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Abstract
Although space syntax is often presented as a *configurational* theory of architecture, this tends to hide the more fundamental claim that it is also an *analytical* theory, a theory based on analytical science rather than on the normative or ideological claims normally found in architectural theory. This article proposes an extension of such an analytical theory in the context of urbanism by using space syntax areas in urban morphology that earlier have not been directly part of space syntax analysis. If one allows for some simplification, one can say that the main variable of urban form analysed in space syntax is *accessibility.* This article introduces two other variables: *density* and *diversity. Density*, the dominating variable in geographic analysis of urban space, is fundamental for the development of knowledge about urban space and in the practice of urban planning. *Diversity*, at least since Jane Jacob's writing of *The Death and Life of Great American Cities*, has been another focus for urban analysis and urban planners, yet one that has proven to be more difficult to address.

A study of an urban area in Stockholm identified three convincing correlations: 1.) a correlation between *integration* and movement; 2.) a correlation between *accessible building density* and population; and 3.) a correlation between *accessible plots* and diversity indices such as number of age groups and lines of businesses. Whereas the first correlation is not very surprising in the context of space syntax research and the second correlation is interesting mostly because of its original measuring technique, the third correlation must be considered surprising and an original finding.

The present study proposes that the three ways to measure the three variables *accessibility, density* and *diversity* could be combined into a more general analytical theory of urban form, directly stemming from space syntax analysis, significantly widening the scope of space syntax into a more general urban morphology. In addition, it is proposed that these measurements capture something that can be called *spatial capital*, that also can engage adjacent scientific disciplines.

Keywords: analytical theory, urban form, accessibility, density, diversity, performativity

1. Introduction: space syntax as an analytical theory of architecture

Space syntax is often presented as a *configurational* theory of architecture; that is, it specifically deals with 'the relations of parts in architecture rather than the parts themselves'. This tends to hide the more fundamental claim that it also is an *analytical* theory rather than an ideologically founded or normative theory, as so much of architectural theory - but a scientifically founded theory. As such, it can be seen as an answer to Françoise Choay's critical investigation that identifies theories in urbanism as

inherently normative theories disguised in scientific rhetoric (1997). Similarly, Bill Hillier critiques the scientific posture of theories in urbanism (1996). By placing his critique of theories in urbanism in relation to the practice of urban planning and design, he also emphasises the practical problems of such theories. In short, he puts forth the quite alarming conclusion that we are rich in theoretical support for the *generation* of urban designs, but poor in well-founded support for the *prediction* of the actual performance of such designs. A conclusion well supported by the fact that so much of urban planning and design in the 20th century failed to deliver on its claims.

This article proposes an extension of space syntax as an analytical theory in urbanism and tries to incorporate into its field areas in urban morphology that earlier have not been directly part of space syntax analysis. If one allows for some simplification, one can say that the main variable of urban form that is analysed within space syntax is accessibility: how the *accessibility* between spaces in a spatial system varies according to changes in the configuration of urban form. This article introduces two other variables: *density* and *diversity. Density*, the dominating variable in geographic analysis of urban space, is fundamental in the development of knowledge about urban space and in the practice of urban planning. *Diversity*, at least since Jane Jacob's writing of The *Death and Life of Great American Cities* (1961), has been another focus of urban analysis and urban planners, yet one that has proven more difficult to address.

In addition, this article extends such an analytical theory not by simply adding other measurements or types of analysis, but rather by using and developing traditional space syntax analysis in an imaginative way. Perhaps the most important reason for such an approach lies in the unique ability of space syntax analysis to combine the structural component with the phenomenological component of urban space in a joint analytical mode, which, using the concepts of Jürgen Habermas, opens the possibility to move between the perspectives of the *system* and the *lifeworld* (1984).[1]

This article comprises two parts. In the first part, findings from a study of an urban area in Stockholm are presented that show that through the application of developed techniques of space syntax analysis one can find strong correlations between urban form and indices of both *accessibility* and *density* as well as *diversity*. In the second part, it is discussed how this could form an outline of an extended analytical theory, specifically aiming at the social performativity of urban form, directly stemming from space syntax analysis while also significantly widening the scope of space syntax into a more general urban morphology.

