

# NEW THEORIES OF URBAN FORMS AND THEIR IMPACT UPON ARCHITECTURAL EDUCATION, URBAN DESIGN AND SOCIAL BEHAVIOR ON CITIES

Josep Muntañola<sup>1</sup>,

<sup>1</sup>Departamento de Projectes Arquitectonics. Universitat Politècnica de Catalunya, newsletter.pa@upc.edu

Magda Saura Carulla<sup>2</sup>,

<sup>2</sup>Departamento de Projectes Arquitectonics. Universitat Politècnica de Catalunya, newsletter.pa@upc.edu

Sara Molarinho<sup>3</sup>,

<sup>3</sup>Departamento de Projectes Arquitectonics. Universitat Politècnica de Catalunya, newsletter.pa@upc.edu

Josue Nathan<sup>4</sup>,

<sup>4</sup>Departamento de Projectes Arquitectonics. Universitat Politècnica de Catalunya, newsletter.pa@upc.edu

Yuraima Martín<sup>5</sup>,

<sup>5</sup>Departamento de Projectes Arquitectonics. Universitat Politècnica de Catalunya, newsletter.pa@upc.edu

Fernando Espósito<sup>6</sup>

<sup>6</sup>Departamento de Projectes Arquitectonics. Universitat Politècnica de Catalunya, newsletter.pa@upc.edu

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## **Abstract/Resumen:**

Our research group has been working in the last twenty years on the theoretical frameworks involved in the architectural and urban design practices of research on architectural and urban design, and we have produce el lot of publications in different international academic books and magazines (.....) In this article we will start with some considerations about the situation of the morphological classical schools of thoughts until 2000<sup>th</sup>(Anne Vernez Moudon, 1997).

After, we will analyze the theoretical impact of the new digital tools, mainly space syntax, in order to uncover the theoretical innovations by David Kirsh ,Rainer E Zimmermann, David Seamon ,Karl Friston, Jan Gehl, Jonas Langer, Ole Moystad and others. The theoretical confrontation between space syntax and social phenomenology by Bill Hillier himself since 2005 on, will be the best guide for our argumentation and also the work by David Kirsh on social cognition.

We will focalize our attention into the significance of all these innovations in relation the way architects, urban planners and designers think in order to improve the quality of design practices in a lot of new interdisciplinary ways.

Finally, and in order to make more explicit the practical dimension of those theories, we will present some research examples pointing out to clarify the cognitive qualities of architects, urban planners and designers in relation to the understanding of the morphologies of the cities.

## **INTRODUCTION AND OBJECTIVES.**

The aim of this text is to clarify the way designers think in architecture and urban planning practices. We will argue that the morphological theories in the last twenty years experimented big transformations in relation to the classical, city form paradigms, either in Italy, England, USA or anywhere etc. as was very well described in previous analyses. (A. Vernez-Moudon 1997) They uncover the cognitive limitations of those paradigms in relation to design practices. At that time, the objectives of the morphological theories were, more than to analyse how architects and designers think, they intended to understand how a city works as a configurative whole. The different morphological schools were pointing out specific descriptive forms: types, property frames or historical rules of growth, however the relationships of these morphological schools with how designers think was not a priority objective, since the poor scientific quality of that knowledge was accepted. This has changed completely with the new digital tools and the new worldwide systematic theories in several key disciplinary scientific developments. Among all these tools and theories, the space syntax paradigm by Bill Hillier deserves a special attention, not only for the digital power of it, but also for the theoretical challenge uncovered by Bill Hillier itself. There is another important point on this to take into account. Either Christopher Alexander "patterns" or other design methods of the same period, shared the same position in relation of how designers think that we have pointed out above: that the cognitive deep study of how designers think was irrelevant since they ignore the new design systems and the new mathematical concepts. From the beginning, the position of Hillier was very different, space syntax was not a way to design, but a way to help designers to do a better work. As we will see this difference changes the whole interdisciplinary environmental design priorities.

Then, in the Space Syntax International Conference in Lisbon, in 2017, where Bill Hillier did not attend because of health problems, a general sensation of confusion on these facts was extremely clear, and a need for a deep reevaluation of the way space syntax should be implemented in architectural design was uncovered.

