

## #134

### THE CONFIGURATIVE KNOWLEDGE OF ARCHITECTURE:

From childhood to adulthood uncovered by the space syntax analyses

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**JOSEP MUNTAÑOLA**

Universitat Politècnica de Catalunya, Barcelona, Spain  
jose.muntanola@upc.edu

**MAGDA SAURA**

Universitat Politècnica de Catalunya, Barcelona, Spain  
magdalena.saura@upc.edu

**SERGI MÉNDEZ**

Universitat Politècnica de Catalunya, Barcelona, Spain  
smndz84@gmail.com

**JÚLIA BELTRAN**

Universitat Politècnica de Catalunya, Barcelona, Spain  
julsbel@gmail.com

**J. NATHAN MARTÍNEZ**

Universitat Politècnica de Catalunya, Barcelona, Spain

**S. C. MOLARINHO MARQUES**

Universitat Politècnica de Catalunya, Barcelona, Spain

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#### ABSTRACT

We have applied space syntax analyses in order to uncover the configurative architectural knowledge into two different, however complementary, scenarios. One scenario, the children constructions of city models with wooden blocks, from 5 to 9 years of age, and in teams of six children, three boys and three girls. The studies show a lot of differences in relation to school, family background and social qualities of places where children live. However, the main differences come from the dialogical qualities of the social interactions among all these factors, and we think that the space syntax analyses are able of measuring these dialogical qualities.

The second scenario is urban history scenario in medieval villages in Catalonia and we have analysed thousands of them, and they are deposited in the Catalan National Archive of Catalonia. We use the space syntax analyses to uncover the knowledge of the generation of the urban structures, even if the meaning of them in history has been lost. The forms by themselves can show a lot of information invisible for the users of today.

In this paper we will focus our attention into the first of these scenarios: The one related with architectural cognition and with architectural education in childhood. As Bill Hillier has stated: The configurative knowledge of architecture and planning is embedded into building and urban forms in a "generative way", so we will analyse how this generative and configurative knowledge develops in children.

## KEYWORDS

Architectural Education, Environmental Cognition, Configurative Spatial Cognition

## 1. INTRODUCTION

The configurative knowledge of architecture is studied through space syntax. Bill Hillier defined in his seminal book: *Space is the Machine* (Hillier B. 1996) the specific configurative qualities of architecture and the ways these qualities can be used in the architectural and urban design theories and practices.

Moreover, Professor Bill Hillier in his text about “The Art of Place and the Science of Space” (Hillier B. 2005) insisted upon a spatial quality of space itself that has eluded clear analysis until now. On the one hand, he insisted upon the consideration of urban grids as historical records of a city creative process driven by human activity. Second, space can be used in a generative manner or in a conservative one, to create or to support co-presence throughout movement, to various degrees. In public places often we maximize local and global integration to maximize movement and co-presence, but in residential spaces, according to culture, we restrict and modulate movement and co-presence. So the relation between space and activity is not direct but “generic”. The old patterns and new patterns of activities fit well in the same physical forms because space reflects the generic relationships between activities that need co-presence and activities that do not need them and, in this way, it not reflects the relationships among activities in themselves. So, the configuration of space plays an intermediate role between physical forms and human activities. Then, the self-organization of cities is a positive power for the new innovative designs, instead to be a force to be defeat and, “consequently”, design can be a science and an art simultaneously.

Even though the use of space syntax expands around the world very fast, the understanding of their theoretical and practical powers are still unknown. The late work by Paul Ricoeur (Ricoeur P. 2003) reaffirmed this configurative dimension of the built environments that, according to him, configures the human space in a similar way that writers do in literary texts. This link between the verbal written text and architectural design was brilliantly described by Professor Michael Holquist in a lecture in Barcelona in 2015 (Holquist M. 2015).

Both, in architectural design and in literary works, the basic textual configurations are made by two basic structural frames. One between View Points or Displacements in the space-time related to our cosmic environment in general, and another are the Voices, or subjects recognized and presented in the text. Paul Ricoeur takes these two basic structures from the known dialogical theories by Mikhail Bakhtin (Bakhtin, M. 1990). A clear difference between written texts and architectural design is related to the subjects or voices. In literature we have the author, the subjects, that is, the implicit authors included in the argument or script, and the readers confronted with the configurative text. In architecture, we have authors and users or, according to Bakhtin: The Potential Users, the virtual potential society, defined by Hillier. Since users are the readers of the configurative architectural text according to Ricoeur, in architecture and in the city life, the users are both, protagonists of the text and readers of the text, in some way similar to a verbal dialogue, where we are at the same time speakers and listeners; this is the basic origin of human communication. As late professor Pierre Kaufmann indicated, architecture organizes a “vis a vis” cultural communication, and it is a code for these “vis a vis” educative encounters too. That is, architecture organizes the co-presence and the best movements as defined by Hillier (Kaufmann P. 1995).