2. Urbanity as accessible diversity

On the most general level, an analytical theory on the social performativity of urban form addresses the relation between urban form and urban life and how these two can be said to generate a socio-spatial category that we call *urbanity.* Put more distinctly, it addresses how urban form, as a result of urban design, influences urban life: how it supports, hinders, and organises urban form, creating

potentials for variations of urbanity. In addition, this article argues that urban form creates some¬thing that can be called *spatial capital* and that this can be measured, providing researchers and urban planners a new way to evaluate the efficacy of urban planning as it relates to social performativity.

What we need as a point of departure is an appropriate and powerful definition of urbanity by which we can discern the variables of urban form that will be particularly influential. It follows that we are looking for a definition on a generic level so as not to get caught in particularities. The singular most common concept in such definitions is the earlier mentioned *density* measure - e.g., density of population or density of building mass. Still, the concept of density is problematic. First, it conveys many technical problems of description constantly debated in geography (e.g. O'Sullivan and Unwin, 2003). Second, density in itself is far from an adequate description of urban form, especially on the experiential scale fundamental for urban design. For example, high density can be achieved both in traditional inner-city grids as well as in large modernistic housing estates, but the impact on urban life in the two cases differs dramatically. From an experiential point of view, it can be argued that what really matters is the degree of *accessibility* to density, which is achieved by design of the urban fabric of streets and buildings - urban form. Degree of accessibility seems to be a vital complementary variable to density.

Even so, high density does not in itself necessarily capture urbanity, even when easily accessed. For example, many institutional areas such as hospitals can be both dense and accessible, but we do not regard them as typically urban, other than in a derived sense. There seems to be one more variable necessary to capture a distinctive feature of urbanity, and that variable is proposed to be *diversity*. As a matter of fact, it could be argued from a heuristic point of view that the two variables of accessibility and diversity often over-ride the impact of the more common variable of density when it comes to discerning urbanity; for example, many small cities with low density present a high accessibility and diversity and thereby also a strong sense of urbanity.

Therefore, the generic definition of urbanity proposed here is as follows: *urbanity, both socially and spatially, primarily is constituted by high accessibility and high diversity.* We live in cities so that we can get close to many different things.[2] This is not saying that density is unimportant; it is proposing that the two concepts of accessibility and diversity are more poignant descriptions of urbanity. According to the theory of spatial capital, *urban form generates variations in spatial accessibility and diversity with direct effects on social accessibility and diversity, which are possible to measure, whereby, in turn, it is possible to measure variations in urbanity as a socio-spatial category.*

3. Spatial accessibility and how to measure it

The next step is to find analytical means that can capture and measure aspects of urban form that directly relate to its social performativity and have a powerful influence on the degree of accessibility and diversity for urban life.

The most developed technique for such analysis when it comes to accessibility on the detailed scale we are discussing here is, beyond doubt, *spatial integration analysis* developed in *space syntax* research. Instru¬mental for such analysis is the invention of the axial map, which is a representation of urban space as structured by urban form and from the point of view of an experiencing and acting human being. In the map, each axial line represents an urban space that is possible to both visually and physically access (Figure 1). In short, such analyses measure the accessibility of each and every axial line from each and every other axial line in the map, the *integration value* of each line. Such analyses have proven, in a long series of studies from around the world, that there is a strong correlation between such integration values and pedestrian movement, the most generic aspect of urban life (e.g. Hillier, et al., 1993). For example, in the urban areas in Stockholm studied for this article spatial integration (radius=n) correlated with observed pedestrian movement by 70% (R^2=0.70) (Figure 2).

Figure 1. Urban space as structured and shaped by urban form in a city district in Stockholm (left) and the axial map of the same area (right).

Using this technique to measure integration value, other studies have found other correlations where move¬ment is the intermediary, such as social segregation (Vaughan, et al., 2005), crime (Hillier and Xu, 2004) and rent-levels for floor-space (DeSyllas, 2000)..