Bill Hillier himself was the first to advise that space syntax systems are not a direct tool for architectural and design practices, as he argued extensively in his important book "Space is the Machine" (1996), but researchers, either do not understand the complex ideas in this book, or wanted to challenge the difficulties without clear new alternative concepts.

We will try to clarify the future role of the new digital tools in the architectural and urban design practices and theories, as a first step, in a long interdisciplinary way to study the relations between artificial intelligence and human history, that has started just by now to be undertaken. Besides, perhaps the bio-revolution produced by the coronavirus will accelerate this process. Just take the premonitory text by professor Jonas Langer in his web as a cognitive clarification of the matter:

"My research on the evolution and development of cognition in human and nonhuman primates is currently expanding from two- to three-pronged. The first is on the origins and development of physical (e.g., causal), logical (e.g., classificatory), arithmetic (e.g., numerical) cognition in humans from early infancy on. The second is on the comparative development of these cognitions in humans, chimpanzees, and monkeys. The third, which is entirely 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." (Jonas Langer, 2019)

This paradigm of a cognitive tree with three branches as a representation of the human mind is far from to be a innocent proposal. It implies the reorganization of our knowledge based upon the last ideas by the worldwide known German philosopher E.Kant about the "gradient" in between the physical and the mental dimensions of the humanity. These are good news for the designers dedicated to this third cognitive branch, however they bear bad news too. In fact, this new branch cannot be detached without killing the tree and the human being with it. And the two older branches are the ontogenetic cognitive development from childhood to adulthood, that is education, (.....) and the specific cognitive powers of our species in relation to other primate species, that is, the human cultures developments. Both have been analysed by our research group.

## **THE NEW MORPHOLOGICAL DIGITAL THEORIES IN CITY PLANNING.**

Let's start with the key ideas by Bill Hillier written some years before his death in 2019. More specifically we selected some texts from two articles: B.Hillier, 2014 and B.Hillier, 2005. Both have been analyzed by a

lot of experts, and among them, we want to point out the significance of the recent comments by David Seamon and by David Kirsh .

“...the main role of a city is to support specific activities in social co-presence thanks to specific places,” (B. Hillier, 2014)

“space syntax is already a synthesis between the socio-logics and the physico-logics of urban spaces... however, a better bridge should be conceived...for instance, in the general theory of relativity are not the ‘masses’ that causes gravity but the distortion of space.”(B. Hillier, 2005)

These texts situated the cognitive complexities of how designers think in the right way, however they do not present clear theoretical issues for these complexities. The first text in 2014 coincides with what we have always define as the “poetic power” of design practices. Eventhough Hillier is never using this terminology, a specific activity in a specific co-presential cultural social manner existing in a specific place that support this situation is, in our opinion, a poetic social cognitive definition that we have analyze in a lot of our precedent publications.(.....) However, it is a lot of other things too, and this is what should be clarified by now.

The second text quoted above, asks for some kind of “concordance” between space syntax as a “physico-logical” system, on the one hand, and the phenomenological and social analyses by David Seamon and others, on the other hand. However, Bill Hillier insisted on the need for a scientific dimension of this “concordance” or dialogue, pointing out to a mathematical explanation of it, such as an structural similarity in mathematical terms between the physico-logical analysis and the behavior of “masses” in the general theory of cosmic relativity by Einstein.

According with these two texts and after the huge effort made by David Seamon and others to find this concordance, the whole morphological future systems and digital tools are open to new questions in relation to the meaning of architectural design and urban planning practices.

This is not an easy cognitive exploration to undertake. Works developed inside natural sciences (Mc Namara-Mc Kinney 1991) philosophy (Rainer E.Zimmermann, 2018.) semiotics (Moystard Ole,2018) and our own work in architectural cognitive theories have dedicated a lot of years of research to this exploration, because it has a very complex and interdisciplinary structure. We have selected a recent article by David Kish as a good point of theoretical departure towards a conceptual clarification of it. (David Kirsh 2019).