We will show some examples of these “vis a vis” encounters extracted from architectural children education. In this paper, we will just intend to confirm the chronotopic dimensions of the configurative knowledge of architecture and planning, according to their dialogical socio-physical dimensions.

## 2. THE COGNITIVE DEVELOPMENT OF THE CONFIGURATIVE KNOWLEDGE OF ARCHITECTURE IN CHILDHOOD

During forty years we have studied the way children built models of cities with dolls and wooden blocks (Muntañola J. 1973). We present here just some examples of city models built by three boys and three girls altogether, the process of socio-physical construction of the city models is analysed by different computer tools such as space syntax analysis and the Elan software. What we want to insist here is that the relationships between the physical forms and the functions and co-presences designed on them by children, follows the configurative knowledge announced. So, the configurative knowledge of architecture is not arbitrarily generated or produced by chance, it follows the cultural and educative social rules transmitted by the school and the families to the children, with an special role of some activities such as theater, group musical events, social parties events etc. The “virtual potential society”, defined by Hillier, is made of cultural shared values and costumes, or of the absence of them, and each city built process is a social co-presence construction as much as a physical material construction. (Muntañola J. et al, 2016. Muntañola J. et al, 2012)

The methodology has been carried out in different countries (Muntañola, 2007). We present here two examples of children’s conceptions of places to live in (figures 2 and 3) recently recorded from two different schools in Barcelona. The whole research analyzed six schools and in each school three different groups of children from 6 to 9 years of age were asked to participate. Each group gathers from 4 to 6 children, half boys, half girls. They are asked to build a city with a wooden block game without any other order. The VIDEOS last approximately thirty minutes, and include preparation, construction and verbal explanation of the model of city.

The findings were analyzed with a qualitative analytical tool for audiovisual data, ELANÒ, a software developed by the Max Planck Institute for Psycholinguistics, for gesture and small-scale interactions. Systematic audiovisual analysis needs a strong model or codification to start with, in order not to get lost with the data. Our units of analysis were labelled Activity Recurrent Episodes (or ARE) [activity occurrences that are judged to be significant happening in the learning context and that are delimited by a change in theme (Barab, Hay & Yamagata-Lynch (2001): p. 66). Through the classification of (or ARE), we traced the directive interactions between the children when constructing the city. We looked at the type of interaction (unisex or mixed), the modalities of communication involved (speech, touch, gesture, gaze, movement), and the moments for joint action, when the children moved blocks and planned the ideal city collaboratively. In figure 1 we see two snapshots of two sampled schools, both private schools located in Barcelona. The children came from Upper-Middle Class urban families, so they had a similar social background, We coded and analyzed in depth two representative schools of the overall sample (6 schools in Barcelona) dividing them into 2 different categories, A and B, depending on their resulting cities, monological or dialogical (see figures 2 and 3).

Our descriptive analysis of the interaction differences between the two types of schools is summarized in tables 1 and 2.

