PLACES IN MOTION

THE DIURNAL DYNAMICS OF VISITOR POPULATIONS IN THE NETHERLANDS

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SAMENVATTING

Plaatsen in beweging; de dagelijkse dynamiek van bezoekerspopulaties in Nederland

In een netwerksamenleving hebben technologische, economische, demografische en culturele ontwikkelingen ertoe geleid dat individuele activiteiten- en verplaatsingspatronen in ruimte en tijd zijn gefragmenteerd. Deze fragmentatie zal een grote invloed hebben op het gebruik van plaatsen door bezoekers. Inzicht in het effect van verschillende ruimtelijke contexten op de aanwezigheid van bezoekers ontbreekt tot op heden. Het doel van deze studie was tweeledig. Ten eerste het uiteenrafelen van de complexiteit en dynamiek in de aanwezigheid van tijdelijke populaties door middel van het identificeren van de belangrijkste dimensies die ten grondslag liggen aan de variatie die gedurende een doordeweekse dag optreedt binnen bezoekerspopulaties in Nederlandse gemeenten. Ten tweede het onderzoeken van de mate waarin deze dimensies tot uitdrukking komen binnen verschillende ruimtelijke contexten gedurende verschillende perioden van de dag. Met behulp van het Onderzoek Verplaatsingsgedrag 1998 hebben we voor zes representatieve perioden van de dag een verkennende factoranalyse uitgevoerd teneinde de onderliggende dimensies te vangen. De oplossing omvat één dimensie die refereert aan deelname aan verschillende activiteiten, twee dimensies gerelateerd aan de omvang van het gebied waarbinnen bezoekerspopulaties opereren gecombineerd met het gebruik van verschillende vervoerswijzen, één dimensie die de richting van interlokale bewegingen tot uitdrukking brengt en drie dimensies die verschillende levensfasen binnen een bezoekerspopulatie aangeven.

SUMMARY

Places in Motion; the Diurnal Dynamics of Visitor Populations in the Netherlands

In a network society, as a result of technological, economic, demographic and cultural developments, individual activity and travel patterns have fragmented in space and time. The fragmentations will have a large impact on the use of places and spaces by visitors. To date, insight into the impact of a large variety of urban, suburban and rural areas on the presence of visitors is lacking. The aim of this study was twofold: first, to unravel some of the complexity and dynamics in the presence of temporary populations by identifying the most important dimensions underlying diurnal weekday variations in visitor populations in Dutch municipalities; second, to examine the degree in which these dimensions express themselves in different spatial contexts during different times of day. Using the 1998 Netherlands National Travel Survey, for six representative one-hour time periods, we performed an exploratory factor analysis to capture the underlying dimensions. The solution comprised one dimension referring to participation in activities, two dimensions related to the size of the territory in which visitor populations operate combined with the use of different transport modes, one dimension expressing the direction in which inter-local movement occurs, and three dimensions capturing different life stages within the visitor population.

1. INTRODUCTION

Technological innovations in transportation and communication and rising levels of affluence have allowed people to overcome distance constraints by minimizing time constraints (*1*), resulting in a steady increase in the spatial scale of their daily activity and travel patterns. As a consequence, the lives of many people have become increasingly independent of territorial boundaries. These developments have led Hajer and Zonneveld (*2*) to assert that, instead of the city centre of a well-defined urban region, in a network society a person's own home and residential area form the functional as well as the symbolic and mental core of a large urban field. At the same time, many more different groups and life-styles have developed within society (*3, 4, 5*). As a result, the diversity in activity and travel patterns has increased in a temporal as well as in a spatial sense (*6, 7*).

These fragmentations of individual activity and travel patterns in time and space will have a large impact on visitors' use of spaces and places. This impact could lead to the divergence of the characteristics of temporary and permanent residents of areas. The fact that visitor and residential populations differ is underlined by different statistics in for example the US (*8*), Japan (*9*), and Great Britain (*10*). These dynamics in the distribution of populations will have an impact on the demand for consumer facilities, the use of public transport and the road network: or, in more general terms, on the economies and diseconomies of the agglomeration of urban functions (*11-17*).

