SOCIAL HOMOGENEITY AND SPACE SYNTAX OF TOWNS IN ISRAEL

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Abstract

To what extent does the spatial structure of a town influence residential distribution of social groups? So far, no study provided empirical evidence regarding the correlation of syntactic values of spatial configuration and social homogeneity degree in a given urban area. Due to improvements in the construction of population census and GIS technology, it is possible now to obtain high-resolution socio demographic data at house/axis level. The paper presents preliminary results of a study that examines the correlation between spatial integration of urban layouts, and the homogeneity/ heterogeneity of income distribution in six towns in Israel. The results of the analysis showed that the spatial integration, described by space syntax techniques, has the potential to predict residential integration between different income groups. Thus, the study illustrates the potential combination of detailed GIS social census data and space syntax methods.

Introduction

To what extent does the spatial structure of a town influence the evolution of homorganic areas or neighborhoods? The focus of this paper is on the properties of spatial integration between areas and neighborhoods and the effect of these properties on social heterogeneity in the city. The paper presents an analysis of the relation between the spatial layout and social heterogeneity in six towns in Israel based on the mean space syntax values of all the town' streets and on local segregation measures of income distribution at house level.

So far no study provides empirical evidence, based on objective socio-spatial data, for the influence of the syntactic values of spatial configuration of a given urban environment on its social homogeneity degree. Objective socio-spatial data is mostly available in aggregated areas, such as official political units, and thus is insufficient for the examination of varied fine-scale urban environment of streets or axial lines, whose size is much below the average size of aggregated official areas, and which often do not fit into their borders.

However, due to improvements in the construction of geographic databases and GIS technology, significant progress has been made toward addressing the issues at hand by making it possible to obtain high-resolution socio demographic data in urban locations (Omer, 2006a). These census databases contain socio-economic attributes of householders at house/axis level, which are linked to the polygon representing the house, thus making it possible to study relations between space syntax values such as local and global integration etc. and social properties.

The examination of the relation between urban layout and the distribution of social characteristics by using space syntax techniques means abstraction and isolating of spatial relation from urban layout. Such examination is not new and previous studies have already showed the potential of space syntax method to clarify and explain this relation in the context of residential segregation, differential associability of social groups, social exclusion and social deprivation and etc. (Lima, 2001; Vaughan et. al., 2005).

108-02

In the following section, we discuss the concepts of urban layout and social homogeneity. In the third section, we present the methodology for examining this involvement. In the forth section, we present the results. The significance of the results is discussed in the concluding section.

Concepts:
The Link between Social Heterogeneity and Urban Layout

The relation between the urban layout and residential segregation of social groups has a long history in the research of city. The urban layout properties such as street pattern, house type, spatial form of houses, open spaces and other infrastructure and land uses properties are considered an integral component of residential segregation of social groups. They play a main role in the concept of 'urban ecology' and 'natural areas' originated from the urban ecological studies of the early Chicago School, namely, groups of residing in the city are sorted into locations according to their socioeconomic properties as well as the urban layout properties. However, spatial layout properties also provides impotent role in later and more humanistic consideration of the relation between social groups and physical properties of locations in the city like 'place' (Relph, 1976) and 'neighborhood' (Brower, 1996).

The urban layout properties like street pattern and identifiable boundaries play a main role in the identification of places and neighborhoods in the city (Golledge and Stimson, 1987). They also take part in the identity inhabitants establish with their neighborhood and allow them to differentiate themselves from the inhabitants of other neighborhoods. Moreover, the urban layout can serve as a channel for symbolic communication (Rappaport, 1982) that contributes to a sense of community (Plas and Lewis 1996). In this respect, the spatial layout affords social homogeneity and social interactions within neighborhoods, and by that, contribute to social areas and neighborhoods institution in the city.

Methodology

The study conducted in six Israeli towns - Netanya, Kefar Saba, Ramla, Lod, Ramat HaSharon, Bat Yam. These towns represent different urban morphologies (Zafrir, 2006) as well as different income level (Omer, 2006b).

