Breaking Down the Daily Use of Places

A Space-Time Typology of Temporary Populations in the Netherlands[1]

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Abstract. In a network society, spurred on by technological, social, and economic factors, the process of land use deconcentration has resulted in various new urban forms such as edge cities and edgeless cities. While the consequences of this process for the distribution of the residential population and travel patterns have been extensively described and analyzed, there has as yet been little investigation of the effect on visitors' use of places. Using the 1998 Netherlands National Travel Survey, we developed a typology of urban, suburban, and rural municipalities located in monocentric and polycentric urban systems on the basis of dimensions of diurnal weekday variations in visitor populations. A two-step cluster analysis resulted in five types of municipality: 'central place', 'contemporary node', 'self-contained', 'mobile children', and 'local children'. [Key words: temporary populations, use of places, polycentricity, cluster analysis, the Netherlands]

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1. Introduction

Changing infrastructure networks dramatically, but highly unevenly, 'warp' and refashion the spaces and times of all aspects of interaction (Graham & Marvin, 2001). As a result, the opportunities for participation in activities and travel in a network society have become highly fragmented in space and time. Paralleled by an increase in the heterogeneity of social networks as many new groups and lifestyles sprung up within society in the last few decades (Musterd & Van Zelm, 2001; Giuliano & Gillespie, 2002; Wachs, 2002), these developments have led places in contemporary society to be increasingly structured around and by highly divers (rhythms of) flows of people, goods, and information (Castells, 1996).

Many studies have discussed the impact of these processes on the distribution of the residential population (Dieleman et al., 1999; Bontje, 2001; Champion, 2001; Batty et al., 2002; Camagni et al., 2002) as well as on the travel patterns of the residents of urban, suburban, and rural communities (Badoe & Miller, 2000; Crane, 2000; Ewing & Cervero, 2001; Schwanen et al., 2004). There is, however, another dimension of the use of places that has hitherto remained largely unexplored: namely, the function of places for visitors. In the web of individual movements through time-space, intersections of individual paths lead to the *becoming of places* (Pred, 1984): as Massey (1993, p. 66) states, places are increasingly becoming "articulated moments in networks of social relations and understandings." Places can be interpreted as clusters of spatial events that take place in time and space, and "where the event is characterized by its duration, intensity, volatility, and location (Batty, 2002, p. 1)." This interpretation implies that, in a network society, large differences develop in the ways in which residential populations and temporary or visitor populations use places. As Van der Knaap (2002) states, places may increasingly show an uncoupling of economic threshold, the supply of goods and services, and residential population size. At the same time, new opportunities arise for developing small and medium-sized cities that lack a strong local basis. Increasingly, visitor populations now determine the social, economic, and environmental performance of places.

By looking at the characteristics of visitor populations, the aim of this study is to provide an alternative way of understanding the performance of places in a network society. In this paper we report our development of a typology of urban, suburban, and rural municipalities located in monocentric and polycentric urban systems based on diurnal weekday variations in

visitor populations. For this analysis, we have used the 1998 Netherlands National Travel Survey (NTS) from which we derived dimensions of diurnal weekday variations in visitor populations.

In the next section we briefly discuss the main factors that have contributed to the process of land-use deconcentration that has resulted in the development of various new urban forms. The implications for the distribution of visitor populations are also discussed. Section 3 consists of a description of the research design. The constructed typology of municipalities of visitor populations is discussed in Sections 4 and 5. Our conclusions are given in the final section.

2. Land-Use Deconcentration and Temporary Populations

In the second half of the last century, the spatial structure of urban systems was dramatically modified as the result of technological innovations, rising levels of affluence, and changing lifestyles and household structures. In the first place, mass transit and the private automobile increasingly enabled people and economic activities to move out of town, creating huge suburbs and out-of-town locations for all kinds of business activity (Kloosterman & Musterd, 2001). In the past two decades, these tendencies were spurred on even further by the adoption of innovations in information and communication technologies (Wheeler et al., 2000). Second, prosperity and car ownership offered people the opportunity to suburbanize: "the bargaining power and spatial mobility (on a daily basis) of almost all households expanded more and more (Musterd & Van Zelm, 2001, p. 690)." Third, new household structures have also diminished the notion of monocentricity since members of two-earner households have to find a residential compromise between two different job locations (Gordon et al., 1998; Champion, 2001; Kloosterman & Musterd, 2001). Finally, as the consumptive order replaced the productive order (see for example Glennie, 1998), mobility patterns became increasingly affected by the locations of leisure facilities, which specialize and concentrate in space without regard to their local demand.

These developments in society have led to land-use deconcentration in various forms. Land-use patterns are seen primarily as the outcome of accessibility and locational trade-offs (Clark, 2000). Initially, this mechanism led to concentric circles of land use around one dominant center (see for example Alonso, 1964). However, as cities expanded, the

applicability of this monocentric model was increasingly questioned (Davoudi, 2003). According to Clark (2000), the traditional mechanism still applied, but the model itself needed modification. The *edge city* is one of the paradigms the suggested polycentric model facilitates. Garreau (1991) characterizes an edge city as a large-scale sub-centre at the edge of the built-up area of a metropolitan region; it is a single destination for jobs, shopping, and entertainment. Others (Gordon & Richardson, 1996; Lang & LeFurgy, 2003) take a decentrist view, stating that households are the centres in a post-polycentric urban landscape, with urban sprawl or *edgeless cities* as the dominant settlement structure. In the decentrist view the dominant structuring mechanism is personal mobility. Since these two mechanisms – centralizing and decentralizing – co-exist, the contemporary landscape is characterized by a large variety of urban forms, ranging from historic urban centres to Lang & LeFurgy's (2003) edgeless cities.