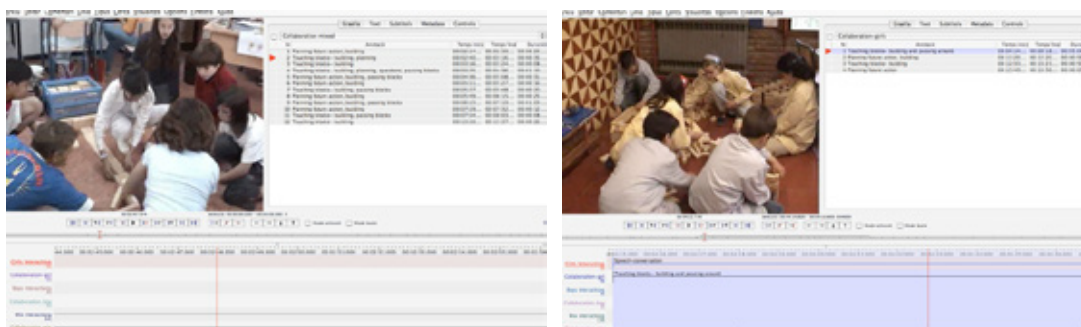


Figure 1 - A snapshot from the ELANÒ software for qualitative analysis

Interactive Activity	School A		School B	
	Duration (in seconds)	% Total Duration	Duration (in seconds)	% Total Duration
Collab_girls	789.6	43.5	102.7	17.4
Collab_boys	253.2	13.9	76.1	12.9
Collab_mix	772.9	42.6	411.3	69.7
Total Duration	1815.7	100	590.1	100

Table 1 - Distribution of children interactions by gender and school.

Comparing schools A and B, we see how the main type of interaction by gender varies: in the first schools, interaction takes place mainly among girls, with a 43,5% of all interactions, closely followed by girl-boy collaboration in a 42,6%, and a residual exclusive boys collaboration, 14%. In the second schools, the main collaboration is mixed, with almost a 70%, with a low 17% girls collaboration second, and a similar residual masculine collaboration as in school A, around 13%. From here we see how the interactions in schools like type B, the boy-girl interaction dominated. Taking into account that all groups were composed by 3 girls and 3 boys, it is apparent that school B types displayed closer transgender interactions, as a group, which also shows in figure 5. The children from the type B school pose as a group next to their city, while in school A each kid stands next to his or her individual construction. Nevertheless, in both cases some common

Collaboration Modalities (in %)	School A			School B		
	Girls_Collab	Boys_Collab	Mixed_Collab	Girls_Collab	Boys_Collab	Mixed_Collab
Planning Action	22.6	0.0	26.9	26.6	0.0	35.4
Building	55.6	0.0	27.0	73.6	100.0	44.6
Passing Blocks	21.1	94.7	33.7	0.0	0.0	20.0
Question	0.7	0.0	5.6	0.0	0.0	0.0
Comments	0.0	5.3	6.8	0.0	0.0	0.0
Total Duration	100.0	100.0	100.0	100.0	100.0	100.0

Table 2 - Distribution of collaboration modalities by type, gender and school.

identification was expressed since the participants created a name for the city that integrated all the group components.

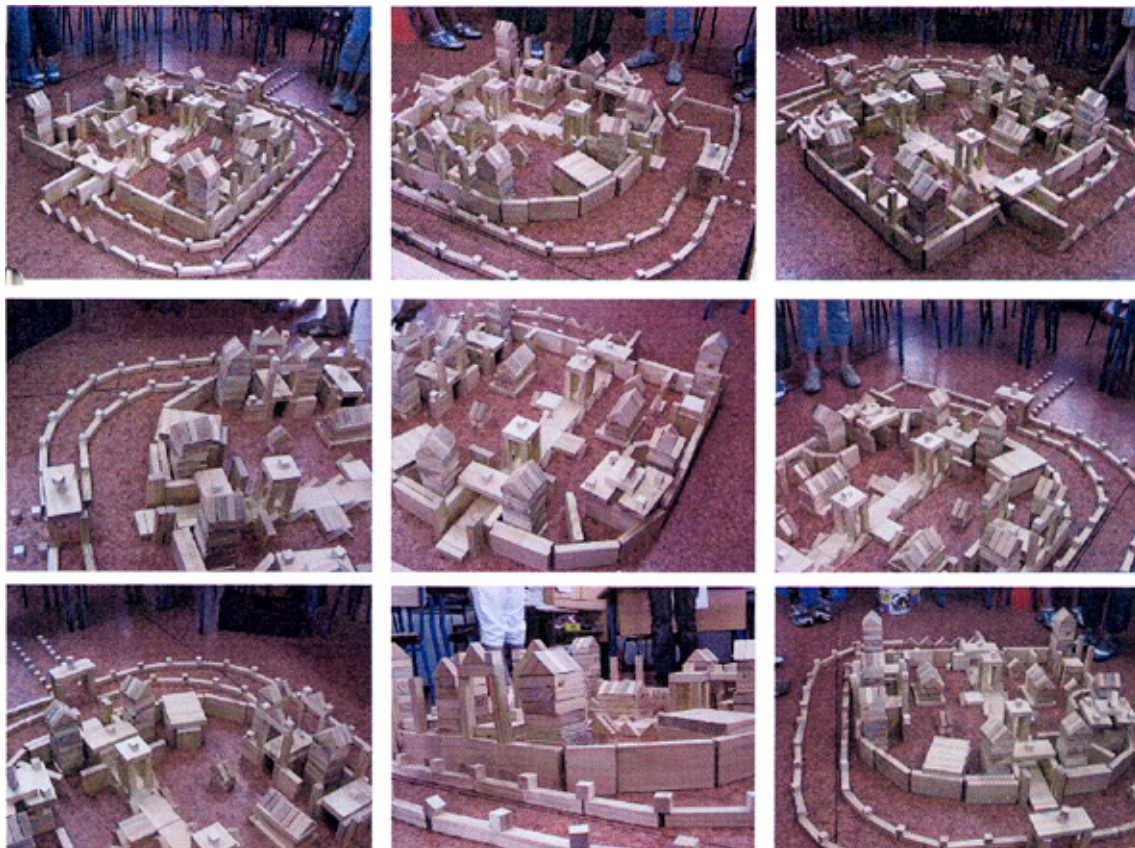
If we look into the modalities of collaboration by gender, in table 2, we see how the distribution of modalities also varies by type of school. Both groups of girls' interactions have building as the main interaction. However, while in schools B it represents a 76,6% of the total girls' interactions, in schools A this percentage goes down to 55,6%, while 21,6% goes to passing around the blocks necessary for individual construction, which represents a lower level of coordinated actions. The second most common interaction is planning further actions, which implies common negotiation of what ought to be built, how, and where. The percentages are 22'6% of all girls' interactions for schools A, and 26% for schools B, so higher for the second type. So in all schools the girls' interactions show a high level of joint action at the imagination level (coordinating intentions to decide what will be built next), with a lower involvement in



