

# BRAIN PRINCIPLES AND URBAN DESIGN, MEMORY AND EMOTIONS

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Università Iuav  
di Venezia



INSTITUT D'ÉTUDES  
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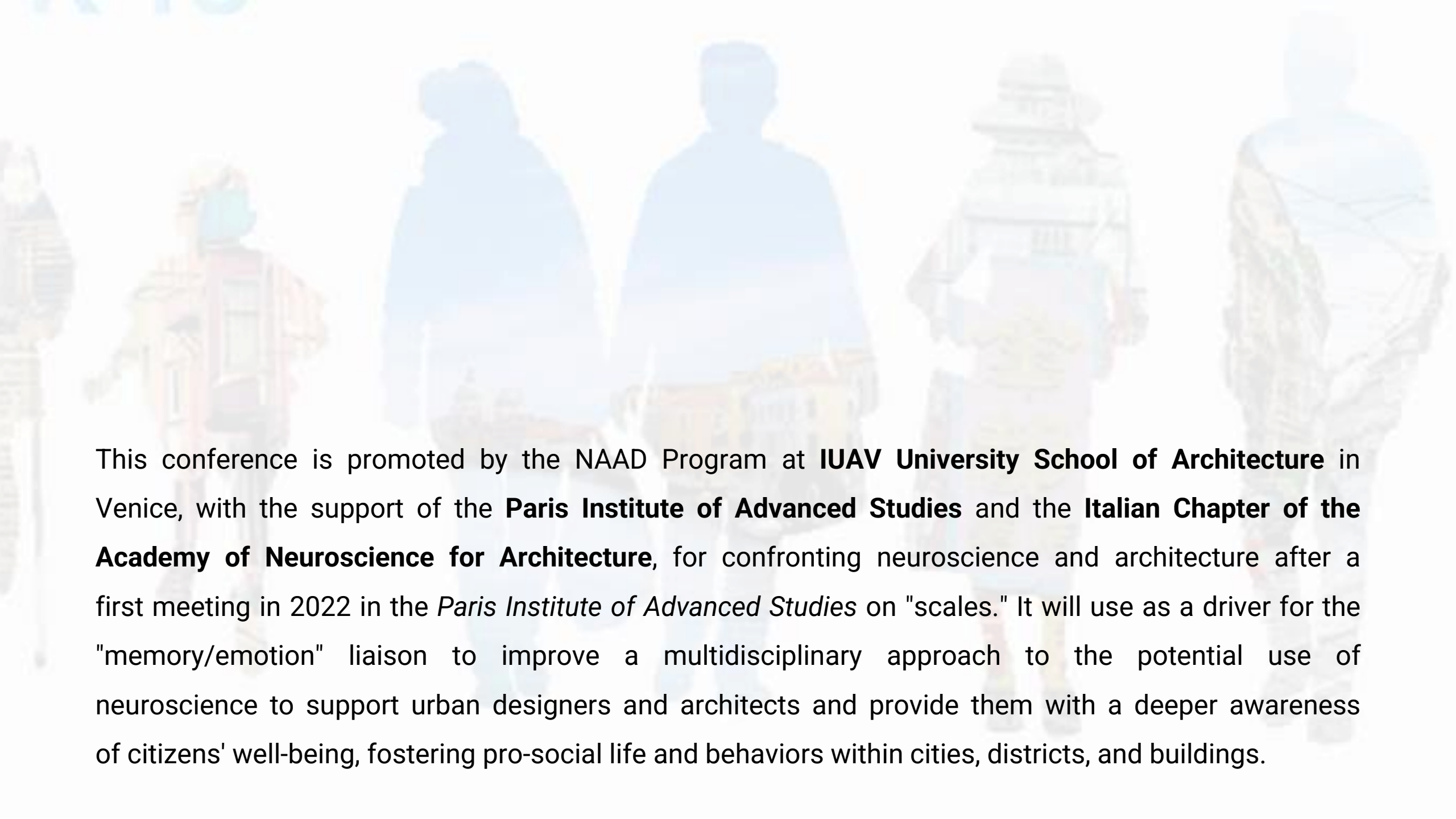
**Neuroscience Applied to Architectural Design**