In view of these dynamics in temporary populations, their impact on the functional organization of settlements and their relevance for planning and policies, it is surprising to observe with Janelle and colleagues (*18*) that research to date has shown little interest in investigating visitor population characteristics at different time periods and different places. Little is known about the size, distribution, timing, and characteristics of visitor populations (*14*) and the influencing factors. The research reported to date is diffuse, fragmented, descriptive, and unsystematic (*6, 19*).

One of the issues that need more thorough analysis is the impact of spatial contexts on the characteristics of temporary populations. Studies on diurnal patterns of social group distributions focus on just one settlement or metropolitan area, such as Halifax-Dartmouth (*20, 21, 18*), Flint (*22*), Milan (*23*), and Portland (*24*). However, no insight has as yet been acquired into the impact on the presence of people of a large variety of urban, suburban, and

rural areas that differ in the opportunities they offer for participation in activities and travel. The aim of this study was to determine the main dimensions of daily visitor populations of Dutch municipalities and to examine the degree in which these dimensions express themselves in different spatial contexts during different times of day. For this analysis, we used the 1998 Netherlands National Travel Survey (NTS) to calculate visitor populations, their characteristics, and their participation in activities in different municipalities during different time periods. Since the Halifax-Dartmouth studies were based on data collected in the early 1970s, analysis of the 1998 data would be capable of showing the impact on the composition of visitor populations of the increased differentiation in activity and travel patterns that has occurred in the past 25 years.

In the next section we provide an overview of the relevant theoretical and empirical literature concerning the temporal and territorial distribution of populations. Section 3 describes the data preparations and research design. Section 4 discusses the results of a factor analysis. Two questions are addressed here: *What dimensions of visitor populations can we identify? How do different types of municipality contribute to extensive differences between visitor populations?* Our main findings and conclusion are given in the final section.

2. EARLIER WORK ON DAYTIME POPULATIONS

The use of space by individuals can be studied on different time scales ranging from long-term 'permanent' migrations to temporary movements, such as nomadic, and daily and weekly mobility (*6*). In this paper we limit the discussion to daily mobility. Various concepts are used to capture the presence and co-presence of visitor populations in certain places and time periods, such as 'daytime population' (*11*), 'temporal specialization' (*20*), 'temporary populations', 'chronotypes' (*25*), and 'mobility environments' (*7*).

One of the first scholars to point out the relevance of studying visitor populations was Wirth (*26*), who drew a distinction between night time (residential) and daytime (visiting) populations. In the 1940s, Engel-Frisch (*27*) observed that the temporal aspects of human ecology have been unjustifiably neglected. She asserted that changes in the distribution of land uses are not a consequence of the migration of people and land use functions, but is usually brought about by the daily mobility of people. Based upon her conceptualization and statistical study of temporal processes she made a plea for further studies of temporal ecology

and temporal planning. In the fifties, Foley (*11, 12*) carried out some descriptive analyses on daytime populations for large American cities and central business districts of middle-sized and large cities in the US.

Outside the US daily temporary populations have been studied as well, especially in Italy. Martinotti (*28*) and Bonfiglioli (*25*) present cities as a system of chronotypes, "…physical places of spatial and temporal architecture animated by the rhythms of presence and co-presence of its citizens and temporary inhabitants" (*29*, p. 192). Time ecological studies have been carried out for several Italian cities, including Milan (*23*). Based on these studies urban time policies were developed. These policies were launched at the end of the 1980s; they focus on matching the time organization of cities and the needs of its users.

In general, simple statistics were used to monitor changes in visitor populations. More thorough analyses of the 'ebb and flow of the total population of a city' (*22*), were undertaken in the 1970s and 1980s. Taylor and Parkes and especially Goodchild and Janelle applied multivariate analytic methods, such as factor analysis, on activity-diary data collected in 1971-1972 for the metropolitan area of Halifax-Dartmouth, Canada, with a combined population of 187,000 in 1971.