David Kirsh knows very well, on one hand, the computer thinking, including spatial systems, and on the other hand the distributive thinking, since he was one of the founders of the definition of this kind of social knowledge with E. Hutchins (Kirsh David 2000). But the new important cognitive step in his last article is to admit that, neither one or the other of these two kinds of knowledge are able to do the cognitive “concordance” that designers do and that ,we think, it is the one Bill Hillier was looking for. His hypothesizes that there is a third kind of knowledge, is defined by him as a result of “a reflexive social interaction”, that he describes in the following way:

“only an ecological and social interaction is also reflexive. [...] an interface for an architect is a niche that includes the very people that interact with it “(David Kirsh, 2019)

It is easy to uncover the clear links between this conclusion of David Kirsh, and the ideas of Bill Hillier, David Seamon, Rainer E Zimmermann, Mc Namara-Mc Kinney and, of course, Jonas Langer works (2019,2003). Also, our recent PHd dissertations, some of them published in a book form, have analysed the place-making capability that architects and designers have or should have, according to David Kirsh, as we will describe in the next chapter.(.....)

In order to understand these links, we need to summarize the theoretical analogies involved. Either Bill Hillier, Rainer E.Zimmermann, Mc Namara, and Mc Kinney, K. Friston or Jonas Langer ,all have a lot of common roots in the work by Jean Piaget about the genetic epistemology, or genetic cognitive development in children. This root relates structuralism with the cognitive social studies and with the neurological studies of the human mind. It has always been a central scientific research theory in architecture and planning, in spite that some architects strongly reject it now. They do that for a lot of different reasons, (.....) such as the dangers that a research on the way architects think can implies because this knowledge should be analysed only by architects. Notice that, these reasons, at this point ,are similar to the ones claimed by Christopher Alexander, but from totally contrary positions. Alexander

undervalue these knowledges, architects overvalue them, as some kind of independent scientific domain that can only be understood by the architects themselves.

With the impact of the computer analyses in environmental design, research theories are changing a lot too.

As the works by Zimmermann and Friston are making more and more clear, this gap between the inside and the outside of the human bodies it is not an obstacle for the scientific study of it. With the aid of the computer, on the contrary, if we understand the position of Jean Piaget on biogenetic theories on adaptation and on the phenotype correctly, organisms "experiment behaviors" when environments change in order to survive, and this experimentation exists from the viruses until the more develop human cultures and systems, by going back and forth along the chain of life.

In summary, this third cognitive dimension, is the one announced also by Jonas Langer as a new dimension that needs a computer to be uncovered. And that, he insists, it is the first time in the humanity that this can be done. We think that it seems to have in the designer mind's some kind of pre-historical scientific significance, by making the link between artificial intelligence and the real human cultural experiences. And it is also the cognitive link between the digital morphological systems and the real phenomenological living city experiences, a key research field for all the disciplines and countries from now on. After the coronavirus biosocial revolution this research field will be day by day more fundamental.

The challenge presented by Langer it is a very basic one. Either, there is a scientific new cognitive power in objects- for example in cities-, out of the control of the individual brain tied to the experience in a real space and time situation., but that it can be analyzed by computer, or this brain experience spatial knowledge cannot be totally scientific but related to the poetic knowledge suggested before. In a lot of ways, this position agrees with Aristotle "practical wisdom"-phronesis- of the designer, where: "in order to teach it, art is rather a science". Also the significant recent works by Karl Friston (2019) seems to follow this interface between the inside life and the outside constraints that we have said that Jean Piaget already outlined fifty years ago (1974).With other words ,that means that we should accept the no-deterministic and complex nature of human evolution since, neither the genes, neither social and physical environments, can scientifically define totally the laws of evolution. The ontogeny of cognition can help as a bridge between the genes and the natural selection of species, as Mc Namara and Mc Kinney proposed (1992), but the three branches cognitive trees by Jonas Langer make our task very challenging.

This is not to say that scientific morphological research of cities cannot scientifically be done. On the contrary, this indicates new ways to improve it, with artificial intelligence, but not only with the scientific dimensions of it ,poetics and ethics should have their roles too. The first step is to accept the key concept by Rainer E Zimmermann (2018) about the fundamental differences between the living subjects and the virtual ones, in spite that they can only survive in interaction. The virus epidemic of today, again ,is a prove of it.