Figure 2. The distribution of spatial integration, correlating in this case with observed pedestrian movement by 70% (R^2=0.70)

In space syntax research, accessibility measure has been further developed into place syntax-analysis (Ståhle, et al., 2006). Integration analysis, as well as space syntax research in general, deals with the analysis of urban space *per se:* what is analysed is the accessibility to urban space in itself without any regard for the 'content' of space, such as residential population, retail or bus-stops. There is an important point to this approach, since the differentiation of space as a system in itself, apart from its 'content', is seldom done with any consistency in urban analysis. At the same time, what we often look for in urban analysis is accessibility to particular contents in urban space such as the ones mentioned above. In *place syntax analysis*, the axial map is used as a way to measure distance to such contents, loaded as place-data on, for example, plots or address-points. It is not only possible to analyse the accessibility to other spaces, but also the accessibility to specific contents in space. Place syntax analysis can be said to deal with *specific spatial accessibility*, such as accessibility to different attractions, while integration analysis deals with *general spatial accessibility,* such as accessibility to urban space in itself.

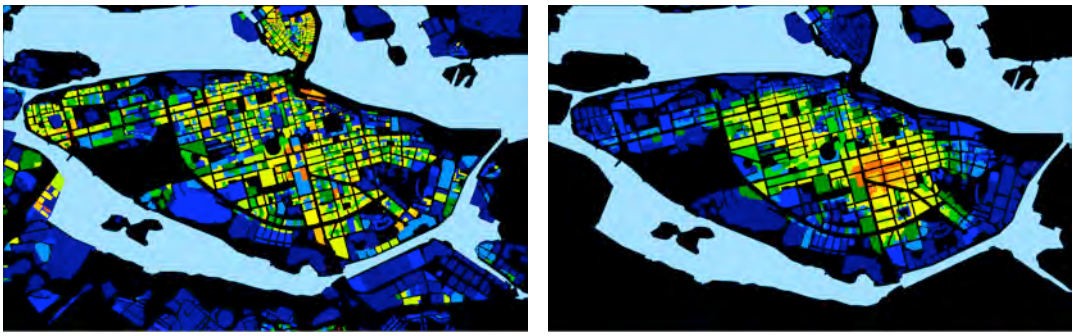

Figure 3. Building density per plot (left), and accessible building density per plot (right), where the latter correlates to accessible population density by 82% (R^2=0.82).

Returning to the issue of density, place syntax analysis thus presents a new and in many respects more life-like mode for representing geographical data. While traditional geographic descriptions usually deal with representations of such data as *density within geographical units* (such as city-districts, blocks or plots), place syntax deals with representations of the *accessibility within a certain radius* (such as walking distance) to such data (Figure 3). We can then produce maps showing 'accessibility to density', refocusing on density through the lens of accessibility.

In the urban area studied for this article, we found a correlation of 82% (R^2=0.82) between accessible building density and accessible population density, a finding that confirms the rather obvious correlation between high building density and high population density. More importantly, this correlation was done using measurements that change the perspective from a traditional *system* perspective, typical for conventional geographic descriptions, to the perspective of the experiencing subject in urban space, what can be called a *lifeworld* perspective.[3] In addition, this correlation was done using a measurement that brings the ubiquitous density description into the descriptive methodology developed in space syntax research.

4. Spatial diversity and how to measure it

Since the variable of diversity has no analytical techniques as sophisticated as integration analysis, it is proposed that we need to shift focus from *experientially defined space*, such as the axial line, to *legally defined space*, such as the privately and publicly owned domains we call plots or properties (Figure 4).[4] The plot, through its disposer, represents the presence of an actor in urban space and the location of the influence of that actor. Such actors normally develop particular strategies for their domains. An area with comparatively many plots then seems to have the potential to carry a higher amount of such actors and thereby a higher amount of strategies for action; in turn, it seems likely that this would produce a larger amount of diversity among these strategies. In the end, such an area seems to carry the potential to more easily develop a diverse content than an area with comparatively few plots and hence few actors and strategies. Obviously, other things like land use regulations can override the effect of this, but what is tried to be captured here is the particular influence of urban form in itself.

