Making spatial sense of historical social data

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Analysing the relationship between urban form and society through time is key to understanding the patterns of socio-spatial phenomena observable in contemporary cities and the mechanisms through which such phenomena unfold. The engagement of space syntax research with historical comparative studies of urban form has opened up possibilities for studying the relationship between urban development and social phenomena through time. The theory and methods of space syntax have a positive contribution to make to this research agenda. They need, however, to be better integrated within a multifaceted research framework. While space syntax provides a reliable methodology to compare the city’s urban form at different points in time, the evolution of a city’s spatial structure is only one component of the processes which shape the city as a social entity.

In recent years, relational theories such as Actor-Network Theory (ANT) and assemblage theory have highlighted the value of integrating different social science approaches in the analysis of social entities if we are to truly understand the complex processes which define the ways in which the social is realised in urban form. Although the implications of these theories in geography and urban studies have been widely explored, their relevance to space syntax research has received little attention. A meditation on their possible relationship informs the research presented in this paper. Drawing on key findings of an ongoing research project into the relation between social and spatial changes in the city of Nicosia through time (1883-2014), the argument advanced is that a critical reflection on the ways in which syntactical theory can engage with approaches from other disciplines is needed to inform methodological developments and facilitate the better interpretation of research findings in making spatial sense of historical social data.

1. Introduction
Cities are complex entities that are constantly changing in terms of their built forms, social and demographic compositions, street networks and public spaces, as well as the ways in which they are inhabited by their populations. Theorising the relationship between the material form of the city and social processes through time is key to understanding contemporary patterns of socio-spatial phenomena, as well as interpreting historical data. The fact that the organisation of space is a reflection of social relations, a cultural and economic product, is neither a new nor particularly controversial idea. It spans the work of social theorists from diverse backgrounds such as Simmel (2004 [1908]), Logan and Molotch (2007) and Lefebvre (1991). The systematic study of the relationship between space and social phenomena arguably started with Charles Booth’s analysis of the distribution of social classes in London (Booth, 1902). Many of the issues identified by Booth in noting how the physical elements of the city served to separate areas, mark territories and segregate populations anticipate the core programme of urban sociology pioneered by the Chicago School in the 1920s and 1930s. The Chicago School viewed urban environments as spatial localities structured in time by habitual social
practices. Its approach to the mapping and spatial analysis of social factors, however, fell somewhat out of favour in the latter part of the twentieth century due to an unfortunate tendency to stereotype social groups and an increasing scepticism towards quantitative spatial models in human geography. Even so the Chicago School remains a foundation of socio-spatial theorisations of the city, and its research agenda underpins serious attempts at understanding the role of the urban environment in producing and reproducing social differences (Tonkiss, 2005).

Cities are invariably a collection of material entities – their buildings linked by streets and roads with their urban infrastructure and furnishings – but they are also a system of human activity and interaction. These qualities are what Hillier and Vaughan (2007) term the physical city and the social city, arguing that ultimately the city is one entity as ‘the physical and social cities act conjointly to produce significant outcomes’ (ibid., p.205). Relational theories, such as Actor-Network Theory (ANT) (Latour, 2005) and assemblage theory as developed by De Landa (2006) highlight a number of key issues in the knowledge domain of urban development, in particular regarding the mechanisms for the emergence and transformation of city forms. Both these relational theories propose that analysing the processes of urban development that shape the city as a social entity involves assessing the relationship between their physical and human components. While the implications of these relational theories for the fields of geography and urban studies have been explored (Anderson et al., 2012; Farias, 2010; Jacobs, 2012; McFarlane, 2011) they have not prominently featured in discourses on space syntax theory and methodology.

This paper identifies a need for enhancing research into the relationship between physical transformation and social change in a city through time. It suggests that space syntax, as a theory that addresses the ‘lived relationality’ of space and links social phenomena back to their spatial descriptions, could profitably engage with recent theoretical developments in social sciences to open up new avenues of methodological development and hermeneutic possibility. This potential became particularly evident in researching Nicosia, where the nature of city and the available historical data called for a broad engagement with different perspectives in order to develop an effective methodology and enable adequate interpretation of research findings. The implications of integrating different social science approaches into historical research using space syntax are introduced, therefore, through a discussion of the methodology deployed in this study. The aim is to explore links between the development of Nicosia’s spatial structure and the distribution of different population groups in the city through time. The study enquires whether such a methodology can provide a reliable basis for inferring the extent to which socio-spatial phenomena in the contemporary city can be traced back to an ‘inherited’ spatial order linked to historical spatial development of the city.

The theoretical background underpinning this study is presented in Section 2. The paper’s proposed methodology is presented in Section 3 followed by a description of how the various analyses are layered to provide relevant outputs. In Section 4, the main socio-spatial mechanisms of Nicosia’s development are identified and critically discussed with reference to the historical events which marked shifts in the spatial properties of areas where certain groups lived or, alternatively, changed the demographic composition of areas with specific spatial characteristics. The inferences which can be reliably drawn from the analysis are presented in Section 4.1-4.4. This discussion highlights the methodological challenges and gaps in findings which are then critically reviewed in Section 5 in order to pinpoint the areas where further developments might be
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Notes:
1 In order to clarify the processes of territorialisation and deterritorialisation in cities, DeLanda (2011) often uses the example of the Lebanese civil war (in many ways comparable to the ethnic conflicts that occurred in Cyprus). Here, Beirut prior to the war is seen as deterritorialised since the boundaries between neighbourhoods were fuzzy and different population groups ‘crossed over’ their neighbourhood boundaries. Due to conflict the city became more and more territorialised, with different groups withdrawing to their own areas, ‘patrolling’ their borders and thus causing the areas to become highly homogenised.

needed to address such shortcomings. The final section discusses the usefulness of exploring a variety of analytical perspectives and suggests future steps to create bridges between theories, methodological tools and different analytical strategies. A discussion of the interpretive possibilities offered by the engagement with relational theories and social sciences is complemented by suggestions as to what other approaches might address the present methodological limitations and shortcomings in the interpretation of findings.