We set up a theoretical framework for the analysis reported in this paper on the basis of these former studies on temporal populations. The likelihood of the presence and co-presence of particular individuals and groups in certain time-spaces is dependent on individual needs and constraints. As conceptualized by Hägerstrand (*30*), subject to capability, coupling and authority constraints, individuals follow a continuous path through time-space to participate in activities. Visitor populations are constituted as the result of the coupling together of these individual paths at specific temporal and spatial locations. This presence of individuals in particular places is also determined by the functions or institutional projects within any given place. These functions structure the daily paths of individuals by taking time allocations and by scheduling activities (*31*). In particular, the dominant functions and connections supplied by transport and communication systems in any place account for most of the structural properties of temporary populations. The whole of these external conditions that influence the temporary presence of people in given temporal and spatial locations is called the *mobility environment* (*7*).

The results of various studies on visitor populations can be fitted into this conceptual model. Based on factor analyses for a hypothetical, medium-sized (200,000 inhabitants)

British city and Halifax, Canada (approximately 200,000 inhabitants) respectively, Taylor and Parkes (*32*) and Goodchild and Janelle (*20*), Goodchild et al., (*21*) and Janelle et al., (*18*) identified certain factors that influence the temporal and spatial distribution of people. Taylor and Parkes used socio-demographics and aggregate land use and travel data for their analysis, while the other studies also used behavioral data (*20*), or activity data exclusively (*21, 18*). The main factors can be categorized along activity and socio-demographic dimensions. In reviewing these results it must be remembered that most of the findings were based only on data collected for the period 1971-1972 in Halifax-Dartmouth, Canada.

Home and work-related activities seem to provide the strongest dimensions of diurnal patterns of social group distributions, followed by leisure, shopping and education. In the 1970s, early each morning commuters invaded the employment areas of the cities, especially the CBDs, leaving behind them purely residential environments with a low density of visitors. Non-job-related obligatory activities, like shopping, were carried out in the mid afternoon in outlying shopping outlets or downtown shopping centers. Social and recreational activities took place in the morning and midday in neighborhood or local recreational amenities, while people visited downtown entertainment facilities in the evening. Finally, visitors participating in educational activities could be found at all times of the day in neighborhoods with school facilities.

The relevant socio-demographic dimensions of visitor populations are related primarily to income, educational/occupational status, and age. The income distribution of visitors shows clear a polarization between the central and the suburban areas in Halifax-Dartmouth. The educational composition of visitor populations resembles the distribution of economic functions, with poorly educated visitors in industrial and commercial areas and highly educated visitors in the university neighborhood. The age dimension illustrates how young visitors can predominantly be found in areas with a high residential turnover, in contrast with older visitors. In general, these status and age dimensions showed fewer diurnal variations in suburban neighborhoods. Studies of population role groups, defined by the combined attributes of gender, marital status, job, childcare, residence tenure, and car ownership (*18*), show that these subpopulations can be characterized by specific temporal patterns of scores on the various dimensions.

These studies reveal some shortcomings, which we have addressed in this paper. First, the results are based primarily on just one metropolitan area of medium size (187,000

inhabitants) that shows limited variation in spatial context. We have studied the impact of a larger variety of spatial contexts varying from rural areas to large cities in the Netherlands.

A second deficiency in the literature is the underexposure of travel behavior characteristics. Taylor and Parkes (*32*) included the share of private and public transport modes and access to vital services. However, Goodchild and Janelle (*20*) did not select these variables, but studied travel purpose instead. A comprehensive analysis of travel-related variables is lacking. In addition to travel mode and travel purpose, travel time and travel direction should also be included in such an analysis. By 'travel direction' we mean different types of origin-destination combinations, such as urban-urban and suburban-urban. In this paper, we have addressed these deficiencies. The next section describes the conditions of our analysis.

3. DATA AND RESEARCH DESIGN

The aim of our analysis was to identify the dimensions underlying the spatial-temporal variations in the presence of visitor populations in Dutch municipalities on an average weekday, and to investigate the relation between these dimensions and spatial context. In our analysis, *visitor population* is defined as *an aggregate of all persons performing out-of-home activities in a particular municipality during a particular time period*; the term also includes visitors active within their residential municipality. For our analysis, we used the 1998 Netherlands National Travel Survey (NTS). Since 1978, this continuous survey has been carried out annually. Every year, approximately 60,000 households participate. The survey yields data on the travel behavior of some 130,000 individuals, including children over the age of four. In addition to providing information on household and personal attributes, respondents are asked to complete a trip diary for an entire day (*33*).