This wide variety of urban forms and structures has had a marked influence on mobility patterns and interactions between locations. Studies analyzing changes in mobility patterns as a consequence of the emergence of polycentric structures or sprawl (see for example Levinson & Kumar [1994] and Gordon & Richardson [1996] for USA; Cortie et al. [1992] for the Netherlands; and Clark & Kuijpers-Linde [1994] for USA and the Netherlands) concentrate on travel direction, travel time, and travel mode. With respect to travel direction, Cortie and colleagues (1992) found that three quarter of all trips in the Randstad had their origin and destination within the residential municipality. They also found that some 40% of the inter-municipal trips in the Randstad took place between central city and suburban locations, while some 60% took place between suburban locations. Thus, while many interactions (such as shopping and leisure) still take place within the residential municipality, the importance of tangential movements relative to radial movements has also increased, especially with regard to commuting (Harms, 2000). In USA the increase in both *suburb-to-suburb commuting* and *reverse commuting* has been emphasized by, for example, Pisarski (1996), Guiliano (1999), and Cervero and colleagues (2002).

While the studies mentioned in this literature review have paid considerable attention to land uses and interactions in polycentric systems, there has been little investigation of the consequences for people's daily use of places. Although people change their daily paths through time and across space, current studies analyzing the daily use of places generally focus on just one settlement or metropolitan area. Goodchild and colleagues (1984, 1993, and

1998) for example have analyzed the temporal specialization of the Dartmouth-Halifax metropolitan area in Canada. They identified certain factors that influence the temporal and spatial distribution of people. The main factors can be categorized along activity and socio-demographic dimensions. Home and work-related activities seem to provide the strongest dimensions of diurnal patterns of social group distributions, followed by leisure, shopping, and education. The relevant socio-demographic dimensions of visitor populations are related primarily to income, educational/occupational status, and age. Other studies include those of Chapin and Stewart (1959), who examined diurnal changes in population densities for Flint, Michigan; Buliung (2001), who studied the spatial-temporal patterns of work and non-work out-of-home activities within the Portland region; Boffi and Nuvolati (2002), who investigated the relationship between time use and urban governance in the metropolitan area of Milan; and Bromley and colleagues (2003), who analyzed the space-time layers of uses and users in the Swansea (UK) city centre.

However, a full understanding of the performance of places in a network society requires the investigation of a larger variety of spatial contexts, including central cities and suburban communities in both polycentric and monocentric systems as well as communities outside these daily urban systems. For example, economic land-use deconcentration may have led to the emergence of new types of spatial environment in which city residents co-determine visitor population characteristics in the surrounding suburbs. At the same time, we expected the orientation of suburbanites towards central places to be lower in polycentric systems than in monocentric systems. Furthermore, in rural municipalities outside daily urban systems, we expected a relatively large share of municipalities to be self-contained.

3. Research Design

In this study, we have constructed a typology of urban, suburban, and rural municipalities based on diurnal weekday variations in visitor populations in the Netherlands, and we related this typology to different types of urban system and types of settlement within them. In this way we have sought to obtain a better understanding of how land-use deconcentration has affected the use of places by visitor populations. In this study, a visitor population is defined as the aggregate of all persons, including persons active within their residential municipality,

performing out-of-home activities in a particular municipality during a particular time period. To obtain a typology of municipalities, a two-step cluster procedure was adopted.

In the first step, we combined dimensions underlying diurnal variations in the presence of visitor populations in the Netherlands into a typology of space-time units. These dimensions, which account for most of the variance in the diurnal variation of visitor population presence occurring within different Dutch municipalities on an average weekday in 1998, were identified using a principal factor analysis. Therefore, we first calculated the total visitor population and subpopulations within it present in each municipality during each one-hour time period of an average weekday. The subpopulations were defined by a selection of categories of individual and household characteristics, activity characteristics, and trip characteristics, and were expressed as a proportion of the total visitor population. Subsequently, the factor analysis was performed using the six one-hour time periods in which overall participation in various classes of out-of-home activity was empirically found to be highest: 8am – 9am (morning traffic), 10am – 11am (work and education), 12am – 1pm (lunchtime), 2pm – 3pm (shopping), 5pm – 6pm (evening traffic), and 8pm – 9pm(leisure [sports, recreation, and entertainment] and social activities).

As a result, after the first clustering step, each type of space-time unit describes the activity, trip, and socio-demographic characteristics of the visitor population present within a certain municipality during a particular time period. In the second step, we searched for municipalities that resemble each other in their diurnal patterns of types of space-time unit. In this way we transformed a typology based on spatial-temporal units into a typology based on spatial units. In this two-step procedure we have used agglomerative hierarchical cluster analysis combined with a k-means cluster analysis (first step), and binary hierarchical cluster analysis (second step).

In agglomerative hierarchical clustering (the first clustering step), Ward's method and the squared Euclidean distance measure were used to gain a more holistic view of visitor population presence in space and time. Ward's method minimizes the within-cluster sum of squares over all partitions in each stage of clustering procedure. In the first step spatial-temporal units (that is, combinations of a municipality and a time period) were grouped on the basis of their scores on the dimensions identified with the factor analysis. The Netherlands comprised 548 municipalities in 1998, and we used six one-hour time periods, so we needed to cluster 3288 space-time units in this step.

The criterion of a meaningful interpretation and graphical plots of four validity indices (see Halkidi et al., 2002) that need to be applied to each stage of the hierarchical clustering algorithm were both used to determine the most suitable number of clusters. First, the root-mean-square standard deviation of the new cluster measures the homogeneity of the clusters formed at each step of the hierarchical algorithm; these should be as small as possible. Second, semi-partial R-squared measures the loss of homogeneity after merging the two clusters of a single algorithm step, with a value of zero indicating that two perfectly homogeneous clusters are merged. Third, R-squared is a measure of dissimilarity between clusters. An index equal to 1 is an indication of a significant difference between groups. Finally, the distance between the two clusters that are merged should be as small as possible. Plotting a graph of these four indices for different stages of the clustering algorithm and looking for the steepest knee in the graph yielded indication of the number of clusters that exist in the data set, bearing in mind that we are looking for as few clusters as possible to begin with.