## **RESEARCH CASE STUDIES AFTER THE BIOEVOLUTION**

We will describe here some examples, of the urban quality indicators in the children friendly cities by UNICEF and the confrontation between physico-logics and socio-logics in the Raval Neighborhood in Barcelona and in other places represented by space syntax analyses.

These two examples point to future different ways of working on the morphology of cities with impacts on architectural education, professional design and social participation in urban planning.

The first example, the ten urban quality indicators in figure 01, intend to analyse the chronotopic socio-physical and space-temporal knots following previous studies by the research group on the Mikhail Bakhtin philosophical and literary paradigm. These chronotopic knots are the product of the epistemological power of the designers that is, the reflexive socio-physical interaction defined above by David Kirsh. They build a bridge between the social and physical qualities of cities with an impact based upon ethnomethodological social reasons. In some way they follow the known "Image of the City" by Kevin Lynch in a more interdisciplinary way. Bill Hillier itself analyses this impact in children social behaviour in some case studies in his book that results in an extremely complicated mathematical analyses of the pathological effects of planning on children behaviour. A combination between those ten indicators and a space syntax analyses that is not yet done.

The second set of examples open a different strategy on the matter. They want to point out to a concordance between the design reflexive sociophysical power and the social use of physical forms already build, thanks to the space syntax digital analyses or other digital tools as ISOVISTS, TRANSANNA, TRACKING etc. This kind of bridge between the social and the physical dimensions of building and cities, is based upon a deep understanding of the communicative power of the design. This possibility was inside the proposal by Bill Hillier from the beginning but was not fully understood since it was analysed as a “direct deterministic relation between the physical form analysed by space syntax and the social use and meaning on the same form. On the contrary, it was an hermeneutic and indirect link between the designer intention and the cultural user “reading of it” with his behaviour, as we are now analysing in specific PHd dissertations on the matter. This misunderstanding is the reason of the misinterpretations of the relations between space syntax and design going to deterministic design theoretical attitudes denounced by Bill Hillier itself.

Then we make a brief description of these case studies.

We presented the urban quality indicators Fig 01 in friendly cities forum in UNICEF Spain in 2012 and they were approved by UNICEF worldwide organization in New York in 2015. Of course these indicators were the result of an interdisciplinary and international research and they have no universal uniform scientific power, because they need to be adapted to each historical and geographical environment.

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.

Fig 01. Ten indicators of urban quality for the assessment of child friendly cities (UNICEF, 2010)

What is important here is, according to the pioneer work by Shonkoff J.P. (2000), to understand what the subject matter is here, that is, the child living in a city as a link, and concordance, between physico-logics and socio-logics. So, the recapitulation between social development and the development of the individual child, is the objective, neither the physical form nor the social-ethnographic social use or social meaning of it. Now is possible to study if these urban quality indicators are a good example of the reflexive interactive social knowledge of the designers or not, and if this knowledge is or is not scientific, or only “convenient”. But, most important, to study the impact of these indicators in a better design practices, in order to teach architecture and city planning in a human integrated manner. The work by Jan Gehl is going in a similar direction (2013). In this way, we are going in a opposite direction of space syntax cognitive power in order to analyse first the knowledge of the designers and after, their effects upon the understanding on the space syntax systems and on the phenomenological social analyses of urban spaces. This “experimental” way of interplay between design practices and space syntax simulations was proposed by Bill Hillier itself some years ago (2014) however the specific knowledge of the designers has not yet the role it deserves.

The second study cases are summarized in Figure 02. The three-space systems analysis of an area of the Raval in Barcelona represent a “concordance” between the new urban transformation proposed in 1990 in relation to the new image of Barcelona Olympic Games in a new democratic political situation and the planning transformation that was finally implemented on the same area. One is the space system before changes, the second the changes implicit in the planning proposal, and the third is the real situation after the planning implementation, not exactly in the way was proposed and that was supported by ethnographic and phenomenological data on the cultural and historical use and meaning of the physical forms involved.