2. Relational theories, the social sciences and space syntax
When analysing the historical evolution of city forms, specifically urban theorists have been more likely to focus on physical aspects and actors with leverage on planning decisions, while sociologists tend to highlight the impact of group formations on urban life and the significance of routine social activities in shaping the identity of a city. In this paper we are interested in developing methods that link these two components: the physical and the human. In particular we take assemblage theory and ANT’s concept of ‘group formation’ as a framework not just to support the use of space syntax and the embedding of established social science approaches such as those of the Chicago School in historical urban research, but also to provide fresh interpretive possibilities of research findings.

Assemblage theory defines cities as social assemblages; wholes whose properties emerge from the interaction between parts. In assemblage theory, the city is viewed as a single social entity, of which both physical and human factors are component elements, although its properties are not simply reducible to those of its parts. Individual social entities at any given scale have an objective existence and a relative autonomy and are thus legitimate objects of study. A variety of scales – not just the macro and the micro – are involved in the emergence of cities, while historical processes play out in their formation and transformation. Assemblages are defined by the variable role of their components (from material to expressive) according to their physical and informational qualities, and by the variable synthesising processes that the components are involved in (territorialisation and deterritorialisation). Territorialisation acts to stabilise the identity of an assemblage by defining and reinforcing both spatial and non-spatial properties, thus increasing the internal homogeneity of an assemblage. Deterritorialisation acts to change the assemblage through destabilising processes.

Specific to the city are the processes that define the boundaries of a given area and determine its internal homogeneity. They include congregation (the tendency to come together in a relatively homogeneous composition) and segregation (the grouping of similar populations or skills induced by external forces). According to assemblage theory, urban form tends to change slowly and it is human routine activities that shape it; however, acceleration in change tends to be caused by breaks with tradition and forceful impositions such as deliberate design choices. The processes that stabilise a city’s identity relate to the definition of its borders and to the routine daily activities taking place within it. Increased geographical mobility interacts with the effect of land rents as a process of deterritorialisation which produces changes in the identity of neighbourhoods and can play a destabilising role. The components that play a material role in the definition of cities are the built form and connectivity of the various locales. Changes in street and transport connectivity affect in various ways the social activities that occur in a given locale. A key expressive role in defining the city as an assemblage is played by the exterior of buildings which defines the personality of a locale. In cities, built form has historically been a stabilising process as changes in building techniques and planning occurred at
a very slow pace. Fashion and the desire to mark social-class territories associated with increased social mobility was a powerful destabilising factor which also points to the fact that forms propagate over time through entire populations.

a. ANT treats human and material actors as equally relevant in the emergence of the social; the social being the product of the associations between components rather than an explanatory factor of certain phenomena. It views group formation as a continuous process by which groups are constantly formed, defined and redistributed. The social is therefore seen as transitory, but can be identified in the traces left by the associations that have been made between elements. Assemblage theory and ANT have important features in common that are relevant to the understanding of city development:

b. Social entities are basically constituted by the connections or associations between different elements. What is fundamental to the development of cities therefore is not what they are composed of, but how these elements are connected together.

c. Both physical and as non-physical entities are either component parts or actors in the constitutions of the social, thus both have to be taken into account in analyses.

d. There are processes of stabilisation of the social carried out by the actors involved in its emergence – destabilisation can also occur. These processes of stabilisation and destabilisations – of assembling and reassembling the social – must be understood in order to understand persistence, continuity and change in cities.

e. Expressive means as produced and articulated by the processes of group formation and stabilisation of groups’ identities are key in determining how the social is expressed in the physical form.

f. Multiple scales are involved in the emergence of cities, while historical processes play out in their formation and transformation.

The fact that both theories focus on heterogeneity, transitory conditions and the complexity of interactions between components enables a deeper understanding of the variety of actors involved in the shaping of cities. De Landa argues for the integration of diverse approaches developed by different social scientists while working at a variety of spatio-temporal scales.