To improve cluster fit (Punj & Stewart, 1983; Aldenderfer & Blashfield, 1984; Milligan, 1996), cluster means found with the agglomerative algorithm were used as initial cluster centres (*seeds*) in a k-means cluster analysis. Each cluster was interpreted on the basis of its mean score (plus / minus one standard deviation) on each of the dimensions. As a result, after the first clustering step, we could indicate for each individual municipality the type of space-time unit to which the municipality belonged to during each of the six one-hour time periods used in the analysis.

The second clustering step consisted of binary hierarchical cluster analysis to identify the main patterns between the various diurnal structures of types of space-time unit (that is, each municipality can belong to more than one type of space-time unit in the course of one day and thus has its own unique diurnal structure). Therefore, since our cases were still spatial-temporal units and needed to be spatial units (that is, municipalities), we restructured our cases into variables. As a result of this procedure each municipality was described by six variables, each of which a one-hour time period reflecting the type of space-time unit to which the municipality belonged during that particular time period. Subsequently, binary variables were created to indicate the presence or absence of each type of space-time unit during each one-hour time period for each municipality. These binary variables were entered into the second clustering step, using Ward's method and the binary squared Euclidean

distance measure (Aldenderfer & Blashfield, 1984). This measure counts up the number of discordant cases or mismatches (0-1 combinations and 1-0 combinations). Since each case (municipality) has exactly six attributes labelled 'present', the maximum distance yields 12, which would mean that two municipalities were completely dissimilar. The minimum distance is 0, indicating that two municipalities have exactly the same diurnal structure of types of space-time unit.

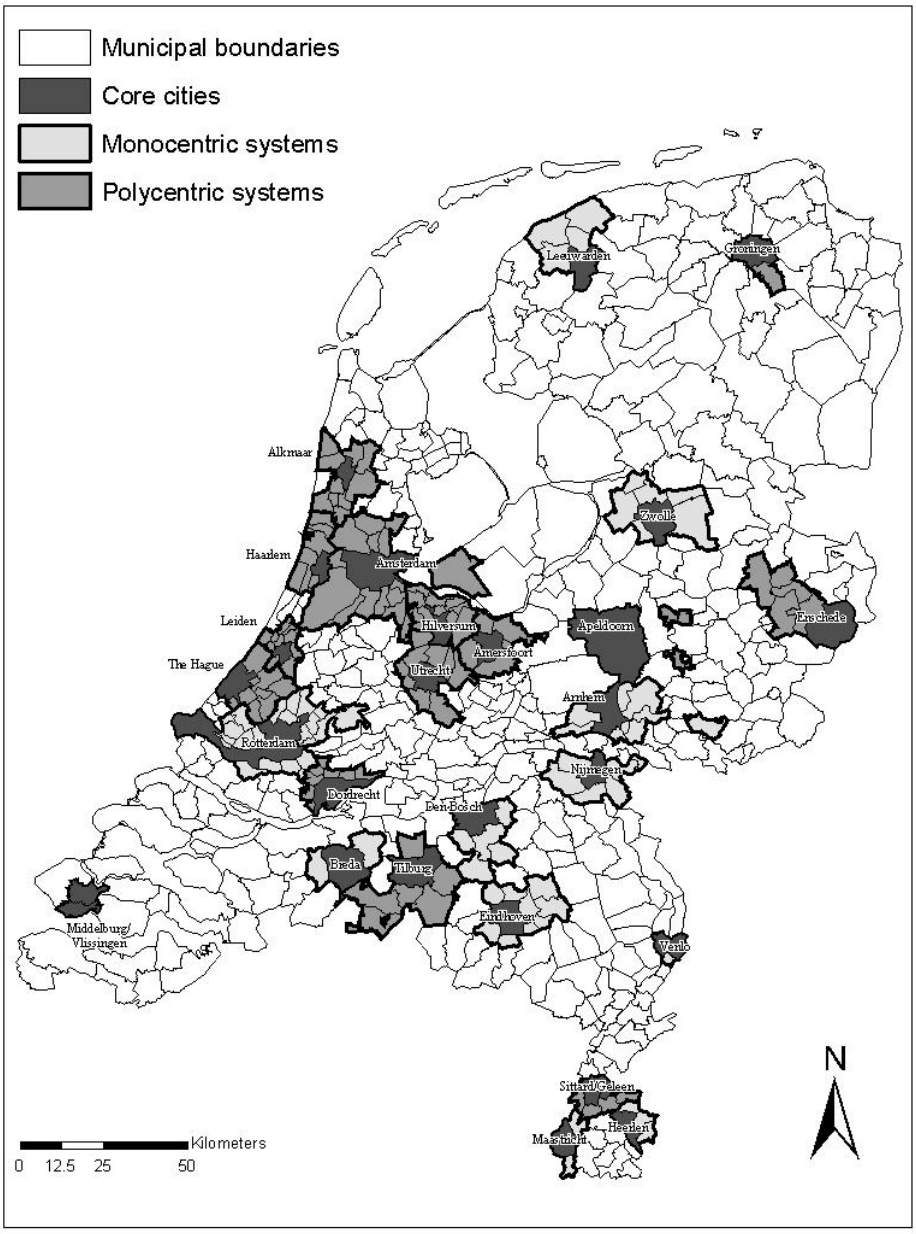


Figure 1 Types of daily urban system in the Netherlands

A discriminant analysis on the basis of a large set of spatial variables, including land use and accessibility measures, was employed for obtaining *spatial profiles* of the types of municipality. Our interpretation and description of the different types is thus based on both visitor population characteristics and spatial characteristics. We used a typology of daily urban systems based on Van der Laan (1996, 1998) to examine the relationship between spatial context on the regional level and the type of municipality based on visitor population characteristics. We distinguished two types of daily urban system: monocentric and polycentric. Both are dichotomized into core cities and surrounding suburbs. We also distinguished municipalities that do not belong to a daily urban system. It should be stressed that this typology of daily urban systems is based only on commuter flows. Figure 1 is a map of the different types of daily urban system in the Netherlands, including their core cities.

