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Urban spatial configuration and socio-economic residential differentiation: The case of Tel Aviv

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ABSTRACT

This paper compares the effect of two aspects of a city's spatial configuration – spatial separation between areas and dissimilarity in spatial integration between areas – on socio-economic residential differentiation in the city of Tel Aviv, Israel. The integration analysis is based on the space syntax methodological–conceptual framework and focuses on Tel Aviv's core, where the main socio-economic differentiations were identified.

Obtained results indicate that socio-economic differentiation between areas correspond mainly with the level of spatial separation or segmentation between areas but much less with the level of dissimilarity characterizing their spatial integration. The empirical findings can be considered innovative in light of the fact that space syntax studies dealing with social differentiation in cities usually focus solely on spatial integration patterns.

The research findings nonetheless support the theoretical understanding that the urban environment's spatial configuration provides a fundamental condition for the creation and preservation of urban social residential differentiation.

1. Introduction

The role of space has been discussed extensively in human geography research with respect to its contribution to the formation of daily space–time routines and interaction between people, as individual and social groups (e.g., Amin & Thrift, 2002; Giddens, 1984; Gregory, 1989; Sibley, 1995). However, little attention has been given in this literature to the question of how the city's spatial configuration relates to the formation of social residential differentiation. This article makes a small contribution to filling this gap.

The spatial configuration of the urban built environment is defined here as the set of spatial relations holding between its objects (i.e., buildings and open spaces) whereas social residential areas are characterized by the spatial distribution of social variables (i.e. ethnic, cultural and socio-economic variables). Soja (1985) refers to these kinds of spatial relations as "the spatiality of social life" – a socially-produced space that differs from its objects' physical (substantive) dimensions.

The effect of the city's spatial configuration on aspects of residential space has been considered mainly with respect to urban street networks (Anderson, 1992; Grannis, 2005; Jacobs, 1993; Southworth & Ben Joseph, 1996). For example, in empirical studies conducted in several American cities, Grannis (1998, 2005) found that racial similarity among neighborhoods, like metropolitan macro-level segregation patterns, emerged primarily from the spatial connections constructed through tertiary street networks rather than from geographical proximity. More specifically, racial variation occurred between neighborhoods having internal access via pedestrian streets, a trend delimited by the presence of non-pedestrian streets. Grannis called this kind of neighborhood 't-communities' in order to indicate their internal connectivity through pedestrian-oriented tertiary streets.

Consideration of the potential effect of the street network on the perceptual aspects of the urban built environment is found in concepts such as "*experiential network*", a pattern formed in cases where the street network lacks continuous boundaries (Stanton, 1986), or in "*street neighborhood networks*", that is, urban neighborhoods formed out of short blocks (Jacobs, 1961). The street network is also an integral component of perceived neighborhoods, that is, subjectively bounded neighborhoods or territories (e.g. Ceccato & Snickars, 2000; Coulton, Korbin, Chan, & Su, 2001; Lee, 1968). The function of street networks in spatial cognitive representation of urban areas is described by Kevin Lynch as follows: "The paths, the network of habitual or potential lines of movement through the urban complex, are the most potent means by which the whole can be ordered" (Lynch, 1996, p. 96).

However, the interesting question in the present context is: How does the spatial configuration of the urban built environment

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affect formation of differentiated social areas? We suggest the following answer: Since spatial configuration is related to the shape and pattern of enclosed spaces and path networks, it is directly relevant to three physical characteristics of the urban environment – complexity, differentiation and visibility – each of which can potentially affect human experience and spatial behavior (Cubukcu & Nasar, 2005; Montello, 2007; Weisman, 1981). Differentiation (distinctiveness) is the degree to which different parts of the built environment have a unique layout (size, color, shape, etc.); in the case of spatial configuration, differentiation implies the ability to distinguish enclosed spaces and street network 'pieces' according the density, length and form of their streets. Complexity refers to the relations, composition and organization of these spaces and street networks. Visibility or visual access is the degree to which different parts of an environment are connected through vistas or visual lines (Montello, 2005; Omer & Goldblatt, 2007).

Significant progress has been made through application of the theory and methodology of the space syntax approach when investigating the relationship between the social or functional differentiation of an area and the built environment's spatial configuration (Hillier, 1996; Hillier & Hanson, 1984). The description and identification of a city's spatial configuration by means of this approach is based on a topological analysis of an *axial map*, i.e., the smallest set of direct axial lines (visible straight lines) covering urban spaces. Such an analysis allows us to model the built environment in a way that reflects how it is perceived by people on the ground (Hillier & Iida, 2005; Penn, 2003; Vaughan, 2007). When applying this approach, the city's spatial configuration is defined by the spatial integration of axial lines, i.e., physical and visual access between spaces in the built environment as represented by topological distances (fewest turns).