At the urban scale there are a number of studies which have analysed the spatial distribution of different population groups. The Chicago School influenced many later works mapping the segregation of residential areas on the basis of class or ethnicity (Abbot, 1997). Spatial distributions of social factors have been explained through various viewpoints focusing on the housing market and economics, labour operations, a combination of material and cultural factors and so forth. However, analyses of persistence and change in such distributions across a whole city are fairly uncommon; notable relevant studies include Orford, Dorling, Shaw, and Smith (2002)’s study of poverty in London which compared Booth’s data to modern census data; and Vaughan’s study of social marginalisation in London, Manchester and Leeds (2005). Furthermore, space syntax has been used to undertake whole-city analysis of the evolution of the urban form (Al-Sayed et al., 2012; Griffiths, 2012). However, when linking physical and social elements historically, studies have tended to focus on small areas and the street-level in order to enable the linkage of data for quantitative analysis (Vaughan, 2005; Vaughan and Geddes, 2009). The methodological implications of integrating different social science

Notes:

2 There are naturally a number of differences between the two theories – a key difference concerns the relevance of scale. According to assemblage theory, the analysis of urban development should focus not only on the micro-macro mechanisms behind the emergence of the city, but also on the micro-macro mechanisms through which the city provides its components with both constraints and possibilities. Since the social processes which shape the city occur not only at these two levels, a method of analysis which accounts for intermediate scales is needed in order to understand how the properties of the whole emerge from the interaction between the parts, and equally how the whole in turn affects the populations, interpersonal networks and organisations which compose it. On the contrary, ANT sustains that scale, in terms of size, is irrelevant and that sites of different size should be placed on the same level. This is because scale in ANT is defined by the actors and by connectedness; moreover, scale can suddenly change form what is commonly understood as micro, to what is commonly understood as macro, hence any size could as relevant as any other in emergence.

3 The conception of segregation as an urban problem, dated back to the 1920s, forms a prominent research issue in a wide range of disciplines, both at a theoretical and at an operational level (Vaughan and Arbasio, 2011), and is increasingly being considered as a complex and multi-dimensional process (Malouils, 2004). Further research is needed to thoroughly assess how the built environment influences patterns of social segregation in Nicosia.
approaches into historical research using space syntax are explored in the next section through our proposed methodology which aims at a more precise understanding of the links between Nicosia’s physical transformation and the distribution of different population groups in the city through time. This approach aims to produce new insights into the complex relationship between the spatial and social – and temporal – dimensions of ethnic and class segregation in the settlement patterns of the city.

3. Methodology

The research presented in this paper is informed by the relational theories discussed above. It is an attempt at implementing a diachronic analysis at a whole-city level which considers both the groups inhabiting the city as well as the physical aspects by integrating the Chicago School’s emphasis on area mapping with space syntax configurational analysis. These approaches can give an indication of congregation and segregation patterns peculiar to groups and physical elements: space syntax analysis provides a measure of connectivity between locales and takes into account different scales, while thematic mapping in GIS addresses the processes of group formation, delineation and redistribution through time. Layering the results of these two methods of analysis and linking them, whether qualitatively or quantitatively, is the means to assess the interactions between the physical and human elements that lead to the emergence of cities as social entities. The basic methodological choices were informed by inferences made about what analytical elements may be required in the context of assemblage theory and ANT’s concept of group formation:

a. Social assemblages exist at different scales and hence each scale is a legitimate object of study; the whole-city scale is studied.

b. Both the physical form and social components have to be analysed; space syntax and more traditional social science approaches are utilised; in particular those of the Chicago School which examined the distribution of various population groups.

c. Social entities are constructed through very specific historical processes, which indicates the need for diachronic analysis to understand the emergence and the endurance of cities.

Given the complexity of cities, a statistical snapshot of a ‘whole city,’ though informative, cannot, as Tonkiss (2005, p.81) points out, fully ‘capture its object’ of study. It is the connections between the elements that are key to the identity of social entities defined by ANT theory as a ‘trace’. These traces or connections must be described for an entity to be defined as social if we are to argue that the city actually is a social entity.

3.1. Space syntax

Six spatial models of Nicosia, at key periods of its development from 1883-2014 described in Section 4, were constructed using space syntax methodology. The specific analysis used in this study is angular segment analysis, which takes into account least angular deviation of each segment from all other segments. The measure used is normalised angular choice (referred to here as NACH, ‘choice’ or ‘accessibility’) which allows for comparison between systems of different size. The normalised measure of choice takes into account the depth of elements within the system and hence it combines a representation of to- and through-movement measures, see Hillier et al. (2012).
3.2. Social data
The main source of contemporary and historical social data in Cyprus is the census.7 In many cases the census only provides information at the whole-city level or at the municipality level, which are significantly large areas. During the British administration, data were recorded for the whole city of Nicosia and for the surrounding villages, which are now part of Nicosia’s urban area. In the following censuses, data were recorded only for Nicosia municipality and its surrounding municipalities, which in some cases correspond to the former villages. Summarisation of this data only includes information on a small number of group characteristics, and recorded categories have changed over time.

In order to compare the data, relevant categories and areas from the years nearest to the date of the available maps were selected. Initially, an attempt was made to collate data relating to ethnicity, employment and occupational status; however, this was not always possible due to the nature of the data. Therefore, the comparative social analysis focuses on majority and minority groups (as represented by a variety of ethno-religious groups across time) and on social class (using occupational status as a proxy) in time series. Table 1 provides a summary of the ethno-religious categories used. The disparate range of cartographic and data sources mobilised for the study points to the complexity of dealing with historical social data. Whenever comparable data sources other than the census were available to fill gaps in either missing categories or specific time periods, these were also used for analysis.

When examining the relationship between the spatial structure of the city and the distribution of different groups, only the 2011 data provide enough detail for a quantitative analysis. In this case, the mean space syntax measures of each postcode area were linked to the proportions of population groups8. Maps of the early 1970s and social data for the early 1990s were not available. In these two cases only the respective social and spatial analyses are presented. For the remaining time periods the social and spatial data were layered in GIS in order to provide a visual representation of the relationship between the two – these are discussed qualitatively in their historical context as provided by previous research and secondary sources.

