
SPATIAL CAPITAL AND HOW TO MEASURE IT:

an outline of an analytical theory of the social performativity of urban form

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Lars Marcus

School of Architecture, KTH

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Lars Marcus

*Spatial Analysis and Design (SAD), School of Architecture, KTH, SE-100 44, Stockholm, Sweden
lars.marcus@arc.kth.se*

Abstract

Space syntax is often presented as a configurational theory of architecture. This tends to hide more fundamental claim that it also is an analytical theory, that is, it is not an ideologically founded or normative theory, as so much of architectural theory, but a scientifically founded theory.

Proposed in this paper is an outline of exactly such an analytical theory in urbanism trying to incorporate into space syntax areas in urban morphology, which 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. In this paper the introduction of two other variables are suggested. One of these variables is density, a dominating variable in geographic analysis of urban space, and therefore very influential both when it comes to development of knowledge on urban space and practice of urban planning. The other variable is diversity, which, at least since Jane Jacob's writing of 'The death and life of great American cities', has been one of the most asked for qualities in cities, but one at the same time most difficult to plan.

In a study of an urban area in Stockholm most convincing correlations have been found: First, between integration and movement; second, between accessible building density and population; and third, between accessible plots and diversity indices such as amount of age groups and amount of lines of businesses. Whereas the first is not very surprising in the context of space syntax research, and the second interesting on the most part due to its original measuring technique, the third could be considered highly surprising and an original finding.

It is proposed that these modes of measurement of the variables movement, density and diversity could be combined into a more general analytical theory of urban form, directly stemming from space syntax analysis but in important respects widening its' scope into a more general analytical urban morphology. It is furthermore proposed that these measurements capture something that can be called spatial capital, whose use-value and exchange-value represent new and promising fields of research that also can engage adjacent scientific disciplines.

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 relation of parts in architecture rather than the parts themselves'. This tends to hide the more fundamental claim that it also is an *analytical* theory, that is, it is not 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 of theories in urbanism, where she, through a close reading of the tradition, finds them to be inherently normative, even though often disguised in scientific rhetoric (Choay 1997).

This aspect of theories in urbanism has also been discussed in depth by Bill Hillier (1996). By putting his critique of theories in urbanism in relation to the practice of urban planning and design, Hillier is able to formulate the urgency of the situation. 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.

In general terms, what it is proposed in this paper is an outline of exactly such an analytical theory in urbanism trying to incorporate into space syntax research areas in urban morphology, which 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*, that is, more specifically, how the accessibility between spaces in a spatial system varies according to changes in the configuration of urban form. In this paper the introduction of two other variables are suggested. First one is *density*, which is the dominating variable in geographic analysis of urban space, and therefore very influential both when it comes to the development of knowledge on urban space and when it comes to the practice of urban planning. The second is *diversity*, which, at least since Jane Jacob's writing of 'The death and life of great American cities', has been one of the most asked for qualities in cities, but one at the same time most difficult to plan (Jacobs 1961).

The intention is, furthermore, to develop 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. The most important reason for such an approach lies, maybe, 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 Jurgen Habermas, opens for the possibility to move between the perspectives of the *system* and the *life-world* (Habermas 1984) ⁱ.

The paper comprises two parts. In the first part, promising and convincing findings from a study of an urban area in Stockholm are presented, which show that through the application of developed techniques of space syntax analysis, one can find strong correlations between urban form and indices of *density* and *diversity* as well as *accessibility*. In the second part, it is discussed how this could form an outline of an analytical theory specifically aiming at the social performativity ⁱⁱ of urban form, directly stemming from space syntax analysis, but in important respects widening its' scope into a more general analytical urban morphology.

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, that is, how it supports, hinders and organises it, thus creating potentials for variations of urbanity. In the following it will be proposed and argued that urban form in doing so creates something that can be called *spatial capital* and that this, furthermore, is something possible to measure.

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What is needed as a point of departure for such an endeavor is an apposite and powerful definition of urbanity, by which we can discern the variables of urban form that will be particularly at work. The singular most common concept in such definitions is the earlier mentioned *density* measure, whether density of population, building mass or other things. Still, the concept of density is problematic. First, it conveys many technical problems of description, constantly debated in geography (E.g. O'Sullivan & 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, that is, urban form, why this seems to be a vital complementary variable to density. Furthermore, high density does not in itself necessarily capture urbanity, even when easily accessed. Many institutional areas for example, 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 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.

The short generic definition of urbanity proposed here is therefore: *urbanity, both socially and spatially, is primarily constituted by high accessibility and high diversity*. Put in more concrete terms; we live in cities so that we can get close to many different thingsⁱⁱⁱ. This is not saying that density is unimportant, and it will be returned to; it is proposing that the two concepts of accessibility and diversity are more poignant descriptions of urbanity. According to the theory of spatial capital then, *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*.