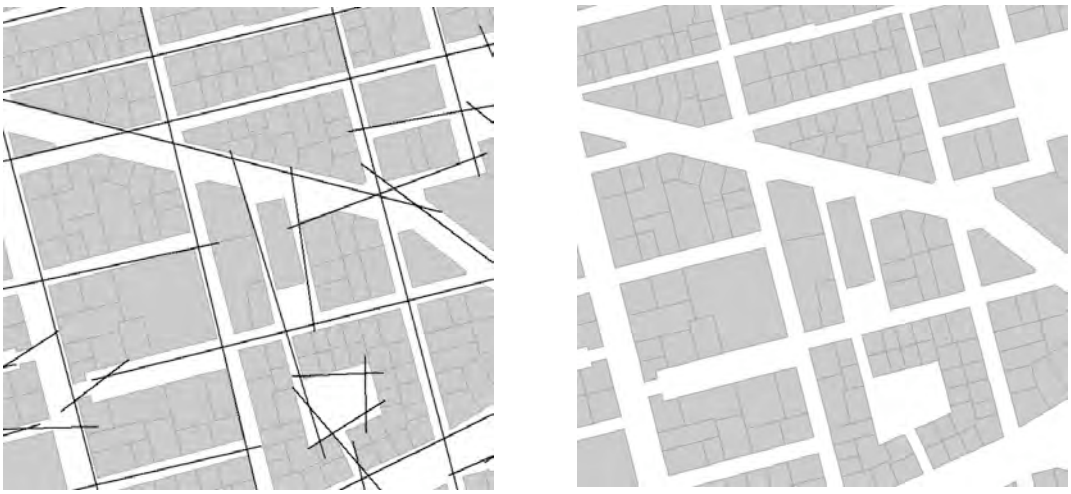

Figure 4. Experientially defined space, where each axial line represents a space that is visually and physically accessible (left), and legally defined space, where each plot represents a domain of an actor defined by legal restrictions (right).

Here again place syntax-analysis can be used; this time not to measure the accessibility to different contents in urban space, but to measure the accessibility to specific types of space in urban space, such as plots or address-points. For example, one can measure the accessibility to plots within a radius of three axial lines from each plot in an area, which, following the argument above, could show the distribution of potential diversity in that area. Still, the measure would be heavily influenced by local accessibility, since the size of a radius of three axial lines significantly varies depending on the length of the lines. This effect can be normalized in one of two ways: either by dividing each such measurement with the accessible plot area within the same radius or by setting the radius to three axial lines but not more than 500 metres. Such measurements are referred to as measurements of *spatial capacity*.[5]