4. Nicosia’s development through time: Mapping, reading, analysing and drawing inferences from historical spatial and social data

Historical background. The island’s two main ethnic groups, Greek Cypriots and Turkish Cypriots, have been co-habiting the city in different ways over time. Initially, during the Ottoman rule and the early British period, they lived together in spatial proximity

<table>
<thead>
<tr>
<th>Year</th>
<th>Data Source</th>
<th>Ethno-Religious Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1883</td>
<td>Survey</td>
<td>Greek, Turk, Armenian</td>
</tr>
<tr>
<td>1891</td>
<td>Census</td>
<td>Muslim, Non-Muslim</td>
</tr>
<tr>
<td>1931</td>
<td>Census</td>
<td>Muslim, Christian</td>
</tr>
<tr>
<td>1956</td>
<td>Registration of the Population</td>
<td>Greek, Maronite, Armenian, Turk, British, Other</td>
</tr>
<tr>
<td>1960</td>
<td>Census</td>
<td>Greek, Maronite, Armenian, Turk, British, Gypsy, Other</td>
</tr>
<tr>
<td>1971</td>
<td>Survey</td>
<td>Migrant, Locally-born</td>
</tr>
<tr>
<td>2001</td>
<td>Census</td>
<td>Cypriot, Non-Cypriot</td>
</tr>
<tr>
<td>2011</td>
<td>Census</td>
<td>Cypriot, Non-Cypriot</td>
</tr>
</tbody>
</table>

Table 1: Summary of ethno-religious categories used in each data source.

Notes:
(6) city – the global structure when considering the whole system or the local neighbourhoods’ structure when considering a specific local radius. The two scales can be matched to identify the multi-scale core of the city – all the segments which have both the highest global and local choice value.

7 The earliest censuses were run by the Ottoman administration, however these were based on taxpayers’ records rather than the actual population and do not provide detail on different groups within each city. Accurate maps from this period are not available in order to relate such data to physical characteristics. A systematic census was initiated by the British administration in 1881 and run every 10 years – with the exception of 1941 – until 1960, when Cyprus gained independence. A micro-census was then run in 1973, but a full one was not available until 1992, followed by 2001 and 2011.

8 The mean NACHN and NACH1200 for each area were calculated in MapInfo GIS by layering the postcode areas over the spatial model, selecting all segments contained within each postcode area and using the Calculate Statistics tool to measure the mean values. The social data were already summarised by
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This situation has changed however, and today the two ethnic groups are spatially and socially separated by a buffer zone. Table 2 shows the proportion of different religious groups in Nicosia for the years when data is available (2001, relating to the southern part of the city only).

The Ottoman conquest and subsequent rule of Cyprus until 1878 is of central importance in understanding the evolution of Cypriot society, as it introduced a number of fundamental changes entailing both ethnic and spatial consequences. During the Ottoman rule, the walled city was inhabited by two main ethnic groups – the Greek Cypriot majority and the Turkish Cypriot minority – and grew around two ‘foci’ that reflected the ‘dual administration’ in Cyprus. With the coming of the British, Muslim Cypriots lost their monopoly over positions of power. Ethnic heterogeneity, established during the Ottoman period, developed into a deep rift. These developments had their spatial consequences: for instance, throughout this period of change the number of mixed villages kept declining – from 346 in 1891 down to 114 by 1960. As Attalides (1981) points out, each community by and large concentrated its residences around the focal points of the school and the church or mosque respectively. In Nicosia this meant that the Turkish Cypriots, who were already concentrated in the northern part of the town, expanded northward to adjacent Turkish villages.

Independence in 1960 did not manage to eradicate underlying simmering tensions, and after the 1963 inter-communal conflict the Turkish Cypriots withdrew into enclaves. Nicosia was now divided into two areas, delineated not by a physical boundary (as previously the riverbed which divided the city in Ottoman times) nor by a commercial street (as the Ermou Street, built over the riverbed in British times), but by an arbitrary military line. Eventually the establishment of a buffer zone with hard boundaries on each side of the city cut off Ermou Street and turned the streets that used to cross it, leading from the northern side to the southern side of town and vice versa, into dead ends. Ever since, the southern side of Nicosia has seen further urban growth spreading out towards suburban areas; most wealthy and middle-class families moved to new areas of Nicosia. The lack of strict planning regula-

<table>
<thead>
<tr>
<th>Year</th>
<th>Orthodox</th>
<th>Muslim</th>
<th>Armenian</th>
<th>Catholic</th>
<th>Maronite</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1881</td>
<td>76.47%</td>
<td>22.46%</td>
<td>0.20%</td>
<td>0.37%</td>
<td>0.20%</td>
<td>0.26%</td>
</tr>
<tr>
<td>1901</td>
<td>76.43%</td>
<td>22.39%</td>
<td>0.29%</td>
<td>0.33%</td>
<td>0.28%</td>
<td>0.25%</td>
</tr>
<tr>
<td>1911</td>
<td>76.83%</td>
<td>21.79%</td>
<td>0.49%</td>
<td>0.35%</td>
<td>0.21%</td>
<td>0.31%</td>
</tr>
<tr>
<td>1921</td>
<td>78.27%</td>
<td>20.47%</td>
<td>0.36%</td>
<td>0.31%</td>
<td>0.18%</td>
<td>0.39%</td>
</tr>
<tr>
<td>1931</td>
<td>78.34%</td>
<td>20.02%</td>
<td>0.57%</td>
<td>0.28%</td>
<td>0.23%</td>
<td>0.39%</td>
</tr>
<tr>
<td>1946</td>
<td>77.65%</td>
<td>19.35%</td>
<td>2.02%</td>
<td>0.22%</td>
<td>0.33%</td>
<td>0.53%</td>
</tr>
<tr>
<td>1960</td>
<td>78.12%</td>
<td>18.98%</td>
<td>1.70%</td>
<td>0.33%</td>
<td>0.34%</td>
<td>0.41%</td>
</tr>
<tr>
<td>2001</td>
<td>94.49%</td>
<td>0.72%</td>
<td>0.47%</td>
<td>0.79%</td>
<td>0.39%</td>
<td>2.37%</td>
</tr>
</tbody>
</table>