actual building and higher involvement in the preliminary and secondary coordinated actions of passing around the building blocks in school A.

The large difference comes in the boys collaboration group, which is the less collaborative groups, as shown in table 1. In school A, 95% of the interactions amounts to the peripheral activity of distributing blocks, while 5% amounts to comments related to complaints, critical comments and emotional interjections about the others' behavior. In school B, 100% of the boys' interactions amounts to building, which indicates a higher level of interaction than the other school. Interestingly, in none of the schools there is an exclusive masculine interaction directed to planning.

Finally, in the third group of interactions, which are those that cross gender boundaries and that we consider as indicators of higher interaction levels of and distribution of cognition, we see important differences. In school A the main type of interaction is passing blocks, that we classified as lower-level and less central type of collaboration, with 33,7% of total girl-boy interactions. In contrast, in school B the main interaction is building, with a clear 44,6%. So not only the collaboration boy-girl is higher in school B than in school A (69,7% for B and 42,6% for A), but also in school B this collaboration seems to involve the central process, the building. Accordingly, the planning activity, which is also key to the building process as it involves the joint formulation of desires and decision-making, is more represented in school B (35,4%) than in school A (26,9%). Finally, while in school B comments and questions are not recorded as a single type of interaction (they do occur simultaneously to other types, such as building or planning), in school B we find an approximate 12% of verbal interactions that consist in questions about the identity or function of a construction built by an individual child, which can evolve in a suggestion of change of function or a negotiation of its physical location.