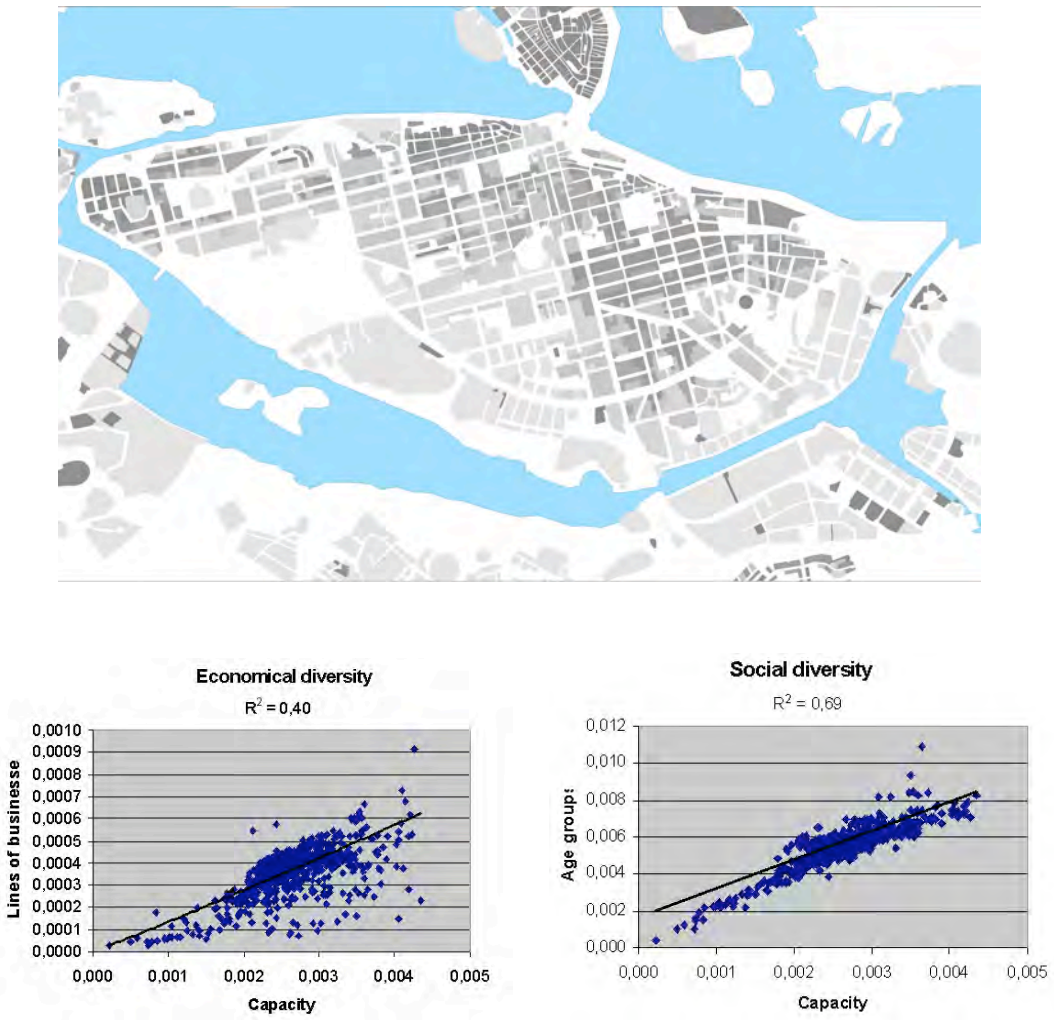

Figure 5. The distribution of spatial capacity, measured as accessible density of plots (top), correlating with accessible density of lines of businesses by 40% (bottom left) and accessible density of age groups by 69% (bottom right).

When this technique was tested, what in effect was measured was the accessibility to plots from each plot within three axial lines, divided by the amount of accessible plot area within the same radius. These measurements were then correlated to the accessibility to both economic and social indices of diversity, where the economical index in this case was lines of businesses and the social index was age groups. It turned out that spatial capacity correlated to 40% with the economical index (R^2=0.40) and to 69% with the social index (R^2=0.69),[6] implying that the higher spatial capacity within a radius from a plot (i.e., the more lines of businesses and age groups within the same radius), the higher diversity.

5. Conclusion: Spatial Capital - a measurement of urbanity

We can then see how integration analysis and place syntax analysis present powerful techniques for the analysis of spatial accessibility and diversity as well as an original way of measuring density, showing how urban form is most influential on generic aspects of urban life.

Figure 6. The variations of urbanity according to the definition of spatial capital as accessible diversity, where spatial diversity is measured as the amount of accessible plots within a radius of three axial lines (top), and spatial integration and capacity overlaid in one map, showing the continuous variations of spatial capital (bottom).

Spatial capital, measured by spatial integration and spatial capacity, then constitute a procedure to measure urbanity that could be both clarifying and useful in *urban design* as well as *urban analysis*. It is important to say right a way that such a measurement *does* imply that the higher accessibility and diversity the *higher* spatial capital, but it does not imply that a higher spatial capital is always *better*. In urban design, it is rather a measurement that is able to tell whether certain design solutions will create greater potential for spatial accessibility and/or diversity or not, where the appropriate level for this can only be judged in relation to the design task at hand. That is, it can work as a most important *design support* but not as a *design director.*