Notes:
(8) postcode areas (n=145), which have a mean population of 1,143. Correlation values between the two and the significance of the correlations were calculated in JMP 12.1.0, which measures the Pearson product-moment correlation (this test was selected instead of a Robust Estimation test as there are outliers in the data) and the significance probabilities (p). The Pairwise Correlations tool was used to report the p since this also performs non-parametric correlations and thus takes into account the fact that some of the data are ordinal. For the purposes of this study we are setting as significant a p<.05.

9 The city is currently divided east-west by a buffer zone implemented by the United Nations following the 1974 Turkish invasion of northern Cyprus which led to the complete separation of the two major ethnic groups on the island.
Figure 1:
Diagram of Nicosia showing the location of the old villages in relation to the city wall, the buffer zone and the river (left) and in relation to the contemporary administrative areas (right).

Figure 2:
Diagram of Nicosia town centre.
tions, fragmented land ownership and a cultural preference for detached low-rise houses has led to extensive suburban sprawl of the southern city, which has come to encompass former surrounding villages (Figure 1).

The old town centre has faced a long decline as it became an area at the edge of the city (the diagram in Figure 2 highlights the main areas discussed in the analysis). Increasing numbers of foreign nationals moved to the area following changes in immigration law during the 1990s; the rentals for these mostly old flats and houses are much lower than elsewhere in Nicosia. Much of the poorer and immigrant population live in this area, although in recent years there has been a revival of commercial uses and investment by wealthier classes in renovated residential historical properties. The opening of the check point on Ledras Street has turned it once again into a thoroughfare for tourists crossing from one side of the city to the other and also recreated a certain degree of mixing between those from the two communities willing to visit the other side.

4.1. Diversity in the town centre for better and for worse

Under Ottoman rule, Cyprus had acquired the character of a ‘plural society’ in which, as Furnivall (1948) put it, different sections of the community lived side by side but separately. They mostly met as individuals in market places (bazaars) in their capacities as consumers and producers involved in exchange relationships (Figure 3). They ‘mixed’ but ‘did not combine’.

Nicosia within the walls presented an urban pattern which accommodated a society composed of different ethnic and social groups: the Turkish Muslim community, the Greek Orthodox community and some other smaller ethnic minorities, mainly the Latin and the Armenian. W.H. Dixon (1879) noted that the social changes brought about by the Ot-

**Figure 3:**
Ermou Street in the early 1940s.
(Photograph courtesy of Mangolian Bros Ltd.)
tomans\textsuperscript{10} had indeed produced a visible spatial impact in Nicosia and that there was an overall division into four quarters, with different patterns of use or residence:

- The north-west (‘Konak’) quarter – the residence of the Muslim ruling class.
- The north-east (‘Mosque’) quarter – the silent area of the residences of the Imams.
- The south-west (‘Levantine’) quarter – the area of dancing women and money lenders.
- The south-east (Cathedral) quarter – the residence of the Orthodox clergy.

A further breakdown of the residential patterns of Nicosia during this period is presented in Figure 4.

These findings have already been highlighted by previous space syntax analysis of Nicosia (Pelecanos, 1990; Hillier, 2002). Local areas settled by Turkish Cypriot residents and those settled by Greek Cypriot residents show a very different pattern: the Turkish Cypriot quarter comprises shorter lines which do not often pass through each other and tend to form separate local clusters – a feature typical of Islamic cities also highlighted by Kostof (1999) – while the Greek Cypriot quarters tend to have longer lines crossing each other and are much more integrated into the wider system. The Turkish Cypriot area is also less intelligible than the Greek Cypriot area as it has less synergy between the global and local scales (i.e. a lower correspondence of lines of high local and global integration) as shown by the multi-scale analysis (Figure 5). However, the global structure of the city still displays the deformed wheel pattern, which ‘overrides the cultural differences in the residential fabric of space, and creates the global system of spaces where cultures come together’ (Hillier and Vaughan, 2007).