For the purpose of our analysis, we first derived activity durations from the trip data, and subsequently excluded activities performed outside the Netherlands, activities taking place at home, activities taking place in a weekend or on a national holiday, and activities of unknown duration. The adapted dataset consisted of 197,400 out-of-home activities, executed by some 80,000 persons.

Second, we calculated the number of respondents characterized by given characteristics and engaged in given activities in given time periods, expressed as percentages

of the sample observed to be in a given municipality in a given time period. In 1998, the Netherlands contained 548 municipalities. With regard to our choice of time periods, we used the six one-hour time periods most representative of various classes of out-of-home activity in the course of the day: 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). Our selection of 32 variables is displayed in Table 1; the selection comprises categories of individual and household characteristics, activity characteristics, and trip characteristics.

For each individual, we weighted his or her presence within each municipality by activity duration within each of the selected time periods. To aggregate to the total Dutch population, we multiplied the weighted presence of a person by weight factors from the NTS. This procedure was applied in calculating both the total visitor population and subpopulations within it (Table 1) for each combination (n = 3288) of a municipality and a time period. Subsequently, subpopulations were expressed as a proportion of the total visitor population. The standardized values of these proportions formed the input for principal factor analysis to capture the underlying dimensions of visitor populations.

After checking the correlation matrix for multicollinearity and factorizability, we removed the following eight variables prior to factor analysis (in order of removal): shopping, came on foot, adult from family or couple with one worker, adult from family with two workers, age 12 –18 years, low educational level, adult part-time worker, and serve passenger. The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO MSA) resulted overall in .673 (cf. *34*), and the individual KMO MSA was above .500 for each variable. The elimination of variables took place in interrelation with various proposed and tested factor solutions, and factor interpretability.

Next, we extracted factors from the remaining 24 variables. Our choice of the number of factors was based on four criteria. First, we used the Kaiser criterion, which advices dropping all factors with eigenvalues below 1.0, since factors are then no longer more important than a single variable. Second, we applied Cattell´s scree test. Third, we investigated the residual correlation matrix. If the residuals are large, the model does not fit the data well and ought to be reconsidered. Finally – and this was considered the most important criterion – we tested the factors for interpretability and stability. This was achieved by investigating different methods of extraction to see whether they produced similar

solutions and whether our method was affected by factor indeterminacy. The perseverance of dimensions and their interpretability throughout different methods that we applied gave us confidence that we were dealing with a stable solution.

TABLE 1 Variables Used in Analysis (Subpopulations as Percentages of the Total Visitor Population per Combination of a Municipality and a One-Hour Time Period)

Individual characteristics	Couple, two workers, adult	Other activity (ref.)
	Family or couple, one worker, adult	
Female	Single, worker, adult	**Trip characteristics**
Male (reference category, thus omitted)	Other household type (ref.)	
		Used car (as main transport mode)
Age < 12	Low income (< 15,500 Euros/year)	Used public transport (as main transport mode)
Age 12 -< 18	Medium income (>- 15,500; < 26,250 Euros/year) (ref.)	Used bicycle (as main transport mode)
Age 18 -< 30	High income (>- 26,250 Euros/year)	Came on foot (as main transport mode)
Age 30 -< 65 (ref.)		Other transport mode (ref.)
Age >- 65	No cars available	
	One car available (ref.)	Travel time < 10 minutes
Low educational level	Two or more cars available	Travel time >- 10 minutes; < 30 minutes (ref.)
Medium educational level (ref.)		Travel time >- 30 minutes
High educational level	**Activity characteristics**	
		Residential municipality at a lower spatial scale than destination municipality*
Non-worker, adult	Work	Residential municipality at the same spatial scale as destination municipality (ref.)
Part-time worker (< 30 hours/week), adult	Education	Residential municipality at a higher spatial scale than destination municipality
Full-time worker (>- 30 hours/week), adult (ref.)	Shopping	
	Social activities	Destination municipality is not residential municipality
Household characteristics	Leisure (sports, recreation, and entertainment)	Destination municipality is residential municipality (ref.)
Family, two workers, adult	Serve passenger	

* 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 thus has a residential municipality at a higher spatial scale than the destination municipality.