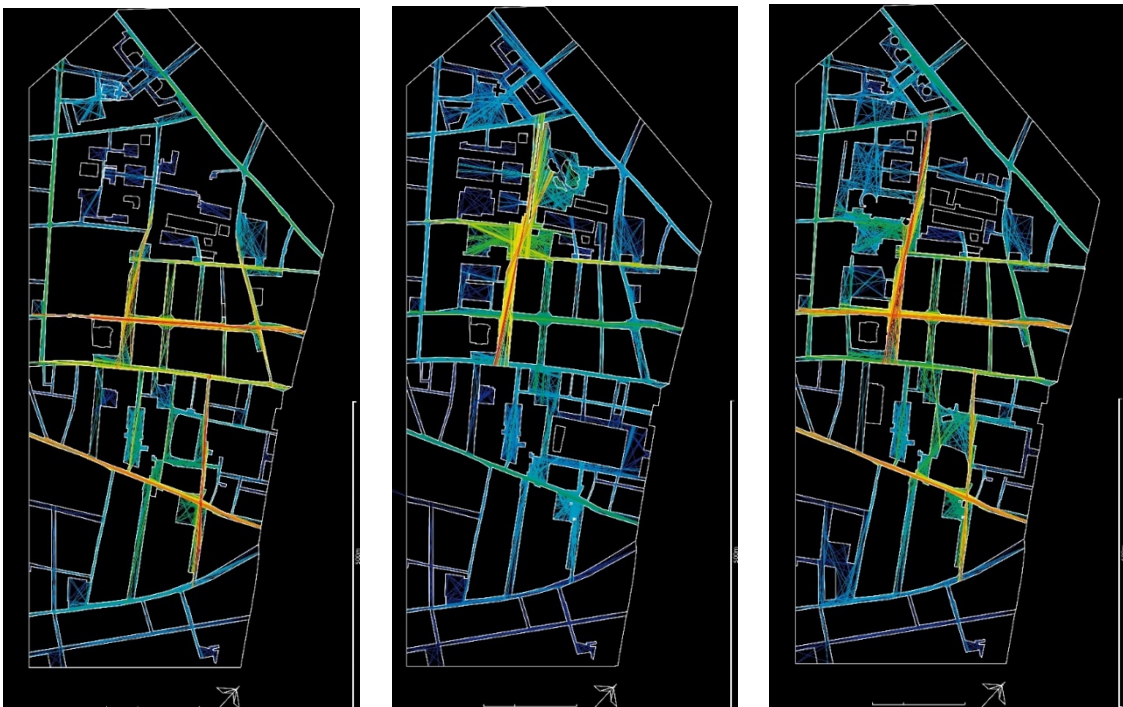


Fig 02. Raval, Barcelona. plan previous to 1980, the urban proposal by Lluís Clotet in 1981 and Barcelona in 2018. Ethnographical surveys confirm the need for the horizontal red lines by the users that the proposal by Lluís Clotet destroyed. This is a good combination between morphological (Space Syntax), and ethnographical city simulations. (Elaboración pròpia, Josue Nathan)

The other examples, form part of PHD dissertations that are working on this “reflexive social and physical interaction cognitive power of designers”. The Intrigue axis made of the poetic abilities of the designer is represented by the Fig 03 and Fig 04 by Peter Zumthor and Juha Leiviskä, where the equilibrium between the two previous axes is shown.