*Organizers*

**Alain Berthoz, Francois Pitti, Davide Ruzzon**

**November 23rd - 24th 2023**

photo by Dids | Pexels



This conference is promoted by the NAAD Program at **IUAV University School of Architecture** in Venice, with the support of the **Paris Institute of Advanced Studies** and the **Italian Chapter of the Academy of Neuroscience for Architecture**, for confronting neuroscience and architecture after a first meeting in 2022 in the *Paris Institute of Advanced Studies* on "scales." It will use as a driver for the "memory/emotion" liaison to improve a multidisciplinary approach to the potential use of neuroscience to support urban designers and architects and provide them with a deeper awareness of citizens' well-being, fostering pro-social life and behaviors within cities, districts, and buildings.

## PANEL I

### *A broader cultural landscape about memory and emotions*

Architect, Architecture PhD student (Architettura. Teorie e Progetto) at the University of Rome Sapienza. In 2018, he obtained the Naad - Neuroscience applied to Architectural Design - International Master, at the IUAV.



Chairman  
**Antonio Sorrentino**

November 23, 2023  
H 9:30-13:30



GREETINGS

BENNO ALBRECHT

10:00



**ALAIN BERTHOZ**

Neurophysiologist



**DENISE PUMAIN**

Geographer



**EDMUND ROLLS**

Neuroscientist

11:00

12:00

13:00

9:30

Berthoz – Pitti -  
Ruzzon

**INTRODUCTION**



10:30

Psychologist

**GRETTY MIRDAL**



11:30

Architect

**DAVIDE RUZZON**



12:30

**FINALE DEBATE**



13:30

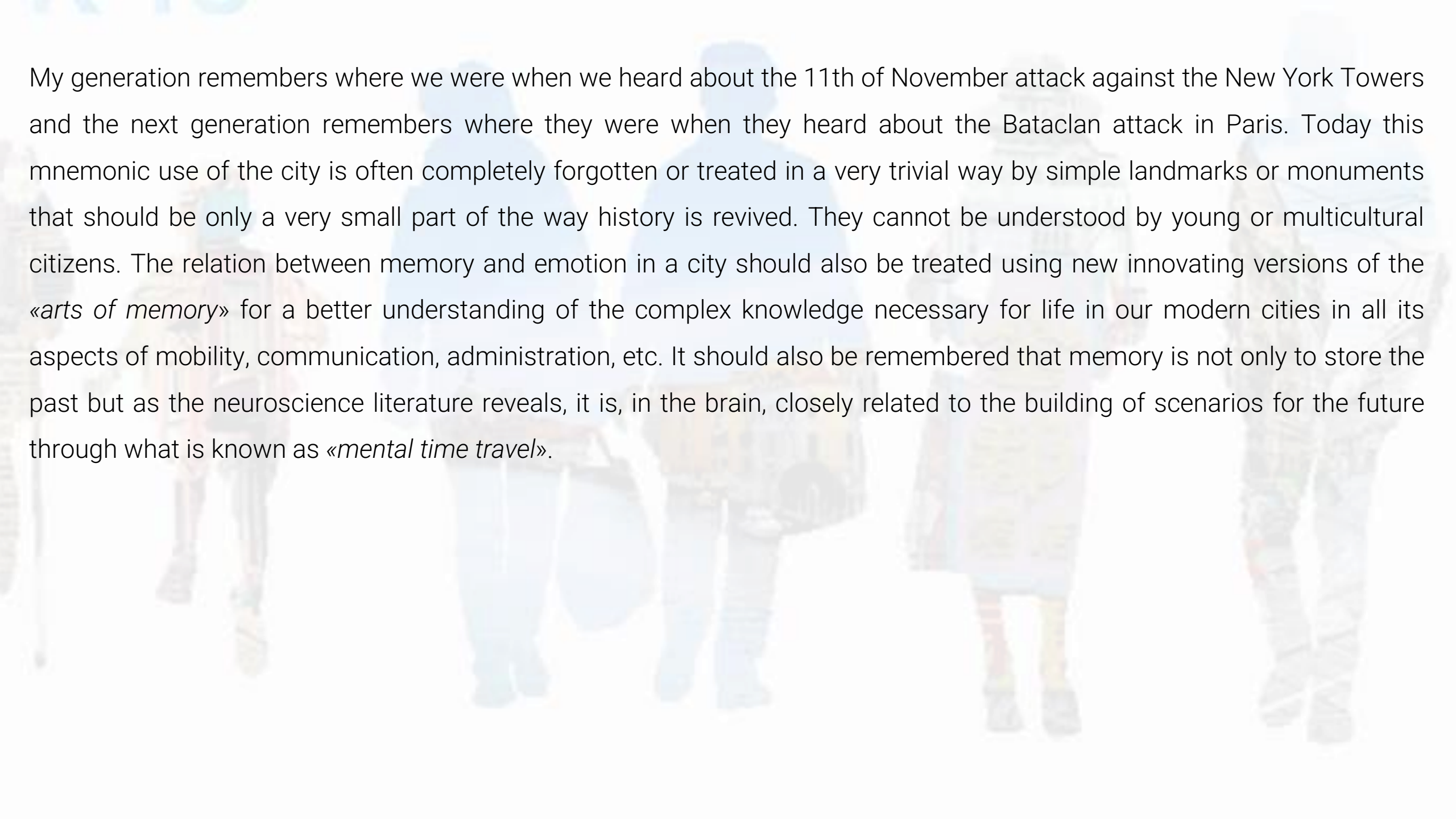


## ALAIN BERTHOZ

Emeritus Professor at the Collège de France (Chair of Physiology) and former founder and Director of the Perception and Action. Lab. CNRS / Collège de France). He is an Engineer (Ecole des Mines. Nancy), and an expert in Biomechanics, Psychology and Neurophysiology. Member of French Academy of Sciences and Academy of Technologies and several other International Académies