4. Typology of Space-Time Units

In this section we describe our typology of space-time units; the result of the first clustering step. Each type of space-time unit describes the activity, trip, and socio-demographic characteristics of the visitor population present within a certain municipality during a particular time period.

Our typology of space-time units was based on seven dimensions underlying diurnal variations in the presence of visitor populations in the Netherlands. The seven dimensions were the result of a principal factor analysis of which the results are provided in Table 1. For example, it can be seen from Table 1 that the variable *work* loads –0.965 on the first dimension. This first and most important dimension was labelled the leisure dimension: it is oriented towards different degrees of participation in leisure activities. Accordingly, we found two dimensions related to the size of the territory on which visitor populations operate combined with the use of different transport modes (the inter-local and local dimension), one dimension expressing the direction in which inter-local movement occurs (the central place dimension), and three dimensions capturing different life stages within the visitor population (children, high-income family, and senior dimensions).

Table 1 Factor analysis pattern matrix (only loadings >- |0.400| displayed)

	Dimension						
	Leisure	Inter-local	Local	Central place	Children	High-income family	Senior
Work	-0.965						
Leisure	0.682						
Social activities	0.509						
Used public transport		0.653					
Travel time >- 30 minutes		0.624					
Travel time < 10 minutes		-0.604					
Destination municipality is not residential municipality		0.550					
High educational level		0.426					
No cars available							
Used car			-0.933				
Used bicycle			0.689				
Residential municipality at a higher spatial scale*				-0.931			
Residential municipality at a lower spatial scale				0.544			
Age < 12					0.674		
Education					0.570		
Age 18 -< 30					-0.505		
Couple, 2 workers, adult					-0.466		
Female							
Single, worker, adult						-0.600	-0.499
Low income						-0.589	
High income						0.543	
Two or more cars available						0.400	
Non-worker, adult							0.661
Age >- 65							0.551

* We formulated four spatial scales. From the highest to the lowest, these are: the three large cities inside the Randstad (1), medium-sized cities inside the Randstad and more urbanized municipalities outside the Randstad (2), growth centers and suburbs inside the Randstad (3), and less urbanized municipalities outside the Randstad (4). Someone living in a medium-sized city inside the Randstad and visiting a suburb inside the Randstad has a residential municipality at a higher spatial scale than the destination municipality. The four scales thus define different levels of urbanization with (1) the highest and (4) the lowest level.

The combined hierarchical k-means cluster analysis procedure based on these dimensions resulted in 10 clusters with each one indicating a different type of space-time unit (see Table 2). These are actually *sub-clusters* since they are the input for the second clustering step. Using the mean score and one standard deviation per factor – approximately 68% of the factor scores are within one standard deviation of the mean factor score – a short description of the sub-clusters is provided in this section. Table 3 shows the distribution of the types of space-time unit across the six time periods used in the analysis.

In general, we can distinguish between three work-oriented space-time units (cluster 1-3), two education-oriented space-time units (clusters 4 and 5), and five leisure-oriented space-time units (cluster 6-10). Among the work-oriented space-time units, the 'central inter-local' type comprises visitors residing in municipalities on lower spatial scales participating in work activities. In contrast, the 'decentral inter-local' type captures visitors whose residence is in a municipality on a higher spatial scale. Visitors from high-income families participating in

non-leisure activities characterize the 'high-income family' type. From Table 3 it can be seen that during the day about 20% of the municipalities belong to the 'central inter-local' type. At noon nearly 50% of the municipalities belong to either the 'central inter-local' or 'decentral inter-local' type, which is mainly the result of children's lunch break. Between 8am and 9am about one third of the municipalities belong to the 'high-income family' type; apparently high-income workers dominate visitor populations early in the morning.

Table 2 Mean factor scores per type of space-time unit

Sub-cluster number	Type of space-time unit	N	Dimension						
			Leisure	Inter-local	Local	Central place	Children	High-income family	Senior
1.	Work-oriented central inter-local	478	**-0.47** **(0.44)**	**1.16** **(0.69)**	0.29 (0.59)	**1.20** **(0.37)**	-0.14 (0.49)	-0.21 (0.53)	-0.40 (0.48)
2.	Work-oriented decentral inter-local	364	-0.52 (0.65)	**0.80** **(0.76)**	-0.35 (0.80)	**-0.94** **(0.72)**	-0.45 (0.63)	-0.34 (0.74)	-0.64 (0.64)
3.	Work-oriented high-income family	405	**-0.99** **(0.53)**	-0.54 (0.64)	-0.19 (0.86)	-0.09 (0.69)	-0.36 (0.74)	**0.84** **(0.72)**	-0.50 (0.55)
4.	Education-oriented children	620	-0.29 (0.48)	-0.22 (0.55)	0.39 (0.58)	-0.12 (0.63)	**0.56** **(0.53)**	-0.29 (0.60)	0.11 (0.65)
5.	Education-oriented children local	346	-0.40 (0.58)	**-0.96** **(0.64)**	0.76 (0.83)	0.06 (0.75)	**1.69** **(0.88)**	0.53 (0.75)	-0.24 (0.64)
6.	Leisure-oriented adults	266	**1.26** **(0.69)**	0.54 (0.81)	-0.45 (0.70)	0.67 (0.72)	**-0.67** **(0.52)**	-0.48 (0.72)	0.11 (0.76)
7.	Leisure-oriented decentral non-local	225	0.61 (0.95)	0.09 (0.63)	**-1.37** **(0.76)**	**-1.64** **(0.90)**	-0.20 (0.87)	0.32 (0.90)	0.26 (0.87)
8.	Leisure-oriented high-income adults	224	**1.28** **(0.61)**	**-0.85** **(0.75)**	-0.47 (1.04)	0.24 (0.59)	**-0.88** **(0.79)**	**1.31** **(0.85)**	-0.01 (0.89)
9.	Leisure-oriented local	148	**1.15** **(1.01)**	**-0.92** **(0.86)**	**1.41** **(1.02)**	0.30 (0.71)	-0.64 (1.14)	-1.10 (1.43)	0.40 (1.14)
10.	Leisure-oriented senior	212	**0.95** **(0.82)**	0.02 (0.83)	-0.55 (0.99)	-0.23 (0.84)	-0.21 (0.71)	-0.93 (1.04)	**2.34** **(1.11)**

Values printed in boldface were used for a meaningful interpretation of the sub-clusters. In these cases the mean value plus or minus one standard deviation does not result in a different sign. Standard deviations are given between brackets.