The factors were rotated in order to improve factor interpretation. Since we suspected there might be some correlation between the factors, we opted for an oblique rotation (that is, direct oblimin). This choice proved to be well justified, since the factor correlation matrix indicated the existence of intercorrelations between the factors that were too large to be ignored. With regard to extraction, however, we tried different methods of rotation to guarantee stability.

The final step in the process of factor analysis was to compute factor scores for each case; that is, each combination of a municipality and a time period – which facilitated the interpretation of the factors. Standardized factor scores were used for further analysis.

We used a typology of municipalities to investigate the relation between spatial context and factor scores. Based on whether a municipality is located within or outside the Randstad (the large and heavily urbanized polycentric region in the western part of the

Netherlands) and on its urbanization level, we distinguish between six types of municipality. Inside the Randstad, we differentiate between the three large cities (Amsterdam, Rotterdam, and The Hague), medium-sized cities (including Utrecht), growth centers, and suburbs. The first two are high-density, work- and service-oriented types, while the latter two are low-density, predominantly residential types. Growth centers, originating from the 1970s, were intended to be suitable locations for both firms and households moving to the suburbs, but evolved into towns with more residences than jobs. Outside the Randstad, we discern more and less urbanized municipalities.

4. DIMENSIONS OF VISITOR POPULATIONS

We applied principal factor analysis to capture the underlying dimensions of visitor populations. The factor analysis yielded seven factors. Both the Kaiser criterion and Cattell´s scree test indicated that a seven-factor solution would be the optimal choice. The residual correlation matrix revealed the existence of 9.0% non-redundant residuals with absolute values larger than 0.05, which is acceptable, considering the size of our sample. Table 2 shows the factor solution adopted; only factor loadings with an absolute value larger than 0.4 are displayed. Other than through investigating factor loadings, factor interpretation was aided by examining the factor scores on each combination of a type of municipality and a time period (Figure 1a-g). In the remainder of this section, we will elaborate further on these seven factors.

Factor 1 expresses a ***leisure dimension*** that becomes stronger as the day progresses. Leisure and social activities have positive loadings, while working has a strong negative loading on this factor (Table 2). Each type of municipality has the same pattern of increasing leisure activity (Figure 1a). Apparently, scores on this dimension are much more dependant of time-of-day than spatial context. However, the highest averages between 8pm and 9pm are found in the three large and medium-sized cities inside the Randstad, probably expressing the abundant supply of night time leisure facilities in these types. Growth centers display the lowest score in the evening, confirming their image as dormitory towns.

For factor 2, positive and negative scores distinguish the municipalities and times associated with mode use, travel time and educational level. This factor has been labeled the ***inter-local dimension***, since public transport use, travel times with a minimum of 30 minutes,

destination municipality not residential municipality, and a high level of education all yield substantial positive loadings on this factor. On the other hand, travel times below 10 minutes have a negative loading (Table 2). It is well known (*35*) that the highly educated in particular travel long distances by public transport, which is then competitive with the use of the private car. A fairly normal distribution of factor scores across time periods can be observed from Figure 1b. Given the necessity for visitors from more distant residential municipalities to travel for a considerable time to and from their destination municipality, it would seem logical for the presence of these visitors to reach its peak at around noon. Less urbanized (rural) municipalities outside the Randstad score negatively on this dimension for all time periods, indicating their lack of both a well-equipped public transport system and attractive opportunities. In sharp contrast are the positive scores of the more urbanized types of municipality – particularly the three large and medium-sized cities inside the Randstad.