Notes:
\textsuperscript{10} To begin with, the Ottomans – following their practice throughout the empire – utilized the millet system to accommodate ethnic diversity, which allowed a limited degree of autonomy and self-administration to the various ethnic communities comprising a captured land. Furthermore, after conquering Cyprus, the Ottomans either killed or expelled the previous European feudal rulers, and distributed the land to the peasants – mostly the former serfs (Christians) and to the newly arrived Anatolian (Muslim) settlers. The latter, along with Muslim military and administrators, formed the basis of a distinct new ethnic community, thus establishing permanent ethnic heterogeneity on the island.
During the Ottoman period the whole city was contained within the walls, so naturally this is where the whole population resided regardless of ethnic or religious background. However, the town centre has over time retained its role as the place where diverse population groups reside, while suburban areas became more homogeneous following ethnic clashes (Figure 6). The ethnic demographic of the city has been subjected to a changing population dynamic precipitated by net in-migration, both from the European Union and developing countries. The historic centre accommodates a diversity of ethnic and religious groups that co-exist and share the public realm with the indigenous population. Recent space syntax studies suggest that the city within the walls continues to present a complex mosaic of different places, ethnically divided at a number of levels and forms (Parpa, 2010; Charalambous and Hadjichristos, 2011).

*Figure 6:*
Distribution of religious or ethnic groups in Nicosia and surrounding villages (from top to bottom and left to right: 1891, 1931, 1956, 1960).

4.2. The persistence of the Greek Cypriot community in the east of the town centre

While in 1891 the great majority of the southern part of the town centre was occupied by the Greek Cypriot majority, today the situation is practically reversed as most of the town centre is settled by minority groups (non-Cypriots, many from south-east Asia). However, the analysis also shows that a Greek Cypriot community persists in the eastern part of the town centre (Figure 7).

This area is bounded by the walls to the east. The buffer line to the north corresponds to a lower-income Christian area of the Ottoman period (the only non-Muslim area with low intelligibility levels as explained in Section 4.1, Figure 5) and continues to be somewhat deprived in the sense that it has higher than average rates of unemployment (Figure 11) despite the fact that it is mixed as regards social class (Figure 10).

Figure 7:
Distribution of minority groups, 1891 (left; mean: 16.1%) and 2011 (right; mean: 24.7%).

Sources: Colonial Government (1893), Statistical Service (2012).

Figure 8:
City-wide accessibility and the location in the town centre which retains an above average Greek Cypriot population, 2014 model, 2011 data.
4.3. The establishment of an upper class area in the west of the city

During the British period, the city extended outside the old walls; British administrators located their offices, as well as some residences, south and south-west of the walled city. By the 1930s some wealthy Greeks had followed the example of the British, moving southwards, out of the walled city. This social phenomenon is reflected in the spatial structure of the city (Figure 9). At this time the main routes tended to concentrate towards the west; Evagorou and Makariou have very high choice values due to the fact that they led to newly built areas where administrative services were located, while the area north of the city walls still has a low number of streets.

Figure 9:
City-wide spatial accessibility, 1933.
This process was accentuated after the post-World War II economic growth and the increasing use of the walled city for commercial purposes, which meant that many residences in the inner city were converted into shops and commercial offices. Gradually this development expanded out of the walled city and a new commercial area grew in a south and south-west direction. Effectively there were two main commercial areas: the older one, within the walled city with Ledras as its primary axis; and the newer one starting outwards from the walls, with Makariou as its primary axis.

In terms of residential patterns, by 1956 the British had established a community further west (Figure 6) and so had the wealthier Greek population. It is also at this time that the main routes leading to Agios Dometios and Egkomi had gained high accessibility values and these areas had become significantly densified to accommodate the residential developments (Figure 10).

Figure 10:
City-wide accessibility and the location of the areas of Agios Dometios and Egkomi, 1956.
The concentration of wealthier classes in this western area continued into the 1960s (Papadopoulos, 1965) and still remains in place today (Figure 11).

4.4. Concentrations and pockets of wealth and deprivation

In the contemporary city, the distribution of unemployment and lower-class groups generally matches the distribution of non-Cypriot residents and is concentrated in the town centre. The exception to this is the refugee housing estates – picked up by the analysis of unemployment by quarter but not by the analysis by postcode area – which indicates that a significant difference exists between the estates and the surrounding areas (Figure 12).

The key finding from the statistical correlations run for the contemporary period is that for all groups analysed there is a significant correlation (set as p<0.05) between indicators of deprivation and the city-wide accessibility values – in most cases the correlation is significant also for local accessibility values, meaning that the higher the mean accessibility of the area, the greater the proportion of unemployed and non-Cypriot residents, and the greater the likelihood for a significantly higher proportion of lower-class residents than the average. In all cases the correlation coefficient is relatively low, meaning that the strength of the correlation is not particularly strong, possibly due to the nature of the administrative areas which do not always reflect ‘real’ neighbourhoods. However, as the n is high (=145) the correlations are significant, particularly in the case of non-Cypriots and city-wide accessibility.
Even assuming that eight years after the opening of the check-points in 2003 such a distribution would relate to the spatial situation of a divided city, in two cases there remains a significant correlation between the variables, and the direction of the correlation remains for all variables even when it is not significant (Table 3).

It is possible that to a certain extent the distribution may be more closely related to the division since it is likely to have emerged prior to the opening of check-points and may be related to a ‘mental’ view of the city by which residents still picture the city as divided (the great majority of the population does not visit the northern half, and even when they do, the visits are sporadic). At least regarding the non-Cypriot population and social classes, however, there is clearly a relationship with global accessibility for both models. If anything, the analysis shows that the opening of check-points may have exacerbated such a relationship and made it stronger.