Among the education-oriented space-time units, the 'children' type is typified by an over representation of children within the visitor population, whereas the 'children local' type combines the presence of children with a strong local orientation and only a few visitors from other municipalities (Table 2). Compared with the 'children' type, the 'children local' type is thus much more restricted to local users. The effect of school times – including the midday lunch break – can clearly be derived from Table 3. It can also be observed that in the afternoon more municipalities belong to the 'children' type (38.0%) than to the 'children local' type (13.5%). In the late afternoon and evening the share of education-oriented space-time units is practically zero.

Among the leisure-oriented space-time units, the 'adults' type represents adults participating in leisure activities. Visitors residing in municipalities on higher spatial scales

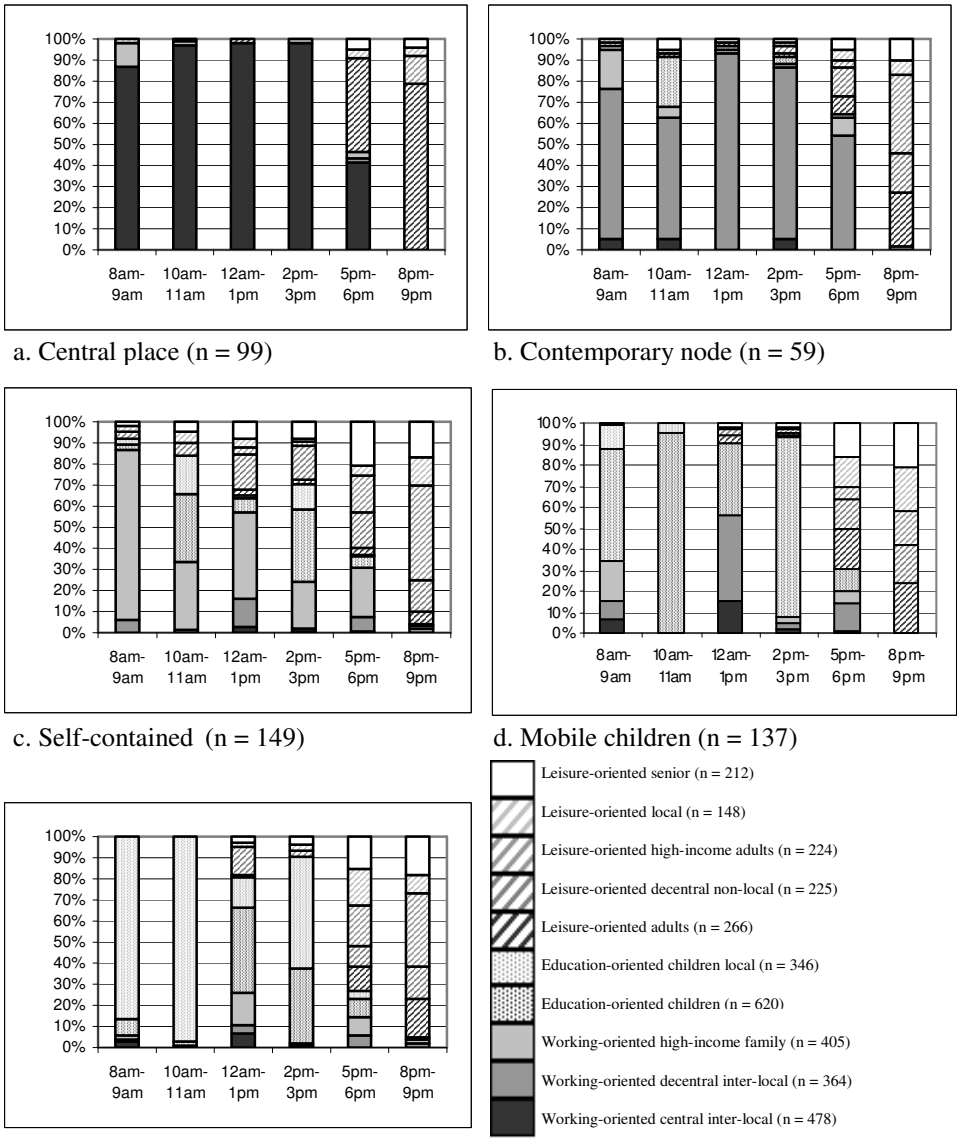
combined with an under representation of visitors participating in local activities can be found in the 'decentral non-local' type. The 'high-income adults' type comprises adults from high-income families participating in leisure activities. This type is also characterized by a relative lack of inflow from visitors from other municipalities. The 'local' type contains visitors participating in local leisure activities, and has an under representation of visitors from other municipalities. Finally, the 'senior' type captures seniors participating in leisure activities. From Table 3 it becomes clear that the leisure-oriented space-time units are concentrated in the last two time periods, particularly in the evening. Between 8pm and 9pm about 30% of the municipalities belong to the 'adults' type and about 30% belong to the 'high-income adults' type, probably indicating an urban-suburban dichotomy in evening leisure environments.