## Combining place, memory, and emotion in a city with the Arts of Memory

The brain can, and does, use the city as a mnemonic device. It is well known that this is performed by the use of places and monuments to mark or represent historical events. In addition, navigation through the city can be used for many different mnemonic purposes. Since the Greeks, a memory technique known as the « Arts of memory » (See Frances Yates) has been used for storing the memory of objects, and plants, in mental palaces. The use of this mental technique allowed not only easy recall of a list of items but also, for example, that Middle Ages priests could store sections of the bible and find each Sunday a new combination for their speech (Mary Carruthers). Many recent studies have been devoted to the variety of uses of this mental process (Lina Manzoni). The book of Marcel Proust, but also of the Nobel Prize for Literature Patrick Modiano, are examples of the use of the arts of memory. Navigation in ancient Rome was used by Petrarque to possibly constitute a memory tool for foreign elites to remember the rules of living in the city of Rome and it was also used in Athens. It is also proposed by Didier Viviers that religious processions in a city stop at precise places which have significance for the history of the city and are therefore also collective memory tools. Modern neuroscience reveals what are the basic neural mechanisms of this remarkable capacity to improve memory. It is the association between place and memory which is mediated by the hippocampal formation and its related networks. What is even more remarkable is that this topographic marking of episodes is also complemented by another association between place and emotion.

A blurred background image showing a crowd of people walking, likely in a public space or transit area. The figures are out of focus, emphasizing movement and a sense of a busy, shared environment.