5. Methodological challenges

Methodological limitations are in many ways fundamental to understanding this research. The problematic nature of using historical data for comparative purposes was assessed for its suitability to be used in conjunction with space syntax analysis in order to draw reliable inferences about historical socio-spatial processes. There are a number of key issues with the social data. Firstly, the categories used differ from dataset to dataset. Religion is, of course, not the same as ethnicity and even less so as citizenship. Broadly speaking, however, the data give an indication of the distribution of majority and minority groups at different points in time. Furthermore, such data is comparable in two ways: up to the first half of the twentieth century, the great majority of the Christian population would have belonged to the Greek Cypriot Orthodox community and the great majority of the Muslim population to the Turkish Cypriot community. Vice versa, the ethnicities recorded in the middle of the twentieth century still reflect the division.

Table 3:

<table>
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<th>Variable1</th>
<th>Variable2</th>
<th>Correlation Coefficient</th>
<th>Count</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>p</th>
<th>Direction of Correlation</th>
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<td>145</td>
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<td>-0.0387</td>
<td>0.0156</td>
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</table>

Model 2 - Divided City

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<th>Variable2</th>
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<th>Lower 95%</th>
<th>Upper 95%</th>
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</table>

Correlation coefficients and significance of correlations (p) for both models – statistically significant correlations are highlighted in bold and red.
Making spatial sense of historical social data

Charalambous, N. & Geddes, I.

The town centre could to a great extent be assigned to either Christian or Muslim religious groups.

In the present day comparison is more problematic. It remains the case, however, that the data do give an indication of the distribution of a population majority (Christian in the past, Cypriot in present times) as opposed to a population minority (Muslim in the past, non-Cypriot in the present). The comparison of social class between the nineteenth century and the present day is more straightforward since the 1883 survey classification of high- and low-income is based on occupational status. Although occupations and their related income have since changed drastically, the relationship between occupation and social class remains for the 2011 data.

Regarding the breakdown of areas for analysis, the visual representation of data can be manipulated to reflect past areas in order to provide a basis for comparison. Naturally, the contemporary situation is, in reality, different and the data relate to large urbanised areas rather than localised villages surrounded by rural areas (as represented in Figures 1 and 6). However, such historical villages are shown by the spatial analysis to be the local centre of their respective contemporary municipalities. Hence, the data can still give a good indication of the differences between the various areas of the city.

The quantitative analysis of the contemporary situation is based on postcode areas of different size (n=145). For comparative purposes, proportions are used in the analysis and the sample size allows for a reliable correlation analysis. However, such areas do not always represent ‘real’ neighbourhoods as would be defined by physical edges and boundaries, such as the city walls, the river and major roads. It must therefore be allowed that the analysis of the relationship between the spatial structure and the social make-up of areas might be somewhat skewed by the arbitrary nature of such areas. This is one of the main reasons why space syntax analysts have perhaps tended to be reluctant to link spatial measures to other area-level measures. It is argued here that, despite the limitations, it is still vital to test the link between the two if we are to gain further insights into the relationship between spatial structures and population groups at the whole-city level.

Following the 1974 division of the city neither cartographic data (with the exception of the contemporary spatial model) nor social data for the northern part of the city are available and the analysis is therefore limited to the southern part. The opening of check-points in 2003 has meant that the spatial properties of the city have changed suddenly and significantly: this has implications for the interpretation of the relationship between the spatial and social data, since the spatial characteristics of the distribution of groups may have changed substantially while the socio-spatial processes leading to such a distribution may have in fact taken place during the time of division and thus relate to the structure of the divided city. In order to assess whether this was the case, quantitative analysis was undertaken for a model of the whole city as it actually is (connected to the northern half through three check-points) and for a hypothetical model of the city as if it were divided (the southern part only, as it would be if the check-points had not had opened). The results of these analyses are compared in Table 3.

6. Discussion and conclusions

6.1 Congregation, segregation, integration

The analysis shows the town centre to the most diverse area of the city over time, accommodating a number of different ethnic and religious groups. However, the historical data from the twentieth century are not detailed enough to show whether any pattern of social segregation exists within the town centre. The 1930s see the first struggles by the Greek Cypriots against the British rule, which
led to riots in Nicosia\textsuperscript{11}, followed by the establishment of a special police force constituted only by Turkish Cypriot, in practice initiating the conflict between the two communities. At this time the spatial analysis clearly shows that the town centre is more fragmented than previously, probably due to some infrastructure interventions. Also, the railway is still functioning at this time and acts as a line of division between the villages of Omorphita (with a Muslim majority) and Kaimakli (with a Christian majority). It is not possible to see with the available data whether this fragmentation is a reflection and/or a contributor to socio-spatial phenomena. However, historical records establish these were areas of diversity where different groups met, along with the border areas between different communities, which became the loci of ethnic conflict, most prominently the street of Ermou and the village of Omorphita\textsuperscript{12}.

While interpreting the socio-spatial changes in the city, it is clear that factors at different scales (not just physical, but also organisational) play a role. It was mainly international political affairs that caused population shifts and the spatial restructurbing of the city (the territorialisation process of the whole city) even in localised areas and even if it meant the moving of population groups from one neighbourhood to the next (a fairly micro-level adjustment). At the same time, the decline of the town centre and the subsequent fall in its rent values triggered a deterritorialisation process which has influenced the increasing diversity of the contemporary town centre.