Table 3 Distribution of types of space-time unit across time periods

Time period	Work-oriented			Education-oriented		Leisure-oriented					Total
	Central inter-local	Decentral inter-local	High-income family	Children	Children local	Adults	Decentral non-local	High-income adults	Local	Senior	
8am-9am	18.4	11.7	31.0	15.9	20.3	0	1.1	0	1.1	0.5	100
10am-11am	18.2	6.6	9.7	35.4	24.8	0.2	1.6	0	1.6	1.8	100
12am-1pm	23.5	24.6	14.2	18.2	3.1	2.4	7.8	0.9	1.6	3.5	100
2pm-3pm	19.2	10.0	7.1	38.0	13.5	1.1	5.7	0.7	1.1	3.6	100
5pm-6pm	7.8	12.4	11.1	5.7	1.1	16.8	11.5	10.0	9.5	14.1	100
8pm-9pm	0	1.1	0.7	0	0.4	28.1	13.3	29.2	12.0	15.1	100
Total	14.5	11.1	12.3	18.9	10.5	8.1	6.8	6.8	4.5	6.4	100

5. Typology of Municipalities by Visitor Population Characteristics

In this section we describe how the typology of space-time units featured in Section 4 was transformed into a typology of spatial units. We use six time periods in our analysis; after the first clustering step, the visitor population present in each municipality is characterized for each of these six periods. Consequently, each municipality can be characterized by its own (in most cases unique) diurnal weekday pattern of types of space-time unit. In the second clustering step, a typology of municipalities of visitor populations is constructed on the basis of the dissimilarities in these patterns.



a. Central place (n = 99)

b. Contemporary node (n = 59)

c. Self-contained (n = 149)

d. Mobile children (n = 137)

e. Local children (n = 104)

Figure 2 Distribution of types of space-time unit across types of municipality of visitor population

Binary hierarchical cluster analysis resulted in five clusters, with each cluster indicating a different municipality type: central place; contemporary node; self-contained; mobile children; local children. The interpretation of these types is partly dependent on the spatial characteristics of the municipalities visited. For that reason we applied a discriminant analysis to a large set of spatial variables including various measures of land use and accessibility. In the remainder of this section we discuss the five types of municipality of

visitor populations bearing in mind both the spatial characteristics of the municipalities and the characteristics of their visitors. Figure 2 indicates which sub-clusters (types of space-time unit discussed in Section 4) belong to each of the five types of municipality at different times of the day. Figure 3 is a map of the Netherlands indicating the spatial distribution of the five types of municipality.

The first type of municipality is defined as the **'central place'** type. During the day, this type of municipality is mainly occupied by visitors originating from municipalities on lower spatial scales carrying out work activities. In the evening, adults participating in leisure activities are particularly apparent (Figure 2a). This type of municipality encompasses Amsterdam, Rotterdam, The Hague, and all medium-sized cities inside the Randstad (including Utrecht), as well as almost all the more urbanized municipalities outside the Randstad (Figure 3). The large supply and variety of opportunities (jobs, shops, restaurants, bars, and so forth) generally found within this type translates into an almost consistent presence of visitors originating from municipalities on lower spatial scales, and thus into a central position within the urban network. A simple central-place – non-central place dichotomy based on spatial characteristics such as job density and size measures still seems to be capable of explaining visitor populations in the Netherlands to a large extent.

The increasing importance of accessibility in the supply of opportunities in a network society, and its influence on visitor population distribution, is revealed in the second type of municipality. As a result of functional deconcentration processes, the **'contemporary node'** type of municipality captures the nodes or centres of (working) activity developed comparatively recently (during the last two or three decades). These municipalities are mainly concentrated around the highway exits at the fringes of the larger 'established' cities, but are also prevalent in more peripheral regions. Figure 3 indicates that many municipalities of this type are concentrated in the Amsterdam and Utrecht regions (Randstad North Wing). Although municipalities of the 'contemporary node' type are very similar during the day (Figure 2b: sub-cluster 2: presence of working visitors originating from municipalities on higher spatial scales), they appear to be considerably more diverse in the evening as some transform into more urban-like leisure environments (sub-cluster 6), some retain their decentral position (as a recreational outlet for city residents) (sub-cluster 7), and some become leisure environments for high-income adults (sub-cluster 8). In contrast with the 'central place' type, municipalities of this type do not offer a wide variety of opportunities;

they mainly offer jobs that are readily accessible by car. This high job accessibility by car enables municipalities of this type to attract visitors with a place of residence on higher spatial scales, undermining the traditional hierarchical system of central places, and claiming a position in the emerging network society.