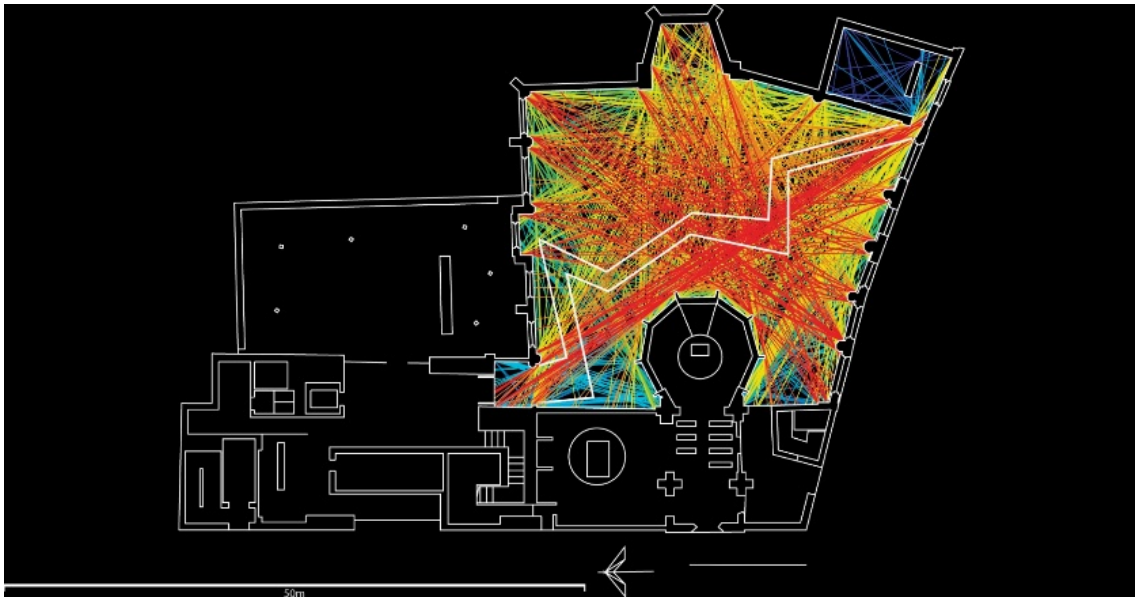


Fig 03. Space Syntax analyses of the Kolumba's Museum where people are walking in the spaces with the maximum visibility, designed by Peter Zumthor in a poetic manner. (Elaboración propia, Josue Nathan)

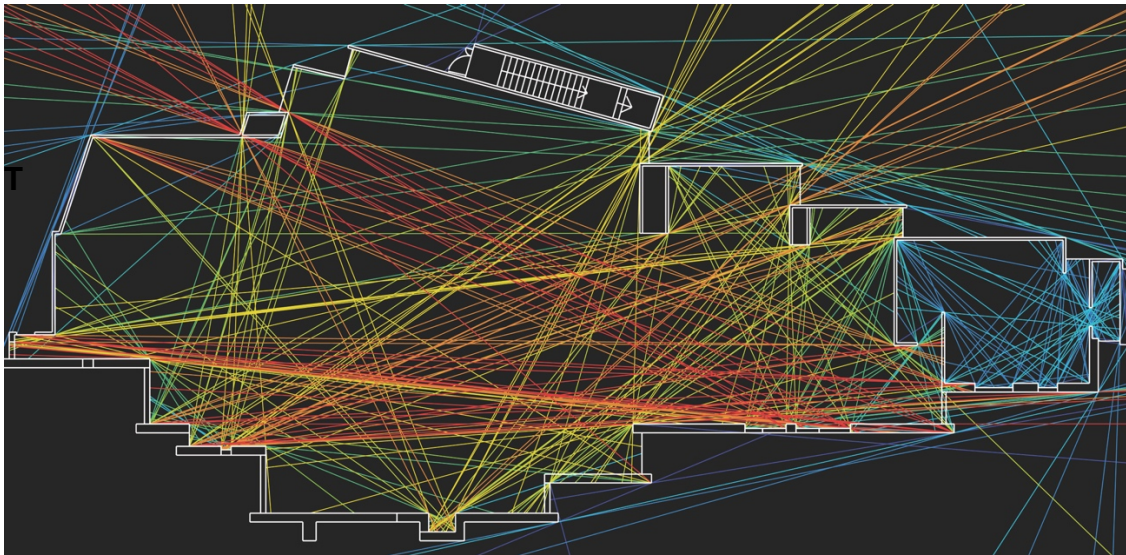


Fig 04. Space Syntax analyses of the church of Männistö by Juha Leiviskä, in Kuopio, Finland (1986-1992). The red diagonal line coincides with the unique step in between the altar and people looking at the ceremony designed by Leiviskä. A nice feedback between experiential and virtual poetic interrelations. (Elaboración propia, Sara Molarinho)

## THE MORPHOLOGICAL CONCORDANCE BETWEEN INNOVATION AND CULTURE AS CONCLUSION

In conclusion, the progressive development of digital tools of morphological simulation of city forms, denominated sometimes as "Smart Cities Analyses", opens again the possibility of using the cognitive power of designers as a bridge between the physico-logics of the cities and the socio-logics of them. The more the artificial intelligence simulations can be developed in both sides of these two kinds of human systems, the more this cognitive power of the designers can be useful in order to build the socio-physical bridge in between these two spatial city basic dimensions. This bridge should be scientific, as well as artistic and political, following the necessary concordances between artificial intelligence and the history of human cultures needed for our survival. In other words, algorithms can save us as well that they can kill us, since they are, in any case, tools.