My generation remembers where we were when we heard about the 11th of November attack against the New York Towers and the next generation remembers where they were when they heard about the Bataclan attack in Paris. Today this mnemonic use of the city is often completely forgotten or treated in a very trivial way by simple landmarks or monuments that should be only a very small part of the way history is revived. They cannot be understood by young or multicultural citizens. The relation between memory and emotion in a city should also be treated using new innovating versions of the «*arts of memory*» for a better understanding of the complex knowledge necessary for life in our modern cities in all its aspects of mobility, communication, administration, etc. It should also be remembered that memory is not only to store the past but as the neuroscience literature reveals, it is, in the brain, closely related to the building of scenarios for the future through what is known as «*mental time travel*».



## GRETTY MIRDAL

Gretty Mirdal is Emeritus Professor of Psychology at the University of Copenhagen, and she is the former director of the Paris Institute for Advanced Study (PIAS). Presently she directs the "Brain, Culture and Society" program at the PIAS and she is an active member of the Royal Danish Academy of Sciences and Letters. Her research and teaching have centred mainly on the areas of clinical, health and transcultural psychology.



## Remembering the feeling of place

Time, space, and memory are deeply interconnected at the cerebral, cognitive, and emotional levels. We do not directly sense time, but the brain can track elements and aspects of the environment to mentally construct the sensation of duration, distance, and the passing of time. When we consider time and space as mental constructs, as is the case here, there is a need to describe the phenomena at two different levels, since the neuronal level does not explain the mental level, and the mental level does not provide knowledge of the biological substrate of the phenomena.

In this presentation, I propose to consider space, time, and memory both as cerebral processes and as subjective experiences, illustrated with literary examples, especially from the writings of Marcel Proust because of his extraordinary contribution to our understanding of memory, not only of time and space, but also of cities, one of the topics of the present conference.

We know now that the brain constructs sequences of neuronal cell assemblies, and that these, in turn, construct relationships between the places that are navigated. These neural mechanisms associated to navigation are then associated to the storage of memory through indexing and sequencing systems.

The type of memory associated to remembering what we have experienced, where, when, and in which context – the so called episodic and semantic memories - is dependent on a set of interconnected brain areas, the hippocampus and the surrounding para-hippocampal areas, and emotional cortico-hippocampal networks playing critical roles in maintaining memories.

Despite groundbreaking scientific research on the neuronal processes of memory, we are still far from understanding how the emotional tone, the mood and atmosphere of an experience are encoded, or become related to a factual or a semantic memory so that we can relive the episode at a later moment in time. Literature and art where the subjective experience of remembering can be described with sufficient detail and precision, can be helpful here. By offering rich descriptions of human experiences and emotions, literature provides a valuable resource for scientists. Dating facts and codifying them is important but if we are to understand memory processes, we need to know what these facts mean and how we interpret them. I will therefore rely on literary descriptions, aware that the methodological distance between the literary and the scientific explorations can seem insurmountable but hoping that scientific research and artistic sensitivity can constitute complementary ways of knowing.



## DENISE PUMAIN

Emeritus Professor at University Paris I Panthéon-Sorbonne, member of CNRS laboratory Géographie-cités. Founder of the research laboratory P.A.R.I.S., Director of the UMR Géographie-cités, Chair of the Commission on Urban Development and Urban Life of the IGU, Director of the European Research Group S4 (Spatial Simulation for Social Sciences), Founder and Director of Cybergeo, European Journal of Geography, PI of the ERC advanced grant GeoDiverCity.