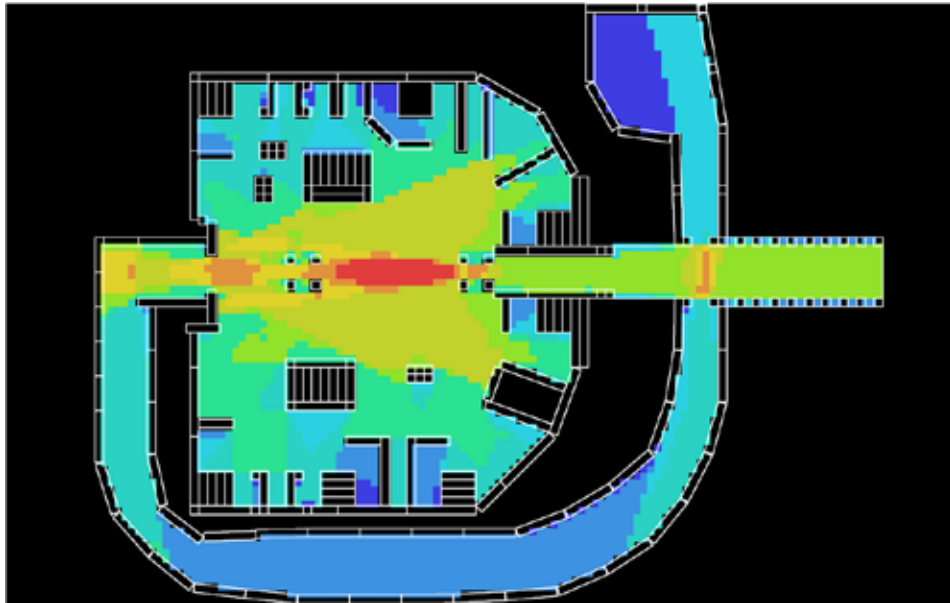


Figure 2 - Model of a dialogical city: physical, social and Space Syntax analysis

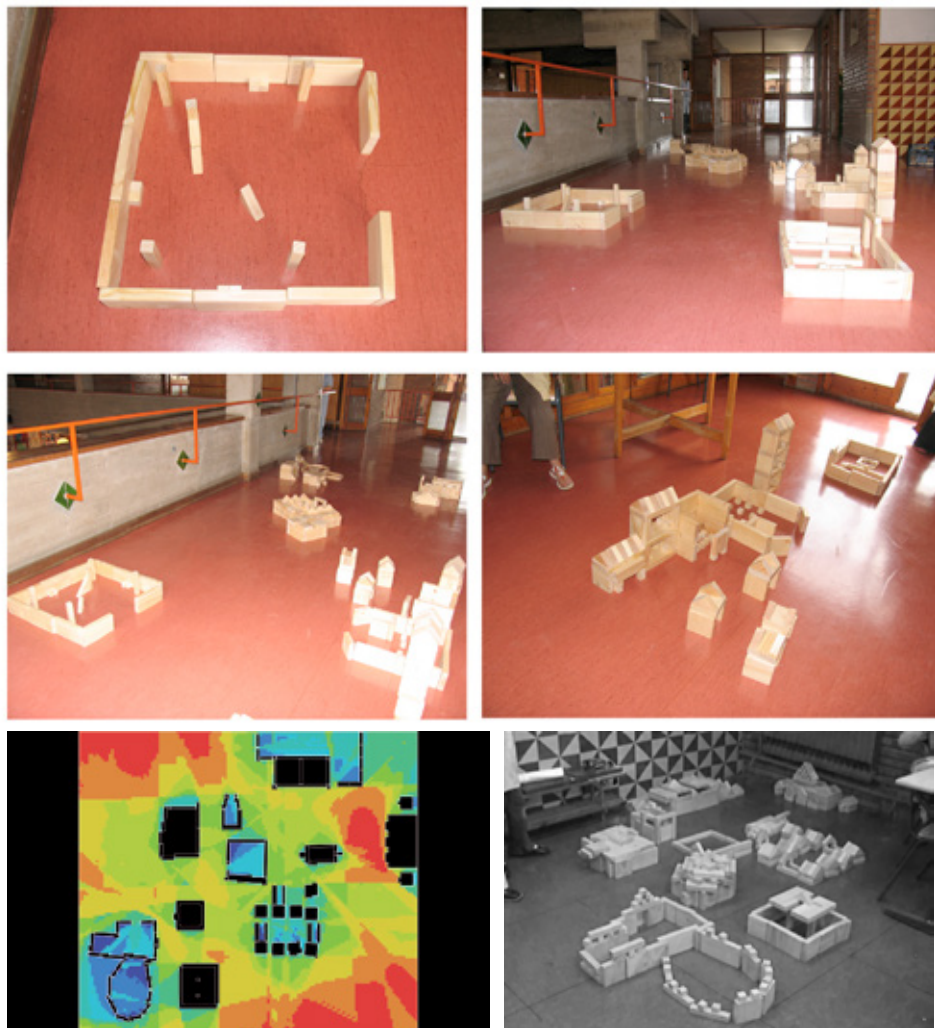


Figure 3 - Model of monological city: physical, social and Space Syntax analysis

Figures 2 and 3 show different types of cities built by groups of children from two different schools. The differences in types of cities come from the type of interaction that each school establishes in the social life of the school.