The examples we have just outlined in this article, should be analysed from the theoretical frames outlined very briefly too. They intend to undercover the way designers think without building walls in between the scientific, artistic and political morphological dimensions of cities and designs. On the contrary, they can clarify the significance of the digital tools in architectural and urban design, by making innovation and cultural history two sides of a process of cultural creativity, where the convergence and the concordance

between both sides eliminate the isolation of some architectural and planning design theories. In this way the "Reflexive Architectural and Social Interaction" will help the humanization of the spatial dimension of our cities and landscapes, since it can only develop: "As an experimental and experiential mental process from the place", thanks to a convergence, concordance or convenience between innovation and the history of human culture.

Both, Jonas Langer and Bill Hillier advise us about the complexity and the difficulties of research analyses on the physico-social bridge. Hillier is right when he points to the intentionality of the user and of the designer as a dangerous research field. Failures to forecast the output in political elections worldwide is a good ascertainment that he was right. However, social cognition should improve in epistemological power avoiding deterministic reasons and analysing historical and cultural contextual reasons and the impact of the physical forms altogether as we have intended to do in the last twenty years of research.



## BIBLIOGRAPHY

- Friston, K. and all, 2018. *A Variation Approach to Niche Construction*. London: Journal of the Royal Interface.
- Gehl J. and Sverre B. 2013. *HOW TO STUDY PUBLIC LIFE*. Washington: Island Press
- Hillier, B. 1996. *Space as a machine. A configuration theory of architecture*. London: Creative Space Platform.
- Hillier, B. 2014. *Space Syntax as a Method and As a Theory*. Space Syntax International Conference
- Hillier, B. 2005. *Between Social Physics and Phenomenology Explorations*. International Space Syntax Conference.
- Kirsh, D. and all. 2000. *Distributive Cognition*. San Diego: ACM June. <https://www.lri.fr/~mbl/Stanford/CS477/papers/DistributedCognition-TOCHI.pdf>
- Kirsh, D. 2019. *Do Architects and Designers Think about Interaction Differently?*. ACM April 2019. <https://dl.acm.org/doi/10.1145/3301425>
- Langer, J. 2020. <https://psychology.berkeley.edu/people/jonas-langer>
- Langer, J. et al, 2003. *Early Cognitive Development :Ontogeny and Phylogeny*. In the HANDBOOK OF DEVELOPMENTAL PSYCHOLOGY. London: Sage.
- Mc Namara K.J. and Mc Kinney, M,L. 1991. *HETEROCHRONY THE EVOLUTION OF ONTOGENY*. London: Plenum Press
- Moystard, O. 2018. *COGNITION AND THE BUILD ENVIRONMENT* .London: Routledge.
- Piaget, J. 1974 *ADAPTATION VITALE ET PSYCHOLOGIE DE LA INTELLIGENCE*. Paris: Hermann.
- Seamon, D.2015 *A Phenomenological Commentary on Bill Hillier's Space System*. in NORDIC JOURNAL OF ARCHITECTURAL RESEARCH . <http://arkitekturforskning.net/na/article/view/719>
- Shonkoff J.P. and Phillips D.A. 2000. *FROM NEURONS TO NEIGHBORHOODS THE SCIENCE OF EARLY CHILHOOD DEVELOPMENT*. National Research Council USA
- Valsiner J.and Connoly K. eds *HANDBOOK OF DEVELOPMENTAL PSYCHOLOGY*. London: Sage
- Vernez Moudon, A. 1997. *Urban Morphology as an Emerging Field URBAN MORPHOLOGY*. International Seminar of Urban Form.
- Zimmermann R.E., 2018. *Methaphysics of Emergence. ON THE FOUNDATIONS OF SYSTEMS VOLUM I*. Berlin: Xenomoi Verlag