## Systems of cities between metaphors and sciences

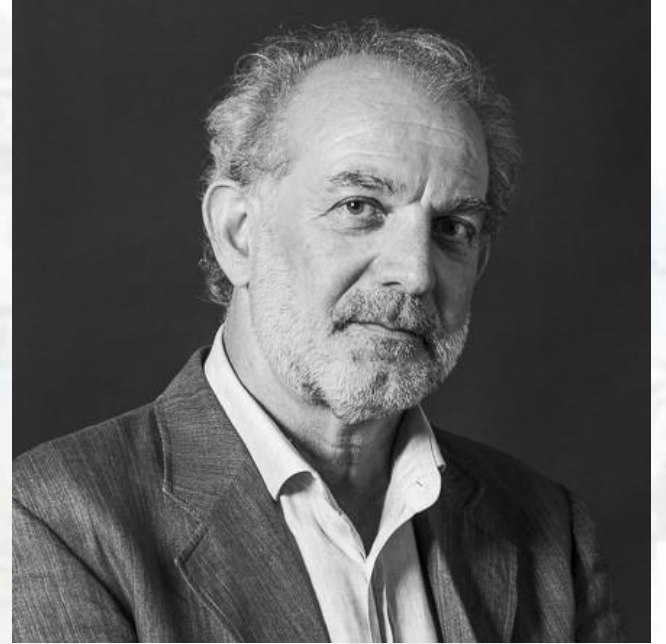
Cities are never isolated entities. Each city is born and built, partly spontaneously and partly deliberately, in close relationship with its environment and with other cities on the earth's surface. Several metaphors have been used to describe the spatial and functional organization of sets of cities. Hardly visible to non-specialists, this remarkable configuration was first described by analogy with a "planetary system" in the 19th century, or the nervous system by Geddes in 1915. The organicist metaphor is one of the three recurrent figures used to think about systems of cities, along with those of stage network and the coverage of the territory (Pumain, Robic, 1996). To avoid the temptation to naturalise, the expression urban network was first used in French-speaking social sciences, while English-speakers preferred the term city system. New metaphors draw their evocative force from the cognitive sciences, combining biological adaptability and computer technology: *«Cognitics, which brings together the functioning of the brain and that of computers, nervous physiology and electronic chips, via learning processes and artificial intelligence, provides the ideal terrain. In the world connected to the virtual [...] the adaptive flexibility of the living combined with the efficiency of computer networks lends itself to allusions that are intended to be rich in meaning»* (Gaudin and Pumain 2000). Alongside neural networks, there may well be an image of the city network as hypertext, an instrument for freely chosen movement between nodes of knowledge and creation through interconnection and navigation between centres of resources, information, and knowledge.

Aren't 'urban nomads' already surfing from one city to the next, between the mirrors of identity or change of scenery that they offer, through the systems of signs and images that they give themselves in the concerted control of urban marketing operations? Organising the production of this image around a city project between local partners is an attempt to take better account of the diversity, autonomy, and inventiveness of local stakeholders, and even of ordinary city dwellers.

One of the main functions of these metaphors is to soften the power relations and the very strong hierarchical differentiation that characterise relations between cities. On the one hand, they serve to naturalise the ideas of self-learning, adaptation, and flexibility now required of urban stakeholders, who are supposed to react with a more precise awareness of the multiple interdependencies in which their actions are situated; on the other hand, and more ambiguously, a representation of the city as a subject, creator of ambiances and bearer of emotions, a recurring organicist image which, under the avatar of the learning network, softens the possible conflicts of interest. Actually, the construction of collective images of systems of cities also takes place through: the competitive power and communication of urban marketing; the diversity and multiplicity of 'rankings'; the violence of the investment choices of multinational companies; exploitation of the less protected environmental resource deposits and major inequalities of income and power between populations. And recent events suggest that the destruction of razed cities may once again become a method of selection that was thought to have been abandoned since the end of the Middle Ages...

## DAVIDE RUZZON

Davide Ruzzon director of the master's degree NAAD 'Neuroscience Applied to Architectural Design' at IUAV University Venice, Founder and director of TA Office Milano.



## Architectural typologies as human-habits' scaffolds

### *Background bodily emotions, and long-term memory consolidation*

According to the theory of mind proposed by Merlin Donald, the last and fourth phase of human mind evolution - that had followed the previous three, episodic, mimetic, and mythic – had also been featured by rituals' and habits' externalization: till that moment, changing daily their life's rooms, our gathers-hunters ancestors had forcibly refined them into the nature. According to this premise, at its inception, architecture would be the petrification of pre-existing habits, namely a steady and precise place where ancestors started developing social habits. Furthermore, it rapidly created codes and rules for communication and strengthened community linkages: that phase would have been named Neolithic Revolution. Primitive artificial stages were nothing but affordances refined along millions of years of bodyspace interplay, some Gibsonian and others metaphorical: the first coupling with a bodily kinematic, the latter, mainly, coupling with an embodied simulation of bodily gestures.