TABLE 2 Factor Solution Pattern Matrix (Only Loadings >- |.400| Displayed)

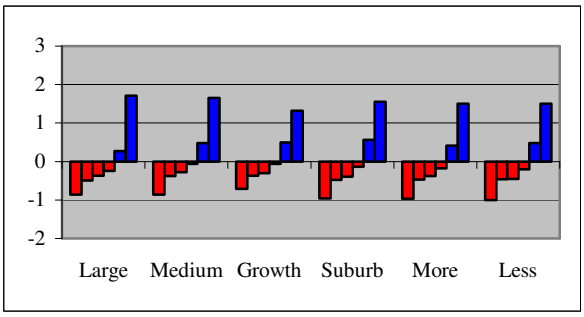
	Factor						
	1	2	3	4	5	6	7
Work	-.965						
Leisure	.682						
Social activities	.509						
Used public transport		.653					
Travel time >- 30 minutes		.624					
Travel time < 10 minutes		-.604					
Destination municipality is not residential municipality		.550					
High educational level		.426					
No cars available							
Used car			-.933				
Used bicycle			.689				
Age < 12				.674			
Education				.570			
Age 18 -< 30				-.505			
Couple, 2 workers, adult				-.466			
Female							
Residential municipality at a higher spatial scale					-.931		
Residential municipality at a lower spatial scale					.544		
Single, worker, adult						-.600	-.499
Low income						-.589	
High income						.543	
Two or more cars available						.400	
Non-worker, adult							.661
Age >- 65							.551

In contrast with the second factor, factor 3 can be typified as a ***local dimension***, with a positive loading on bicycle use and a negative loading on car use (Table 2). Figure 1c shows the local dimension to be most strongly related to medium-sized cities in the Randstad, for which there is even a positive score between 8pm and 9pm, whereas the other types of municipality display negative scores on this dimension in the evening. These medium-sized

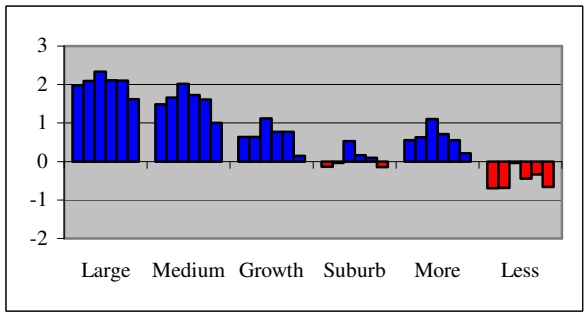
cities seem to be highly self-contained for some residential population categories (students, for example). Apparently, scores on the local dimension are dependent on such constraint factors as car availability on the one hand, and on the other the supply of local opportunities such as schools, universities, and leisure facilities.

Factor 4 captures a ***children dimension***, yielding positive loadings for the presence of young children and educational activities and negative loadings for the presence of people aged 18 up to 30 and two-worker couples (Table 2). Scores on this dimension are clearly influenced by school opening times (8am-9am, 10am-11am, and 2pm-3pm). From Figure 1d it can be observed that the three large and medium-sized cities inside the Randstad score almost continuously negatively on this factor, indicating that populations of young schoolchildren are relatively underrepresented in visitor populations in these types of municipality for all time periods. For some municipalities, and growth centers in particular, the children dimension is strongly associated with the local dimension. On a national scale, the young province of Flevoland has the highest score on this dimension.

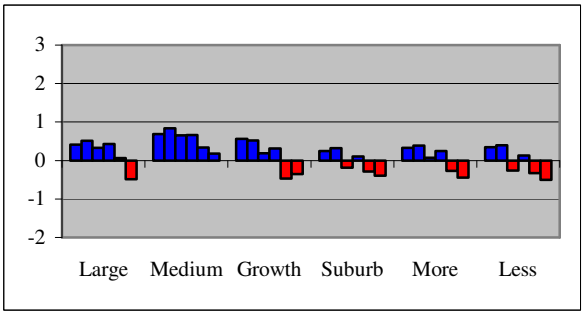
Factor 5 represents a ***central place dimension***, with a positive loading for the presence of visitors living in a municipality on a lower spatial scale than the municipality they are visiting and a negative loading for the presence of people living in a municipality at a higher spatial scale than the municipality they are visiting (Table 2). In short: positive scores indicate more centrality. Figure 1e indicates that centrality is most strongly developed in the more urbanized types of municipality. However, small, temporal shifts in centrality can also be observed, with a dichotomized structure appearing around noon. At that time, the difference in scores on this dimension between the more and the less urbanized types of municipality is maximal, implying that the central position of cities in the urban network then reaches its peak. Growth centers hardly fulfill any central functions for other communities. The contrast between more and less central places appears to be larger outside the Randstad, illustrating the polycentric character of the Randstad compared to areas outside the Randstad.