In the monological cities (Figure 3), each child built his or her own city, disregarding the cities built by others. There are not public places and space syntax analyses shows that the red spaces are out of the cities in empty places. In these schools children do not have theater, social celebrations or social events as essential components of their curriculums. Their parents are not related to the school life in a relevant way, and often they do not share the same spatial values and meanings. The space syntax analyses in Figure 3 show the same lack of social interaction among children architects of the monological city, since red colors means the maximum of interaction and blue colors no interaction.

In the dialogical schools (Figure 2), cities represent the co-presence and the movements in the human space and time "shared" by children themselves. In these schools, theatre, music and social events and celebrations are essential in the curriculum and the participation of parents is crucial. Family environments and school environments share spatial values and social meanings. Then space syntax analysis represent the configurative interaction inside the physical form with the maximum red color just in the center of the city.

So the total lack of co-presence in the monological cities produce necessarily fragmented cities without public spaces and with poor social encounters. On the contrary, in the dialogical cities the co-presence and the movements that they allow are allowed by the configurative knowledge embedded on the city models. The geometry of the models is also an indication of the chronotopic specificities of each city and this can be analysed at a micro genetic level (figure 4).



Figure 4A



Figure 4B

Figure 4b is a group of children that build a monological city. They do not look to each other, each child is alone and close to the building he has built. Figure 4a shows a dialogical city, and children gather as close as the city gathers itself.

In conclusion, these findings points towards an interesting correspondence between the type of social interaction among children and the resulting city that is effectively constructed. Table 3 and 4 explain this correspondence.

In spite of the concrete quality of this research focused on class activity in schools, the outputs explained in Table 4 go beyond any pedagogical consideration. The correlation between social intersubjective relationships and physical spatial and temporal object forms is extremely powerful, investing architectural design and planning with strong socio-physical significance and an ethical dimension.



	Monological City "A"	Monological City "B"
Number of Different Elements	10	60
Parent Participation in School	Does not exist	High participation
Organized Visits and Celebrations	Does not exist	Many
Theatre	Does not exist	Very important

Table 3 - Cultural dialogical differences in children's conceptions of cities in relation to the curriculums of the schools

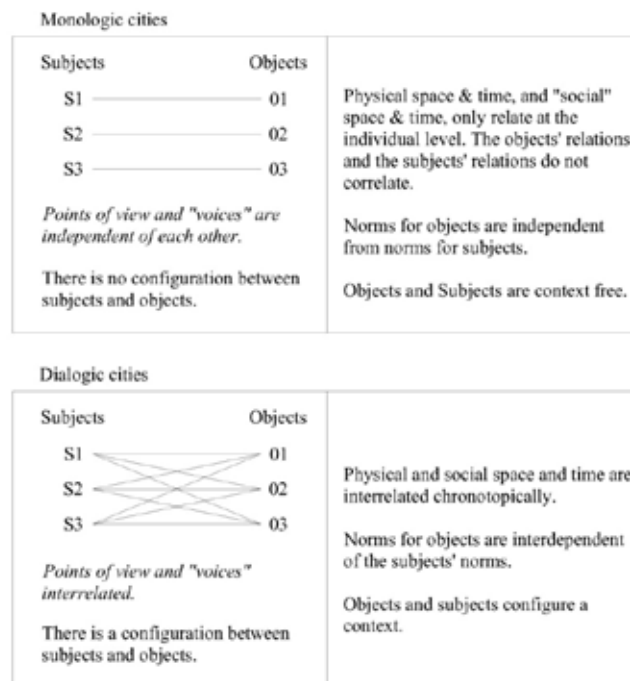


Table 4 - Socio-physical dialogical structures between subjects and objects in monological or dialogical cities

In this sense, architecture is made of socio-physical coexistence. One of the outputs of this research has been the key indicators included by UNICEF in 2009 in the environmental evaluation of child friendly cities (Aranda and Muntañola 2009). Presented in table 5, they are a good example of these specific qualities of architectural research too. Extremely different dimensions of human life are necessarily tied together in the children's use of real cities. The life of children is affected by the combination of all these indicators. We have uncovered in this way a nice example of the interrelation announced by Aristotle between education, urban policies and architecture of our cities.