Primitive patterns aggregated, slowly creating buildings and cities, as cells aggregate to form organs and tissues. Those patterns were long-term memory consolidations of rhythmic endless repetitions of bodily emotions' stratifications. Within more complex proprioceptive and exteroceptive sensory modifications belonging to many diverse gesture/affordance patterns, their interoceptive cores became bodily memories' markers.

In natural scenarios, emotions consolidate some body/space patterns, first into the brain and later as petrification or architecture. Emotions are components of the body/space predictive model of interaction: simulations are top-down spread outward to save energy, optimizing our cognitive and social tasks.

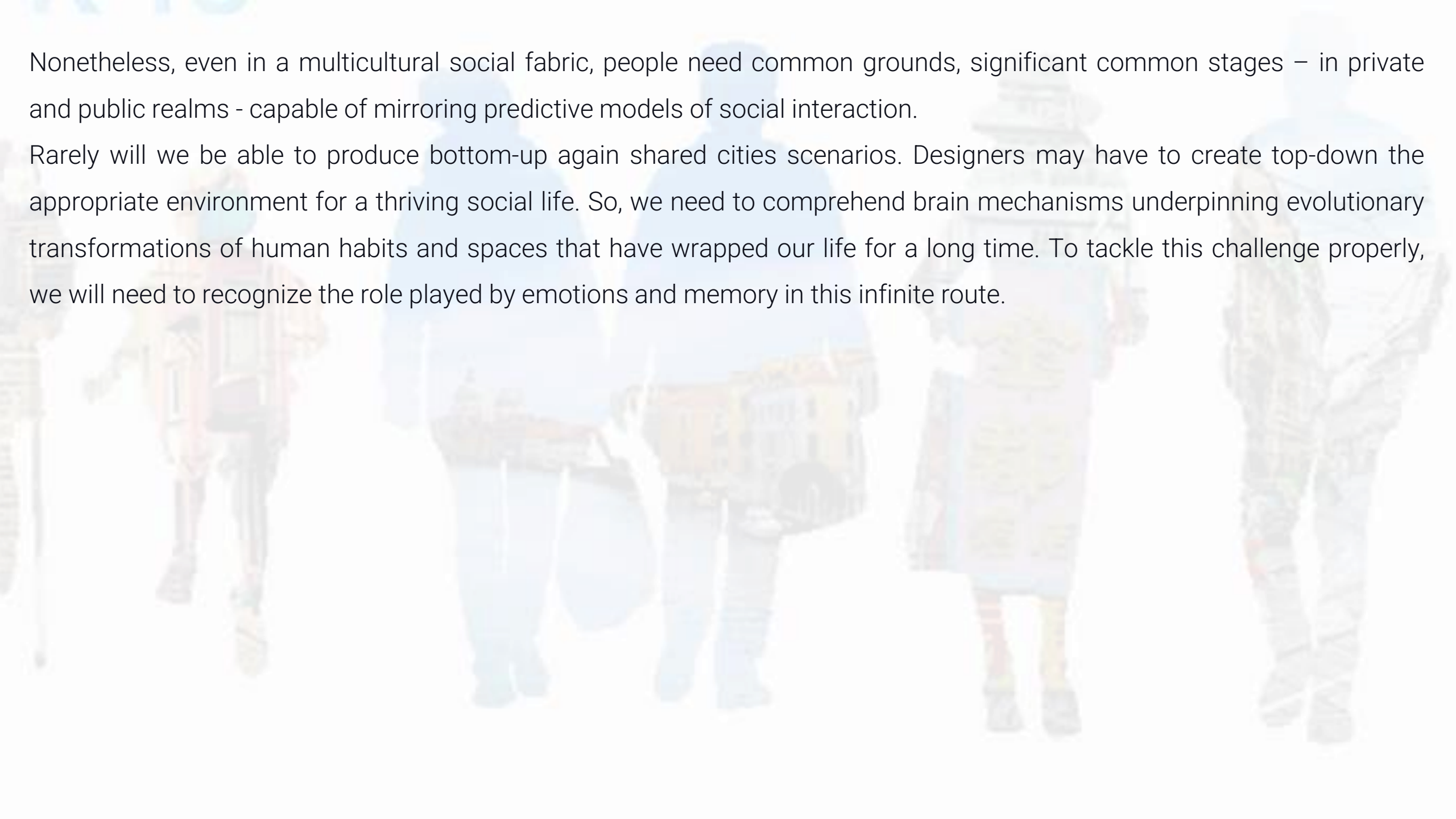
As a final result, different natural forms - or primitive spatial patterns - consolidated emotions for such a long time that, reversely, the same emotions have been literally embedded into architectures. After this change, typologies and forms were materials potentially valuable for transferring emotions from stones to the body of a single person. While at its inception, architecture had been a petrification of common pre-existing habits, now it could be used to empower a single person, using its immense emotional influence. In public architecture, awe as emotion is a paradigmatic example of its political use. Bottom-up against top-down: this is the endless history of architecture.