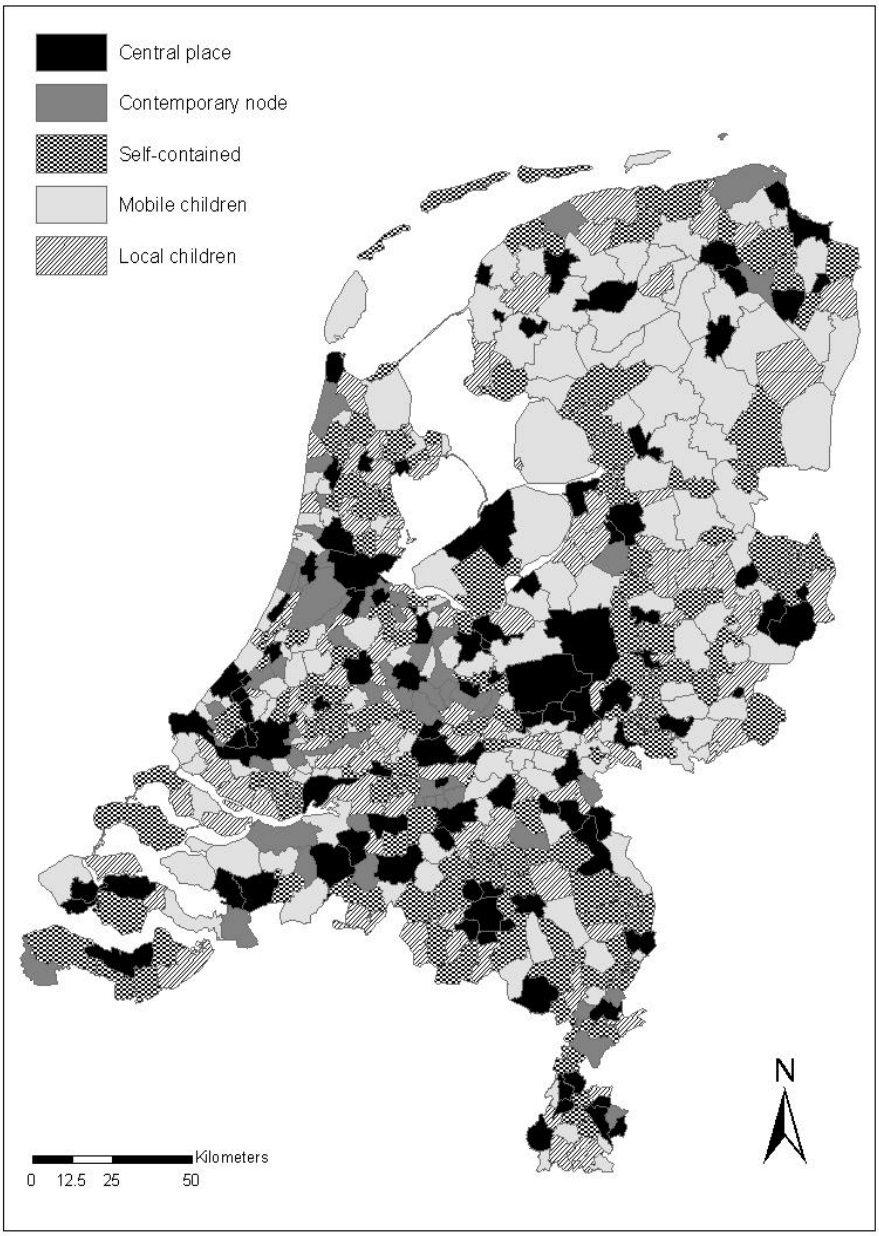


Figure 3. Types of municipality by their diurnal structure in visitor population presence

The third type of municipality generally contains visitors from high-income families participating in non-leisure activities (work) during the day (sub-cluster 3) and in leisure

activities in the evening (Figure 2c). Also, during school hours (10am-11am, 2pm-3pm), children make up a considerable part of the visitor population in this type of municipality. Since this municipality type generally lacks an inflow of visitors from other municipalities, but does contain people at work, learning, and in recreation locally, we have labelled this type **'self-contained'**. Large concentrations of this municipality type can be found in the suburban regions around Eindhoven, Venlo, and Arnhem (Figure 3). Apparently, some municipalities belonging to the 'self-contained' type are capable of profiting from their proximity to larger cities and their industries, and have developed a local job market. Possibly, companies within these municipalities take up a position within the regional business networks of larger companies residing in, for example, Eindhoven (Philips). Other municipalities may be self-contained in that they are farming communities or municipalities with small local businesses or industries served by their own residential population. Municipalities belonging to the 'self-contained' type tend to be small, either by number of residents or surface area. Possibly smaller municipalities offer better (socio-spatial) conditions for establishing self-containment.

The fourth type of municipality is the first of two children-led types; it is labelled the **'mobile children'** type, indicating that the diurnal rhythm within this type is mainly determined by the supply and timing of primary and secondary schools that attract children from other municipalities. Sub-cluster 4 plays an important part within this type during the day; however, in the evening a great diversity of sub-clusters emerges (Figure 2d). Some of the larger municipalities in the northern (and rural) part of the Netherlands belong to this type of municipality (Figure 3), as do some municipalities around large cities such as The Hague, Rotterdam, and Dordrecht. Apparently, visitor population characteristics are quite similar in rural municipalities and a selection of municipalities around large cities inside the Randstad, in particular during school hours; outside these hours these municipalities might actually differ markedly from each other (Figure 2d: compare 10am-11am and 2pm-3pm with the other time periods). A reason for their similarity might be that within this municipality type children are relatively mobile. On the one hand, the sparse distribution of schools in rural municipalities might contribute to such mobility among children. On the other hand, secondary schools in municipalities around large cities in the Randstad may receive children living in those large municipalities but going to school elsewhere, leading to the same kind of child-mobility.

The fifth and final type of municipality has been labelled the **'local children'** type. During the day – particularly in the morning time periods – sub-cluster 5 plays an important part (Figure 2e). This sub-cluster describes a type of space-time unit in which children active within their local environment are over represented. The 'local children' type of municipality is thus much more exclusive to local residents than the 'mobile children' type. Very young children usually go to a primary school within their own residential municipality, providing an explanation for this confined character and the label used. We can find further evidence of the confined character of this type of municipality in its spatial characteristics, which indicate relatively poor accessibility features and a low job-to-resident ratio. Together with a small supply and variety of opportunities these figures might suggest that adults living in this type of municipality often need to visit other municipalities for work, shopping, or recreational activities, and that only a few people from outside are spurred on to visit this type of municipality.

The analysis presented so far provides clues for the emergence of 'new' types of municipality as the result of an emerging network society. The 'contemporary node' type in particular, offering jobs that are readily accessible by car, seems to be the result of the deconcentration of urban functions to more accessible locations. Also, the fact that some of the municipalities belonging to the 'mobile children' type (originally only found in low-density rural communities) can now be found in the Randstad may indicate that this type also developed as the result of deconcentration processes; in this case the deconcentration of educational facilities leads to more child-mobility. In contrast, the 'central place' type, the 'self-contained' type, and the 'local children' type seem to be the more traditional municipality types.

This image is confirmed when we pay attention to the distribution of the municipality types across the different types of daily urban system and settlements within them (Figure 4). From Figure 4 it can be seen that, first of all, regardless of monocentricity or polycentricity, all core cities belong to the 'central place' municipality type. Apparently, in the Netherlands, core cities in polycentric systems still attract large numbers of people from other municipalities. Second, a considerable share (23.5%) of suburbs in monocentric systems belongs to the 'central place' type. Within some monocentric systems core cities and suburbs seem to have coalesced into a cluster that attracts large numbers of visitors originating from

municipalities on lower spatial scales. In contrast, the share of suburbs in polycentric systems belonging to the 'central place' municipality type is relatively low: 13.0%.

