faced by individuals of other gender/ethnic subgroups (especially minority women). Future research should address this limitation through examining these issues using data of various population subgroups. Further, the survey data used in this study do not allow for the examination of other important mediating factors, such as localized social networks, personal choice and preference, as well as labor market dynamics. The interaction between these factors and space-time fixity in women's everyday lives is an important issue for future research.

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