After millennia of typologies' reshaping, our cities progressively have seen many shifts in the last couple of centuries. Nowadays, technology has assumed an identity, moving autonomously for its sake. The industrial revolution first, followed by globalization, digitalization, the climate crisis, and massive cities densification, are all factors that have weakened one side of the eternal counterpoint between bottom-up and top-down ways to produce cities. Habits and rituals, primitive patterns, typologies embedding emotions, and social memory are hardly on the table of designers, nor exist conditions able to open a large room for participative processes.



Nonetheless, even in a multicultural social fabric, people need common grounds, significant common stages – in private and public realms - capable of mirroring predictive models of social interaction.

Rarely will we be able to produce bottom-up again shared cities scenarios. Designers may have to create top-down the appropriate environment for a thriving social life. So, we need to comprehend brain mechanisms underpinning evolutionary transformations of human habits and spaces that have wrapped our life for a long time. To tackle this challenge properly, we will need to recognize the role played by emotions and memory in this infinite route.



## EDMUND ROLLS

Edmund Rolls is a neuroscientist who has contributed at the Universities of Oxford and Warwick to understanding brain mechanisms involved in spatial memory and navigation, emotion, decision-making, vision, mental disorders, and computational neuroscience.



## The neuroscience of spatial and emotion representations, and their relevance to architecture and urban design

To address the above, it is necessary to understand spatial and emotional representations in the brain. There is a revolution underway in our understanding of spatial representations in the brain. Whereas in rodents the representation is about the place where the individual is located (O'Keefe, Moser and Moser), in humans spatial locations being looked at activate the hippocampal memory system (Rolls 2023a, 2023c). The importance of different spatial views in memory and navigation in humans has many implications for architecture and urban design, in terms of providing not only attractive but different and therefore useful spatial views. Moreover, having different spatial views is important in the art of memory, for the memory of who, what and reward value can be easily associated with spatial views in the hippocampal memory system (Rolls 2023a).

Emotions can be defined as states elicited by rewards and punishers, including many related to social behaviour, with many different rewards and punishers gene-defined, and useful for the genes (Rolls 2014, 2023b).

Other rewards and punishers may be defined in humans by the reasoning system, and may instead be useful for the individual person. Understanding the value that humans place on different rewards and punishers, measured by choice tests, for example about biophilic environments, may be very useful in architectural and urban design.