The interaction of macro-level political processes also induced the formation of the population group of refugees. The destabilising process of conflict interacted with the destabilising process of shifting land values to lead to the establishment of refugee housing estates in the outskirts of the city. This was mainly due to developers holding onto land while waiting for dwindling land prices to increase in the post-1974 period in order to maximise profits (Kritioti, 1988). Indicators of deprivation in these areas have now persisted for over 40 years. While in the town centre the persistence of a ‘deprived’ Greek Cypriot population clearly corresponds to the low accessibility values of the area, here it is possible that such persistence may relate to their location in former edge areas of the city, which later were not integrated into the structure that developed around them. This study does not allow us to state with certainty what the links between the concentration of deprivation and the physical features of these areas are – but it does suggest the presences of links. This issue points to the need for further research focusing on the spatial structure of these estates in relation to the whole city.

Immigrant groups, lower social classes and unemployment levels are associated with areas of high accessibility, in particular at the city-wide scale. This is not as surprising if one is familiar with the Cypriot context, where the local population displays a clear preference for quiet, suburban areas and levels of car ownership and car use are extremely high. This phenomenon can be explained through two main processes: a) the deterritorialisation process that occurred in the town centre following the division of the city and the consequent fall in rent and property values in this area; and b) the processes of ‘group formation’ and congregation. On the one hand, the first immigrant communities congregated in the town centre, taking advantage of the low rent values and attracting new immigrants through the provision of communal services and social contacts. On the other hand, the wealthy Cypriots congregated in the least accessible areas through their ability to afford higher land values, higher car ownership, a cultural preference for suburban low-rise housing and, again, access to social networks support.

While social segregation is often assessed with spatial measures of physical segregation, here such an approach is clearly inappropriate; other theorisations of social segregation must come into play in order to fully understand the socio-spatial

Notes:

\textsuperscript{12} In 1931 Omorphita reveals an almost 50-50 split between the two communities, with a small Muslim majority; the village had a slight Christian majority according to the Ottoman census of 1831, while in 1891 and again in 1946, 55% of the population here was Christian. Omorphita was the scene of intensive fighting between Greek and Turkish Cypriots in the late 1950s, when many of the Greek Cypriots left the village and many of the Turkish Cypriots living in nearby Kaimakli moved to this area.
phenomena taking place in Nicosia. While it is clear that immigrant populations, lower social classes and the unemployed might be relegated to certain areas of the city (the highly accessible areas) through congregation, they are socially segregated in the sense that they are unable to access other areas of the city for a number of reasons. At the same time the local population is, to a great extent, spatially self-segregating (i.e. congregating in areas of low accessibility) for a variety of reasons but integrated through their social networks. Fully understanding such processes requires greater insight into different population groups’ choices of residential location in the Cypriot context, but it is clear that a simple equation or dichotomy of spatial-social, segregation-integration is not sufficient to correctly interpret the socio-spatial structure of contemporary Nicosia. We believe that using thematic mapping to understand the distribution of population groups in relation to the spatial structure of the city and embedding the concepts of assemblage theory and group formation with space syntax analysis has been beneficial in suggesting diverse interpretative dimensions to our research findings.

6.2. Evaluating the benefits of the analysis and the needs for further research

Linking space syntax analysis and thematic mapping techniques in GIS has yielded significant findings. Despite the limitations of thematic mapping in representing ‘real’ neighbourhoods, such analyses can enhance the understanding of the broader socio-spatial development of cities. This research also highlights how, in a situation where the available social data may not be ideal, space syntax analysis provides a layer of valuable information to facilitate the interpretation of social processes. For example, when detailed social data are lacking, the space syntax analysis might give an indication of the fragmentation of space, which relates to the fragmentation of society as is the case here for the 1930s period.

Assessing two models of the city for contemporary times has shown that unexpected socio-spatial phenomena may occur through the restructuring of the city, exacerbating processes of territorialisation of suburban areas and deterritorialisation of central areas. Such issues do not feature in political discourse, but the analysis linking the physical and human components shows that such sudden and dramatic changes in the spatial structure might trigger both significant destabilising and homogenising processes in the city. The study shows how clear patterns of historical socio-spatial processes emerged, which can be identified in the contemporary city and also that some reliable inferences can be made as to the socio-spatial mechanisms of development. However, it is also clear that once a variety of groups, actors and processes are taken into account, the methodology has various limitations and analysis still presents significant gaps in contextual knowledge, which can be filled if greater efforts are made to widen the variety of social science approaches used in conjunction with space syntax.

This research emphasises the need for further theoretical work to inform methodological developments and facilitate a more nuanced interpretation of research findings in making spatial sense of historical social data. It also points to the benefit of future research involving further breakdown and summarisation of census data where possible, as well as the necessity to record past social characteristics of small areas which could be linked to spatial properties. Mapping historical travellers’ descriptions of the city, identifying the locations of ethnic clashes or other social phenomena through newspaper reports, recording narratives of the social nature of different areas from older residents and developing methods to layer these with space syntax analyses, are all possible avenues that should be explored to fill our gaps in findings and develop further interpretive potential.
and Geddes, forthcoming). The challenges involved in the Nicosia research project have highlighted the importance of critical reflection on how syntactical theory and research methods can engage with approaches from other disciplines in the study of urban phenomena. Such an ‘open’ research agenda can hope to achieve a better understanding of spatial configuration as a distinctive contribution to relational theory and, in doing so, of the role configuration plays in historical urban dynamics.

References


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