This methodology uses several measures to describe the *spatial integration attributes* of any particular axial line. *Connectivity* denotes the number of directly linked axial lines. *Global Integration* indicates the closeness (or topological distance) of an axial line to other axial lines in the entire system. The *Local Integration* measure describes integration up to a defined number of changes of direction, usually equal to 3. Second-order measures are used to reflect part-whole relations within the city's spatial configuration. One of these measures, *Intelligibility*, is used to describe the correlation between the Connectivity and the Global Integration values of all the axial lines on a given axial map. From this perspective, Intelligibility refers to the degree to which what we can see on the immediate level is a good guide to the integration of each space within the system as a whole.

It should be noted that in some recent studies, spatial integration analysis is conducted with segments. While still based on the axial lines, the basic unit of this analysis is the line segment between junctions. Use of segments enables the conduct of configurational analysis on a finer scale than do axial lines. In addition to topological distance (fewest turns distance), segment analysis allows consideration of angular or geometric distance (least angle distance) and metric distance, factors that might be relevant to spatial human behavior (e.g. Hillier & Iida, 2005).

Space syntax studies have shown that urban areas can be identified by measuring axial lines or segments to obtain the geographic distribution of spatial integration attributes at different geographic scales. The assumption underlying these studies is that the built environment's spatial configuration can support the definition of urban areas in terms of their internal structure (spatial integration within the area), contextual structure (spatial integration within the geographic context, e.g. the surrounding area, the entire city) and relations between the two (Yang & Hillier, 2007).

Hillier (1996, chap. 4–5) has shown that urban areas having distinct levels of spatial integration also tend to be distinguished from their surroundings by their social and functional characteristics. Similarly, later studies have found that the geographic distribution of spatial integration levels tends to be correlated with the spatial distribution of social groups (Vaughan, 2007). For example, based on historical house-level data from 1889 and 1899, Vaughan, Clark, Sahbaz, and Haklay (2005) found that the spatial distribution of relatively wealthy populations tends to be concentrated in more accessible parts of the city (i.e. high global integration). In another study, Lima (2001) found that income distribution in Belem, Brazil was partially correlated with spatial integration attributes.

Social and functional differentiation of urban areas was also found to be related to the linkage between spatial integration at the local as well as the global level, with several methods recently suggested for identifying the specific areas' boundaries (Dalton, 2007; Hillier, 1996; Hillier, Turner, Yang, & Park, 2007; Yang & Hillier, 2007). Yang and Hillier (2007), for example, have suggested a technique for identifying boundaries by measuring the number of axial lines, or segments, found within different metric radii (i.e. measurement on a continuum from local to global).

Empirical research in several urban areas has shown that groups of neighboring lines tend to exhibit similar rates of change along the scale (the metric radius); in many cases, the boundaries between these 'natural areas' correspond with the functional and social boundaries dividing areas. In another study, Dalton (2007) developed a method for measuring the correlation between an area's integration value at different topological radii and its integration value at the city level. He found that the spatial distribution of these correlations corresponded with perceived residential neighborhood delineations.

Social differentiation has also been found to correlate with the spatial separation between areas within a city. That is, a spatially segregated urban environment can potentially stimulate higher levels of group residential segregation and geographic clustering (Legeby, 2010; Omer & Gabay, 2007; Vaughan, 2007; Vaughan & Penn, 2006; Vaughan et al., 2005). For example, Legeby (2010) revealed that spatial separation and physical segmentation between areas in Södertälje, Sweden was correlated with their social differentiation. In other words, the spatial separation of areas in the city can potentially contribute to increasing social differentiation.

According to this perspective, we were able to define two potential sources or forms of spatial separation within a city's street network and its spatial configuration: *discontinuity* and *discordance*. The first refers to spatial partitions such as open spaces or inbuilt areas that create discontinuity in the street network. The second refers to spatial partitions resulting from uncoordinated street networks or the presence of diverse street patterns within a given spatial entity. We later show how these forms of spatial separation pertain to socio-economic differentiation between areas in Tel Aviv.

To summarize, space syntax research deals with social differentiation of urban areas along two aspects of spatial configuration:

a. The dissimilarity between areas with respect to their spatial integration patterns at local and global scales, or the relation between the scales.
b. The spatial separation or segmentation of areas from their surrounding urban built environment.

Although there is some affinity between these two aspects of spatial configuration – dissimilarity in spatial integration between areas and spatial separation between areas – they are not identical and may be independent. Many adjacent neighborhoods have similar integration attributes but simultaneously exhibit weak interconnections (e.g., adjacent neighborhoods having the same street pattern may be connected by only one path), and vice versa (e.g., adjacent neighborhoods may have different street patterns but are connected by several paths).