Data: The Income data study is based on detailed geo-referenced household data of the Israeli Census of Population and Housing for 1995 (ICBS, 2000). The census data is organized within the GIS

framework. In this GIS framework, household records are linked to the polygon representing the house, and, thus, enable the analysis of income distribution at house/axis level in each town.

Measurement: Many segregation indices are used for the description of overall urban social residential distribution. These indices are usually classified according to the dimension of the residential distribution they are meant to disclose, for example, “evenness” of the spatial distributions of social property, such as income and certain ethnic identity, or “clustering” degree of this property over space (Massey and Denton, 1988). However, these measurements are limited to aggregate areas and therefore do not take into account variation and spatial relations between individuals located within the area - all of which makes their usage problematic for measuring high-resolution residential segregation of the kind used in this study (Omer and Benenson, 2002).

The alternative local approach describes residential distributions by characterizing their properties at each location. According this approach, properties of a residential distribution are represented by means of local indices of spatial association (Anselin, 1995). These indices are based on the comparison of the characteristics of a given spatially located object and its neighbors. In our case, the census GIS makes it possible to compare the characteristics of the residents in a given house with the characteristics of the householders living in other houses within that house’s neighborhood. Because the aim of measuring in this paper is to describe the degree of social heterogeneity/homogeneity within a defined neighborhood we estimate moving average $m_{H,Ui(H)}$ and moving standard deviation $s_{H,Ui(H)}$ over the neighborhoods of the given order i:

$$s_{H,Ui(H)} = \sqrt{(\Sigma_{G\in Ui(H)}(z_G - m_{H,Ui(H)})^2/(N_{G\in Ui(H)}-1))} \quad (1)$$

where Z_G is a value of the characteristic of a house H, $U_i(H)$ denotes H’s neighborhood of i-th order, and $N_{G\in Ui(H)} = \Sigma_{G\in Ui(H)}1$ is a number of elements in a neighborhood $U_i(H)$. In this paper, neighborhood U(i) is defined by the adjacent houses of order k=1. As suggested recently (Omer, 2006a) these measures can also help overcome visualization problems related to house-level data that stem from cartography or privacy constraints.

For computing the syntactic characters of the towns' morphology – connectivity, local integration, global integration and intelligibility- the software of Axwomen 2.0 was applied by using the GIS layer of the street network in each of the six examined towns. In this paper, the calculation bases on named streets and not on the traditional definition of axial lines, or in other words, each street considered as axial line in the analysis of space syntax. We believe that street is more appropriate and relevant analysis unit than axial line for the examined phenomena. For examining the relation between the syntactic characters and social heterogeneity in each town the mean syntactic values of the entire town' streets and local segregation measures of all town's houses were used.

Results

The results of the space syntax measurement and the measurement of STD of income distribution in the six towns (arranged according the value of global integration) are summarized in table 1. It can be seen that the two towns with higher global integration – Kefar Saba and Ramat HaSharon - hold the higher values of STD in the distributions of income (average of the Log_2 (Income)) and they also have a higher income average. Namely, the towns with high spatial integration (between streets) are the most integrative city regarding the income

variable. This tendency illustrated in figure 1 by the distribution of income STD and global integration level in these towns: Kefar Saba with the higher degree of spatial integration and in Lod with the lower degree of spatial integration. Kefar-Saba is also holds high value of intelligibility relative to Lod; 0.706 and 0.477, respectively. However, behind this finding, there is no clear picture in the other syntactic values of connectivity, local integration and intelligibility.