Further studies are uncovering new methods and analyses. As the figure 5 shows, we can measure micro genetically the built process with digital tools and ethno methodological surveys. These diagrams analyses the city model constructed by a set of three boys and three girls seven-eight years old. In these diagrams, first of all, the interaction between objects and subjects is measured according the kind of social interaction: If it is between girls, between boys or mixed, if is completed or not and the number of children in interaction, and so on. The second dimension shows the different meanings of the forms in relation their social significances, that is, the names of real places and the attachment of children to them. Finally there is a cognitive analysis of the city model in relation to the classical cognitive structure defined by Kevin Lynch, that is, the nodes, the itineraries and the open public urban places, looking at a formal abstract analysis of the physical form. However we are still working on that direction.



Indicator	Definition	Limits & Actions
I-1 Noise levels	Noise as harmful for children.	Noise Measure Limitation: if it impedes human conversation (40 Db)
I-2 Pollution	Pollution of air, water, earth and materials within a populated area.	Normal environmental controls, e.g. prohibition of asbestos, arsenic, polluted water, etc.
I-3 Electromagnetic Radiation	Harmfull installation of aerials, high-voltage lines, etc.	Min. Distances: High voltage: Aerials: 200m.
I-4 Safe playgrounds	Playgrounds near residential areas.	Max. Distances sq.m. per dwelling Max. Size
I-5 Safe routes between main community areas	The importance of daily routes for the community.	Max. 15mins. on foot or 2 Km, or well-planned school transportation.
I-6 The school as a dynamic center	Schools are open to the community as a social agents.	List of major activities at, or around schools.
I-7 Public facilities for all age groups adapted and supervides for children's use	Promoting the use of facilities by different age groups.	Public facilities within walking distance.
I-8 Child-friendly public services	Adaptation of services for all age groups.	Facilities for the youngest age groups, adequate supervision, information/communication.
I-9 Adequate privacy at home and in community	To ensure privacy as child grows, in accordance with each age needs.	From 7 y. of a: privacy at home; from 12 y. of a: privacy in quiet spaces and in public areas.
I-10 Juxtaposition of built areas and the countryside	To ensure optimum spacing between built-up areas and countryside.	Min. distances to wooded areas or non-asphalted areas. Normal Easy? access to countryside.

Table 5 - Ten indicators of urban quality for the assessment of child friendly cities (UNICEF 2010).

## CDV-ES-B

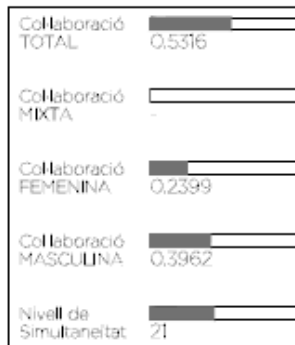
### ENTITATS



### PARTICIPANTS



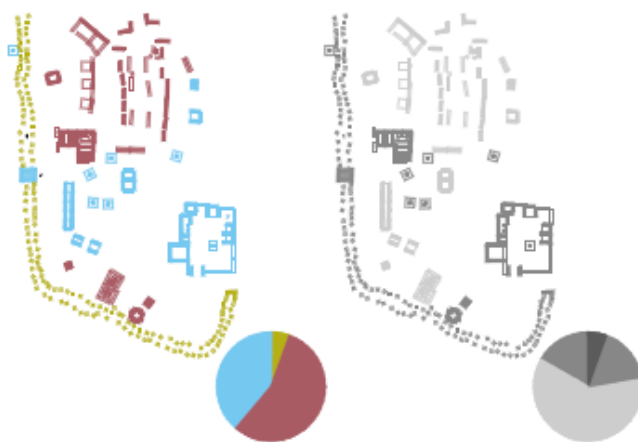
### COL-LABORACIÓ



### INTERACCIÓ



### REPRESENTACIÓ: GÈNERE I NOMBRE



### ENTITATS: GÈNERE I NOMBRE



Figure 5 - Modelling the design process of a children ideal city

#### 4. CONCLUSIONS: THE FUTURE OF ARCHITECTURE AND OF THE SOCIAL SPATIAL COGNITION

We arrive then to the conclusion, in relation with the children configurative spatial cognition that, in real city life, we link creative and conservative chronotopes by mixing scientific, artistic and political human dimensions, and that the space syntax analyses, and other digital tools, can help our understanding of the feedback between physical forms and human activities in a generative way, looking at an equilibrium between real and virtual dimensions of the human experiences.