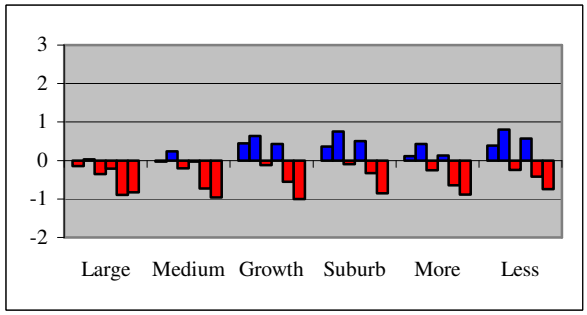
a. Factor 1 ´Leisure dimension´



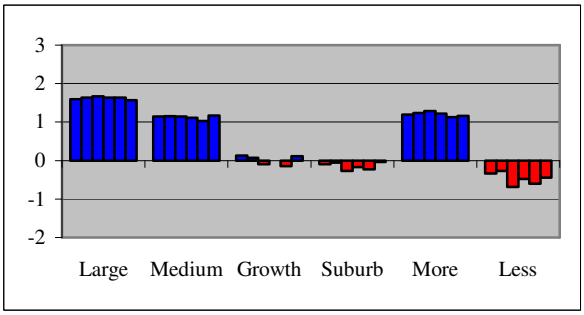
b. Factor 2 ´Inter-local dimension´



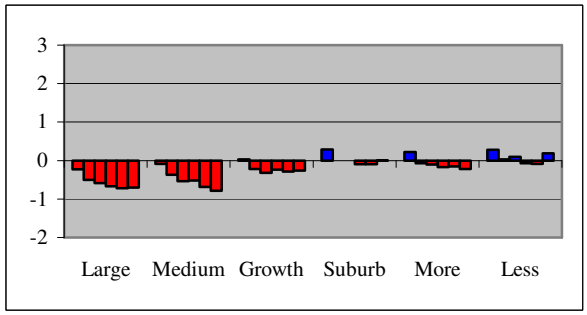
c. Factor 3 ´Local dimension´



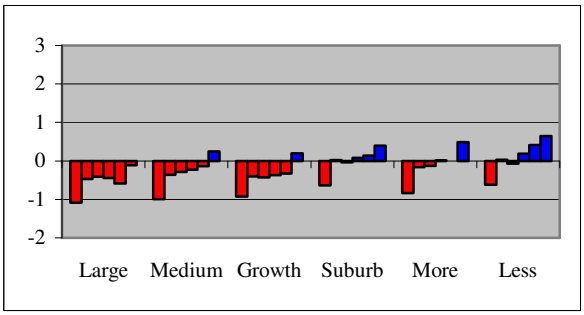
d. Factor 4 ´Children dimension´



e. Factor 5 ´Central place dimension´



f. Factor 6 ´High-income family dimension´



g. Factor 7 ´Senior dimension´

Per type of municipality, scores for individual time periods can be read from left to right as follows: 8am – 9am, 10am – 11am, 12am – 1pm, 2pm – 3pm, 5pm – 6pm, and 8pm – 9pm

Large	= Randstad, three large cities
Medium	= Randstad, medium-sized cities
Growth	= Randstad, growth centers
Suburb	= Randstad, suburbs
More	= Outside Randstad, more urbanized
Less	= Outside Randstad, less urbanized

FIGURE 1a-g Standardized factor scores for factor 1-7 per type of municipality and time period.

Factor 6 expresses a ***high-income family dimension***, with positive loadings for the presence of high-income households and households with two or more cars available, and negative loadings for the presence of single workers and low-income households (Table 2). Hence this dimension is determined by both household structure and household income, with a visitor population containing relatively many low-income singles scoring most negatively on this dimension. Figure 1f indicates that this dimension is strongly related to commuter flows, with increasingly negative scores for the more urbanized types as the day progresses (the share of high-income commuters in the city declines as they return to their residential municipalities at the end of the day), and a sharp contrast in scores in the evening between less and more urbanized types of municipality (high-income commuters have returned home, and [leisure] activity within the cities is dominated by low-income single households).