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

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doubt *spatial integration analysis* developed in *space syntax* research. Instrumental for such analysis is the invention of the *axial map*, which is a representation of urban space, as structured by urban form, from the point of view of an experiencing and acting human being, where each axial line in the map represents an urban space that is possible to visually overlook and physically access (Fig. 1). In short, such analyses measure the accessibility of each and every axial line from each and every other axial line in the map, which is called the *integration value* of each line. Such analyses have proven, in a long series of studies around the world, that there is a strong correlation between such integration values and pedestrian movement, that is, a most generic aspect of urban life (E.g. Hillier et. al. 1993). In the urban area in Stockholm studied for this paper for example, spatial integration (radius= n) correlated with observed pedestrian movement to 70% ($R^2= 0.70$) (Fig. 2).

From this fundament other studies have been able to find other correlations, where movement is the intermediary. It is for example not surprising to find that streets that are well integrated in the system and therefore collect a lot of movement also become prominent locations for retail. This has also been confirmed in many studies (E.g. Cutini, 2001). Taking one more step, it also seems likely that such streets in the long run may gather higher rents for the letting of floor-space. Also this has been confirmed (E.g. Desyllas, 2000).

Figure 1:

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



The accessibility measure developed in *space syntax* research has been further developed into *place syntax-analysis* (Stähle et. al. 2006). Integration analysis, as well as *space syntax* research in general, deals with the analysis of urban space *per se*, in that what is analysed is the accessibility to urban space in itself without any regard of 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 distance measurer to such contents, loaded as place-data on plots or address-points. It is thereby

not only possible to analyse the accessibility to other spaces, but the accessibility to specific contents in space as well. Place syntax analysis can therefore be said to deal with *specific spatial accessibility*, such as accessibility to different attractions, while integration analysis deals with *general spatial accessibility*, that is, accessibility to urban space in itself.

Figure 2:
Building density per plot



Returning to the issue of density, place syntax analysis presents a new and in many respects more life-like mode for representing geographical data. While traditional geographic descriptions most of the time deal with representations of such data as *density within geographical units*, such as city-districts, blocks or plots; place syntax

Figure 3:
Accessible building density per plot, correlating to accessible population density by 82% ($R^2=0.82$)

deals with representations of the *accessibility within a certain radius*, for example walking distance, to such data (Fig. 3). We can then produce maps showing 'accessibility to density' that bring back density to our discussion, but now seen through the lens of accessibility, so to speak.

In the urban area studied for this paper a correlation between accessible building density correlated with accessible population density by 82% ($R^2=0.82$), which confirms the rather obvious correlation between high building density and high population density. More importantly, it does so by using a measurement that, firstly, brings the ubiquitous density description into the descriptive methodology developed in space syntax research. Secondly, by doing that it changes the perspective from a traditional *system*-perspective, typical for conventional geographic descriptions, to the perspective of an experiencing subject in urban space, what can be called a *life world*-perspective^{iv}.

Spatial Diversity and How to Measure it

For the variable of diversity, where there are no analytical techniques as sophisticated as integration analysis developed, it is proposed that we learn from space syntax the minute attention to description, where for example the development of the axial map has proven so successful in capturing movement, asking ourselves what representation of urban space might best capture what we are now looking for. What is suggested is that we shift our 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 (Fig. 4). The reason for this is that the plot, through its disposer, represents the presence of an actor in urban space, and furthermore the precise location of the influence of that actor. Such actors normally develop particular strategies for their domains. An area with comparatively many plots then seem to have the potential to carry a higher amount of such actors and thereby a higher amount of strategies for action, where it seems likely that this in turn 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^v.

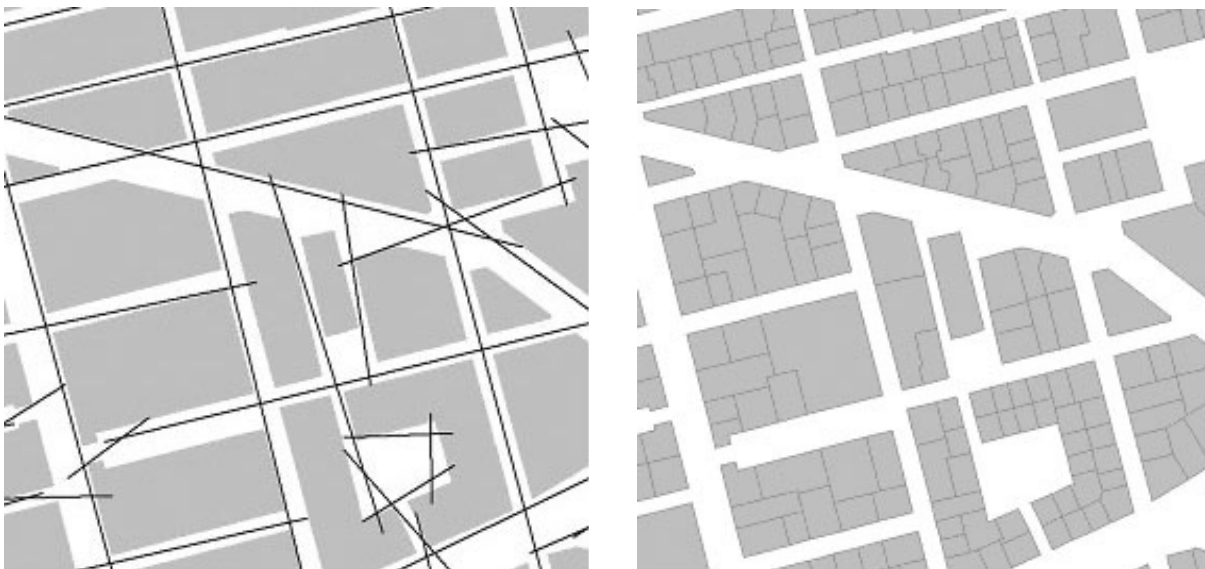
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Figure 4:

Experientially defined space, where each axial line represents a space that is visually and physically accessible

Figure 5:

Legally defined space, where each plot represents a domain of an actor defined by legal restrictions



Here again place syntax-analysis can be used, this time not to measure the accessibility to different contents in urban space, but the accessibility to specific types of space, such as, in this case, plots or address-points. For example, one can measure the accessibility to plots within a radius of for example three axial lines from each plot in an area, which, following the argument above, can show the distribution of potential diversity in that area. Still, the measure will be heavily influenced by the local accessibility, since the size of a radius of three axial lines varies a lot depending on the length of the lines. This effect can be normalized in either 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 for example 500 metres. Such measurements will in the following be referred to as a measurement of spatial capacity^{vi}.

Figure 6:

The distribution of spatial capacity, measured as accessible density of plots, correlating with accessible density of lines of businesses by 40% ($R^2=0,40$) and accessible density of age groups by 69 % ($R^2=0,69$)

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When this technique was tested in the same urban area as used earlier, what in effect was measured was the accessibility to plots from each and every plot within three axial lines, divided by the amount of accessible plot area within the same radius. These measures 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 ($R^2=0.69$)^{vii}, implying that the higher spatial capacity within a radius from a plot, the more lines of businesses and age groups within the same radius, that is, the higher diversity^{viii}.

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 mode of measuring density, all showing how urban form is most influential on generic aspects of urban life. From this it seems possible to conclude that with these measurements we can capture three fundamental variables of the social performativity of urban form.

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Figure 7:
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

Figure 8:
Spatial integration and spatial capacity overlaid in one map, showing the continuous variations of spatial capital

Spatial capital, measured by spatial integration and spatial capacity, then constitutes a procedure to measure variations in urbanity as a socio-spatial category that promise to 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 only can 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 determinant*.



In *urban analysis* it can be useful both as a straight description of the variations of spatial capital in an urban area, or as descriptions of spatial accessibility and diversity separately (Fig. 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, *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 (Tab. 1), where no internal values to the different categories should be implied. Once again returning to density, it is furthermore obvious how the table could be extended by the addition of a high- and low-density type for each category.

Table 1:

Four sub-categories of urbanity and suggestions for ideal cases, discerned through the theory of spatial capital

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

Discussion:

Spatial Capital as Exchange-Value and Use-Value

The concept of capital has in recent decades been intensely discussed and extended; following Pierre Bourdieu for example, we can also talk about *cultural capital* and *social capital* besides *economical capital* (Bourdieu 1986). The more precise meanings of the concept is often forgotten though, as discussed by the economist Hernando de Soto, at times even when it comes to economical capital. In his book, *The Mystery of Capital* (2000), there is a thorough discussion on 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, which is clearly more debatable^{ix}. His main example is land and how land becomes capital, the question being trickier than it first looks, according to De Soto. His answer is that, on the one hand, land, or rather, different land parcels, need to be geographically defined and their particular social and economical values described, measured and put into documents representing the land parcels, and, on the other hand, 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, what in this paper has been called *spatial capital* seems to be a contribution 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 variables in such values 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 presents 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, that is, the value urban form represents in a multitude of ways for every-day urban life, socially, culturally and environmentally. And even though not all needs requests high spatial capital, in general, that is exactly what cities have been answering up to; the generic need for people and societies to access differences as a means for social, cultural and economical development. In the end it is suggested that we here to see a major reason behind the perpetual movement into cities; for those without economical, social or cultural capital, the city has always offered spatial capital.

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- i. This aspect of space syntax in contrast to conventional descriptions of urban space in geography is discussed at depth in Marcus 2006.
 - ii. 'Performativity' is here suggested as a more apposite term for what otherwise often is covered with the term 'function', especially when it comes to social matters the latter term often feels unfit with its connotations to functionalism etc. Still the term 'performativity' is here considered part of the same tradition in architecture going back to Vitruvius' term 'utilitas' of which the term 'function' also is part.
 - iii. 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.
 - iv. A full discussion on this is found in Stähle et al 2006.
 - v. For a full theoretical discussion on this shift in type of space, as well as the plot or property as a representation of an urban actor, see Marcus, 2000.
 - vi. The concept of capacity is chosen in analogy with the concept of capacity in computer science, the ability to carry differences.
 - vii. 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.
 - viii. Earlier successful studies trying to capture the relation between the division of land into plots and diversity in its 'content', can be found in Marcus 1999 and Marcus 2001.
 - ix. See for example the critique put forth by Mike Davis, 2006.

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