So, new architectural urban design processes can be generated by a feed-back between virtual computer abstractions and representations and empirical analysis of historical urban forms and of the social uses of these forms. The theoretical implications of this dialogical feed-back, as Bill Hillier pointed out, are still ill-defined. (Figure 6)

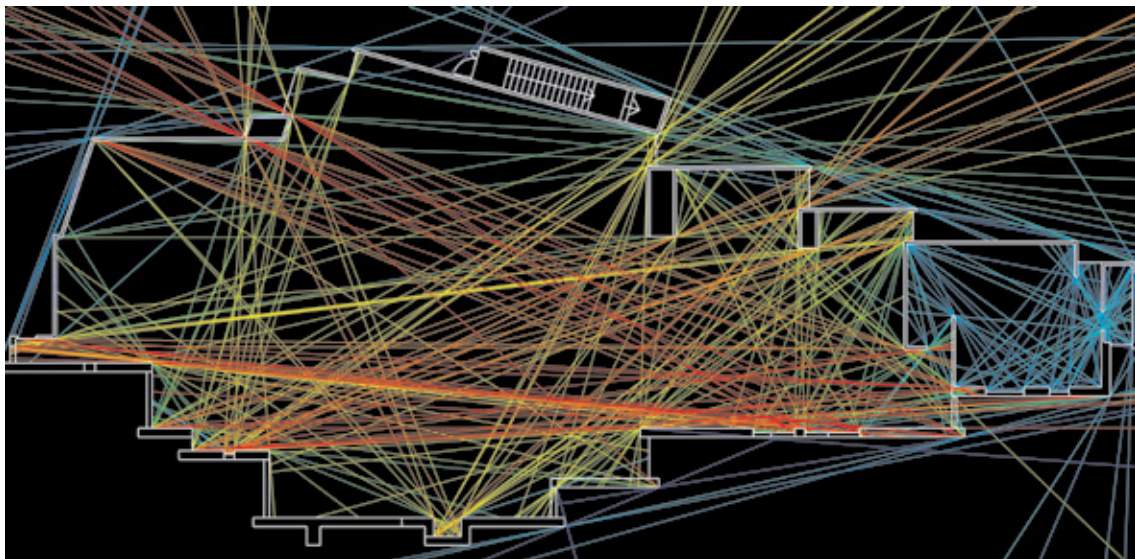


Figure 6 - Space Syntax analyses of the church of Männistö by Juha Leiviskä, in Kuopio, Finland (1986-1992). The red horizontal line coincides with a step in between the altar and people looking at the ceremony. A nice feedback between experiential and virtual realities

When Bill Hillier analysed the social malaise caused by architecture, he insisted upon that the very idea of any architectural determinism that buildings have a systematic effect on human behavior, lead necessarily to the nightmare of the mind body confusion again. Also the proposition that it does not matter at all how environments are designed, because they are behaviorally neutral, is still less credible than the precedent one.

Fortunately a third possibility exists. We need to refine the analysis of both, the architectural physical forms and the social variables related to them. This can be done by the use of configurative cognitive modelling as a bridge between the physical and the social dimensions of the city, either at a low local level or at a high global level. Then we arrive at the uncovering of the patterns of natural co-presence, brought about through the influence of spatial design on movements related to other aspects of the use of the spaces, such as security, urban laws and so on.

If we are not mislead this same conclusion is the one that Professor Jonas Langer from Berkeley (Langer J. 2016) is making in his web today:

*"My research on the evolution and development of cognition in human and non-human primates is currently expanded from two to three-pronged. The first is the origins and development of physical (e.g. causal) logical (e.g. classification) arithmetic (e.g. numerical) cognition from early infancy on. The second is the comparative development of these cognitions in human, chimpanzees and monkeys. The third, which is totally new and just beginning, comprises computer simulation*

*experiments to investigate and model aspects of the evolution, origins and development of cognition that cannot be studied in real time with real subjects”.*

Then, the interfaces between different levels of co-presence between adults, children residents and strangers, can be measured by space syntax modelling both, on the one hand, children architecture and education and, in the other hand, city planning and city modelling. As professor Langer points out, this is a new research development and it is just beginning.

Finally, we should noticed, that we are talking about three “pronged” cognitive developments. In this view, architectural and planning design bridges infancy education and social and historical developmental cognition, throughout a three pronged simultaneous cognitive evolution. However we are just analyzing the tip of the iceberg.



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