In *urban analysis*, it can be useful both as a straight descrip¬tion of the variations of spatial capital in an urban area or as descriptions of spatial accessibility and diversity separately (Figure 6). The latter case, for example, presents the interesting opportunity to discern urban sub-categories. There is an abundance of taxonomies and typologies used in the discourses of urbanism, the *transects* in New Urbanism being just one. There are good reasons for that since categories and types simplify communication. The problem is that such typologies often have weak ties to urban life, which make them isolated and rather uninformative typologies of urban form *per se*. The theory of spatial capital, on the other hand, presents the opportunity to discern such categories or types with an unusually strong analytical foundation, where urban form is tied to generic aspects of urban life, constructing genuine socio-spatial sub-categories of urbanity. From such a description, four fundamental urban categories can be suggested (Table 1) although there are no implied values to the different categories. Once again, returning to density, it is obvious how the table could be extended by the addition of a high- and low-density type for each category.

Urban category	Accessibility	Diversity	Ideal case
Super-urban	High	High	Manhattan, NY
Pseudo-urban	High	Low	Peachtree Centre, GA
Sub-urban	Low	High	Atlanta Sprawl, GA
Anti-urban	Low	Low	IBM Headquarters, NY

Table 1. Four sub-categories of urbanity and suggestions for ideal cases discerned through the theory of spatial capital. overlaid in one map, showing the continuous variations of spatial capital (right).

6. Discussion: Spatial Capital as exchange-value and use-value

Recently, the concept of capital has been intensely discussed and extended; according to Pierre Bourdieu (1986), for example, in addition to *economical capital* there are *cultural capital* and *social capital*. The more precise meanings, according to economist Hernando de Soto, are often forgotten even when it comes to economical capital. In his book *The Mystery of Capital* (2000), he thoroughly discusses how a certain value can be translated into capital, which is of more general interest than his specific propositions in the same book on how to solve world poverty, claims that are clearly more debatable.[7] His main example is land and how land becomes capital, the question being trickier than it first looks, according to De Soto. After land, or rather different land parcels, are geographically defined and their particular social and economical values described, measured, and documented to represent the land parcels, these documents need to be authorised and integrated in a legal system where such things as ownership and economical transactions are controlled and guaranteed.

In this context, the concept of *spatial capital* may contribute to the possibility to measure the effects of urban form on land-value. We all agree that different locations in cities have different economic values, which influence such things as property prices and rents. And even though markets react on exactly such values and there is a whole industry trying to analyse them, the specifically spatial preconditions are difficult to capture, especially on the detailed scale we are referring to here. The analytical techniques above then seem most interesting as a means to develop more precise tools for such evaluations, especially when it comes to predicting how new urban projects will create new

location-values as well as redistribute already present ones. Obviously, there are other values at work here, such as the value of what is actually built, but the theory of spatial capital specifically aims at the evasive value of urban form.

This concerns the *exchange-value* of spatial capital, suggesting how the value of urban form literally can be translated into economical capital. But just as important is the *use-value* of spatial capital, the value urban form represents in a multitude of ways for everyday urban life - socially, culturally, and environmentally. Although not all needs require high spatial capital, on the most fundamental level this seems to be what cities offer: the support of the generic need for people and societies to *access differences* as a means for social, cultural, and economical development. In the end, we here seem to see the major reason behind the accelerating growth of our cities - for people poor in economical, social, or cultural capital, cities offer spatial capital, for people rich in economical, social, or cultural capital, spatial capital enhances its value.

8. Notes

[1.] This aspect is discussed at depth in Ståhle et al. (2006).

[2.] In this regard cities can be said to be very similar to the internet, and both can maybe be seen as successful answers to the same fundamental need.

[3.] A full discussion on this is found in Ståhle et al. (2006).

[4.] For a full theoretical discussion on this shift in type of space, see Marcus (2000).

[5.] The concept of capacity is similar to the concept of capacity in computer science, the ability to carry differences.

[6.] It is important to stress that the population that is correlated here consist of no less than 1700 plots, encompassing a complete inner city district including some pure residential areas. Against that background, the correlation for the economical index is surprisingly high rather than low. Furthermore, by excluding 17 out of these 1700 items, the correlation rises to R^2=0.60, which tell us that the correlation is fundamentally strong. Further and more detailed investigations on these promising correlations are currently under hand.

[7]. See, for example, the critique put forth by Mike Davis (2006).

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