Finally, factor 7 comprises a ***senior dimension***, with positive loadings for the variables 'non-worker' and 'age above 65' and negative loadings on the variable 'single worker' (Table 2). Seniors appear to be very inactive out-of-doors in the early morning, but their representation within visitor populations increases as the day progresses. The fact that seniors are least likely (in relation to other groups in society) to be confronted with strict temporal constraints allows them to postpone activity to less busy times of day. Figure 1g exemplifies this temporal pattern, and also shows that seniors tend to avoid the three large cities inside the Randstad in the evening, possibly through feelings of insecurity. Within the growth centers, this dimension also yields negative scores, indicating the 'young' character of this type of municipality. Nationally, this dimension is strongly concentrated in the northern (rural) provinces of Drenthe and Groningen.

5. CONCLUSIONS AND DISCUSSION

In this paper, we have identified the dimensions of visitor population presence in space and time in Dutch municipalities for an average weekday. The main aim of this study was to analyze the impact of a wide variety of urban, suburban, and rural municipalities. Since the more thorough studies on temporary populations were based on data collected in the early 1970s, we were also interested in the impact on the dimensions of visitor populations of the

increased differentiation in activity and travel patterns that has taken place over the past 25 years.

The solution adopted in our analysis comprised one dimension oriented towards participation in activities (the leisure dimension), two dimensions related to the size of the territory in which visitor populations operate combined with the use of different transport modes (the inter-local and local dimension), one dimension expressing the direction of the relationship between different spatial scales (the central place dimension), and three dimensions capturing different life stages (the children dimension, the high-income family dimension, and the senior dimension). Compared with the studies of Goodchild and Janelle on Halifax-Dartmouth diary data, our analysis shows a particularly large impact of the orientation of travel represented by the inter-local, local and central place dimensions. These dimensions reflect the distribution of opportunities for participation in activities and the supply of transport modes. In general terms, the visitor populations of the different types of municipality can be characterized as follows.

Although many urban systems in the Netherlands have developed from monocentric into polycentric urban systems, especially in the Randstad, we see that the *three large cities* in the Netherlands – Amsterdam, Rotterdam, and The Hague – still function as a magnet for visitors from other municipalities and, because of their large size, also for their own inhabitants. The strong position in the national public transport network and relatively large supply of employment facilities, shops and leisure amenities afford an explanation. Their socio-demographic characteristic is highly skewed, since seniors, young children, and adults living in high-income families are underrepresented during the day.

The *medium-sized cities in the Randstad* share with the large cities a central role for residents from other municipalities, but to a lesser extent. Compared with Amsterdam, Rotterdam, and The Hague, these cities seem to be highly self-contained for some residential population categories (especially students). As a consequence, their visitor populations are less skewed than for the large cities in the Randstad.

The visitor population of the *more urbanized municipalities outside the Randstad* is comparable with the visitor population in the *growth centers in the Randstad*. These types of municipality differ from each other with respect to the central place dimension. While cities outside the Randstad fulfill this function, growth centers do not. The Randstad *suburban* visitor population is mainly dominated by children.

Because of the lack of a well-equipped public transport system and attractive opportunities, the less urbanized *rural municipalities outside the Randstad* attract hardly any visitors from elsewhere. Young children visiting their primary schools and senior people dominate the visitor populations.

Future research could be extended to the weekends, or to other countries. An analysis of visitor population dynamics in different types of municipalities at the neighborhood level would also be valuable. In more specific terms, we hypothesize that, at the intra-municipal level, dimensions emerge that are less relevant, or hidden when the municipal level is analyzed. For example, shopping (a variable removed from our analysis, since it appeared to be insignificant) is probably an activity that concentrates strongly in particular neighborhoods within a municipality, and would thus be spatially more distinctive at the intra-municipal level.

In the introduction, we asserted that the dynamics in the distribution of populations would have an impact on the demand for consumer facilities, the use of public transport and the road network, or in more general terms on the economies and diseconomies of the agglomeration of urban functions. Supplementary analysis based on the locational decisions of the suppliers of consumer services and employment would make it possible to understand the dynamic relationship between the daily mobility of people and land uses in time.

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