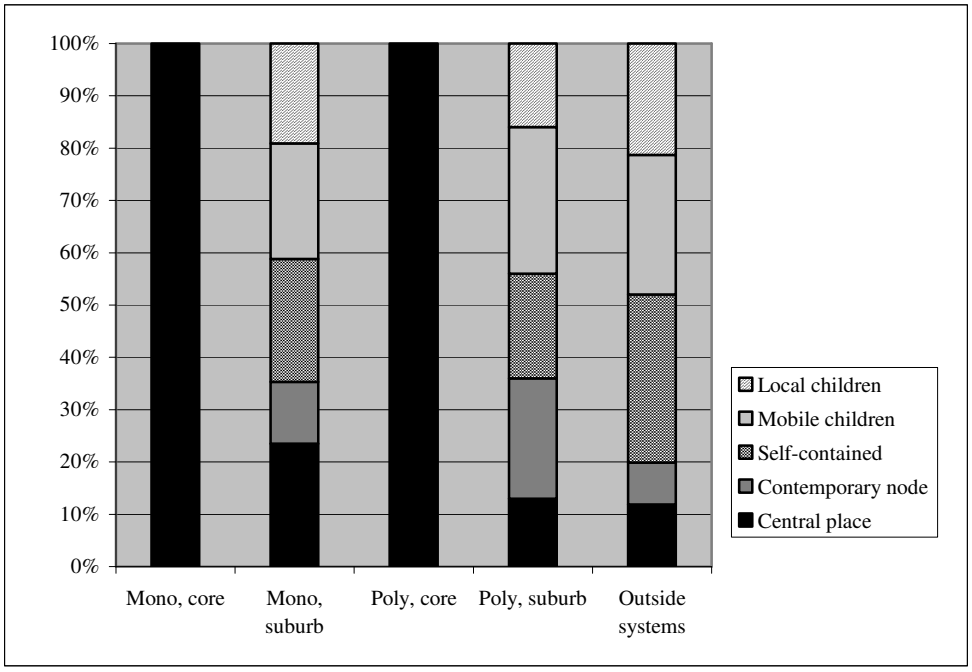


Figure 4. Distribution of types of municipality across types of daily urban system

Third, a considerable share (23.0%) of suburban municipalities in polycentric systems belongs to the 'contemporary node' type. These attract visitors living in municipalities on a higher spatial scale (core cities). Together with their core city, they form a network in the sense that daily visitor flows are multi-directional. In contrast, the share of suburbs in monocentric systems belonging to the 'contemporary node' municipality type is relatively low: 11.8%. Fourth, the share of suburbs in polycentric systems belonging to the 'mobile children' municipality type (28.0%) is larger than the share of suburbs in monocentric systems belonging to this type (22.1%); children are thus more mobile within polycentric systems. Finally, outside the daily urban systems, the share of municipalities belonging to the 'self-contained' type of municipality is relatively large (32.1%).

6. Conclusions and Discussion

In this paper, we have described our typology of urban, suburban, and rural municipalities based on diurnal weekday variations in visitor populations in the Netherlands. The main aim of this study was to investigate the extent to which the process of land-use deconcentration that occurred during the second half of the last century has affected the characteristics of visitor populations. Since this process has led to a greater variety in urban forms, it was expected that not only would visitor population characteristics of 'traditional' places have changed, but also that 'new' types of visitor population characteristics in time and space would have developed. We expected that (suburbs in) polycentric urban systems would show a greater variety in their use as the result of the deconcentration of land uses than (suburbs in) monocentric urban systems. We also expected the orientation of suburbanites towards the central city to be less in polycentric systems. Finally, in the more rural areas the degree of self-containment was expected to be relatively large.

The results reveal that, in comparison with monocentric urban systems, settlements in polycentric urban systems are more networked; suburbs in polycentric regions are capable of attracting a substantial share of working visitors that have their residence in the core city. The emergence of these 'contemporary nodes' is the result of the deconcentration of jobs to locations that are readily accessible by car, creating a new type of visitor environment in which commuters living in large and medium-sized cities visit jobs in the surrounding suburbs. It is mainly the suburbs in the Randstad North Wing that belong to this type; the 'contemporary node' type is far less apparent in the Randstad South Wing or elsewhere in the Netherlands.

The relatively large share of the 'mobile children' type, which attracts school children from other suburban and central city communities, also illustrates the networked character of suburban settlements in polycentric systems. In this way, the trip characteristics of visitors to these suburbs resemble those of some of the rural municipalities outside the daily urban systems. But the underlying reasons differ; in polycentric systems educational facilities have spread out from the traditional central cities, while in rural areas educational facilities are sparsely distributed across space because of low demand. In both cases, however, these spatial structures lead to more mobility among children.

In general, the types of municipality that feature the more 'traditional' visitor population characteristics, such as the 'central place' type, the 'self-contained' type, and the 'local children' type, can be found to a relatively large extent in the suburbs in monocentric systems and in municipalities outside the daily urban systems. It should also be noted that, in the Netherlands, core cities in both monocentric *and* polycentric systems (still) belong to the 'traditional' 'central place' type of municipality, attracting for work and recreation large numbers of visitors who have their residential municipality on a lower spatial scale.

Future research should indicate whether, where, and when network relationships develop on the basis of the temporary presence of people. In this study we have used data from 1998; it would be interesting to see whether a longitudinal analysis would yield a different or changing picture. Such a picture could be of great importance for policy makers since it would provide an empirical basis for applying transportation measures and planning facilities at the right place and possibly at the right time. Moreover, sustainability impacts in a network society largely depend on the relations between places; that is, socio-economic potentials and environmental pressures encapsulated in the residential population of a location are temporary transferred towards other locations as a result of the daily population shift. Using a visitor perspective may shed some light on these relations, how they change through time, and how they affect the sustainability of a community.

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