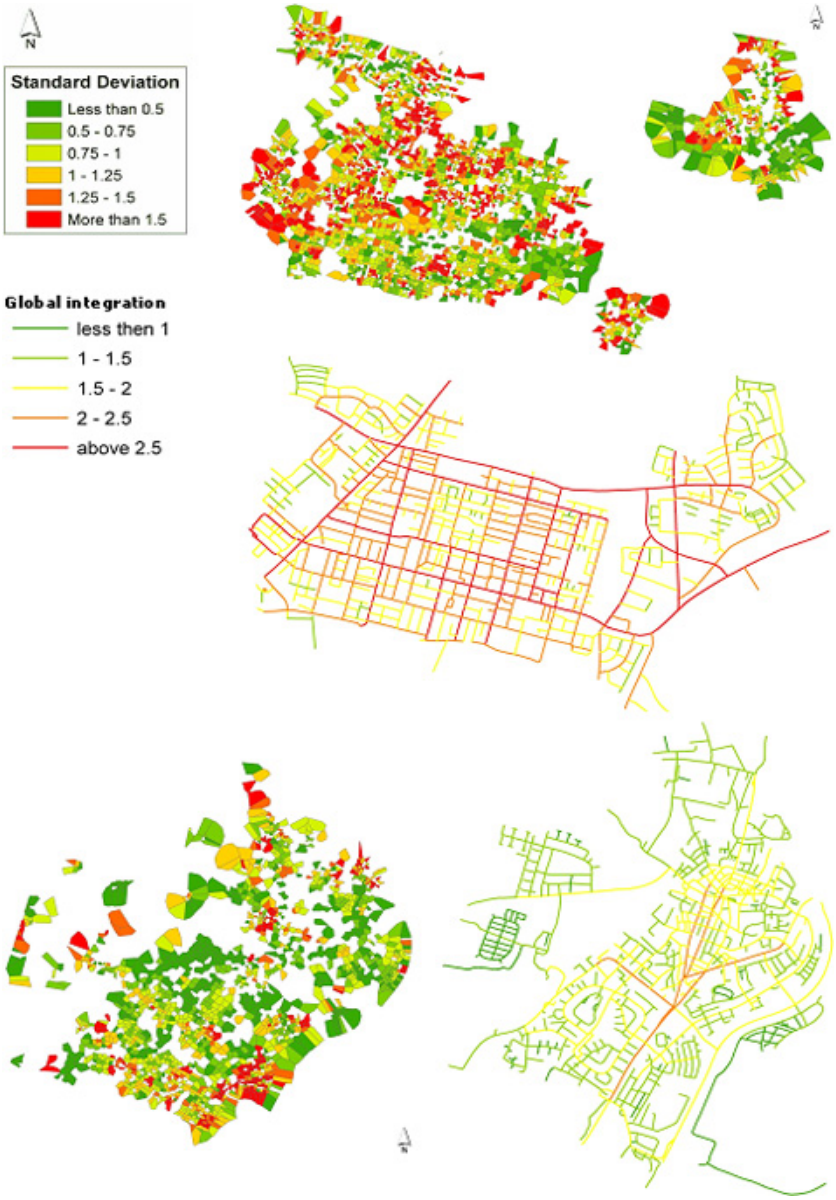
Table 1:

The values of space syntax and of income distribution measurement in six towns in Israel

Town	Conn.	Loc Int.	Glob Int.	Intel. (R^2)	Mean Income	Mean STD
Kefar_Saba	3.728	2.357	1.827	0.706	12.30	1.075
Ramat_HaSharon	3.320	2.322	1.746	0.693	12.55	1.326
Ramla	4.0	2.346	1.500	0.660	12.06	0.923
Natanya	3.843	2.260	1.580	0.448	11.87	0.842
Bat_Yam	3.732	2.264	1.582	0.671	11.77	0.590
Lod	3.393	2.085	1.285	0.477	12.18	0.876

Figure 1:

Distributions of income STD at the level of houses and the spatial integration level (global integration) in Kefar Saba (top) and Lod (bottom)



Discussion

The paper presents preliminary results of a study that examined the influence of spatial integration of the urban layout based on street patterns on the homogeneity/ heterogeneity of income distribution in

six towns. The results of the analysis showed that the two towns with higher global integration and intelligibility are the most integrative city regarding the income variable. We plan to include more towns in the investigation to verify the validity of this finding, that is, if indeed, the spatial integration, described by space syntax techniques, has the potential to predict residential integration between different income groups. The possibility to examine how the spatial structure in an urban environment relates to residential distribution of social groups is a significant advantage of the combination of detailed GIS social census data and space syntax method.

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108-06