**References** (All available as .pdfs at <https://www.oxcns.org>)

Rolls ET. 2014. Emotion and Decision-Making Explained. Oxford: Oxford University Press.

Rolls ET. 2023a. Brain Computations and Connectivity. Oxford: Oxford University Press. Open Access.

Rolls ET. 2023b. Emotion, motivation, decision-making, the orbitofrontal cortex, anterior cingulate cortex, and the amygdala. Brain Structure and Function 228:1201-1257.

Rolls ET. 2023c. Hippocampal

## PANEL II

### *Exploiting memory and emotions Architects and Urban Designers at work*

Architect, graduated at the IUAV University of Venice (2006). Master in Neuroscience Applied to Architectural Design (IUAV 2017), Master in Hospital Planning (Milan Polytechnic 2022). Architect Project Leader at the Department of Architecture and Healthcare design – T.H.E.MA srl since 2019.



Chairman  
**Federica Casetti**

November 23, 2023  
H 14:30-19:00



**ELISABETTA CANEPA**

Architect

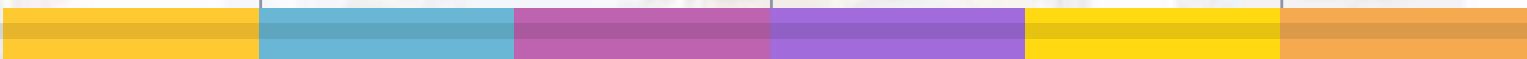


**FRANÇOIS PITTI**

Businessman



**FINAL DEBATE**



14:30

15:30

16:30

Architect

**ROBERTA ALBIERO**



15:00

Architect

**JEAN FRANÇOIS DAURES**



16:00

Neuroscientist

**LAURE RONDI-REIG**



17:00

The background features a light blue and white illustration of several people walking away from the viewer, carrying architectural drawings and bags. In the top right corner, there is a black and white portrait of a woman with dark hair, looking slightly to the left.

## ROBERTA ALBIERO

Roberta Albiero is an architect and a professor of architecture and urban Design at Università IUAV di Venezia. Associate professor of architecture and urban design Ph.D. architecture and urban design. Coordinator of the Master's Degree in Architecture

## The memory of stone: the “piazza” as a collective archive

In the historic European town the “piazza” can be considered the great stone archive of the community. It conveys values, meanings, and memory. The outcome of slow stratifications or geometric impositions, as in the case of the “*Piazze di fondazione*”, the “piazza” constitutes the great invention of Western culture since the Middle Ages, partly heir to the Greek *agorà* and the Roman forum, so well evoked in the pages of Camillo Sitte. The “piazza”, as the architect Costantino Dardi wrote, “is the outcome of the modification of a spatial imagination that conveys through different models of structure and form in new configurations the expectations and demands of new customs and new social relations.” Costantino Dardi, *Place d'Italie, Architettura in forma di parole*, Macerata 2009, p.179) The “piazza” as a value and emblem of the city, in the face of the gradual fading of the *Forma Urbis*, has been losing its role as the center of the activities of leisure and stores as well as a place of exchanges and meetings, trades and events, protests and gatherings. Yet the square continues to represent a permanence in the landscape of collective individual memory, an expression of the link between civil and urban history, between *civitas* and *urbs*. The peculiarity of this space and the propensity to become a theater of human emotions and habits is due to its nature as a void. A permeable enclosure, made of paths, materials, colors, sounds, voices, smells, it represents the scene of human affairs. Crowded and obscured by the encroachment of vehicular traffic in the past decades and saturated today by the masses of visitors, new travelers of the globalization era, who pass through it without experiencing it, the “piazza” once again faces a crisis without losing its evocative and narrative capacity.





## ELISABETTA CANEPA

Elisabetta Canepa is an architecture scholar from Genoa, Italy. She is a Marie Curie Fellow running the RESONANCES project with the University of Genoa, Kansas State University, and Aalborg University.



## MEMORY | EMOTIONS | HUMAN ENVIRONMENT

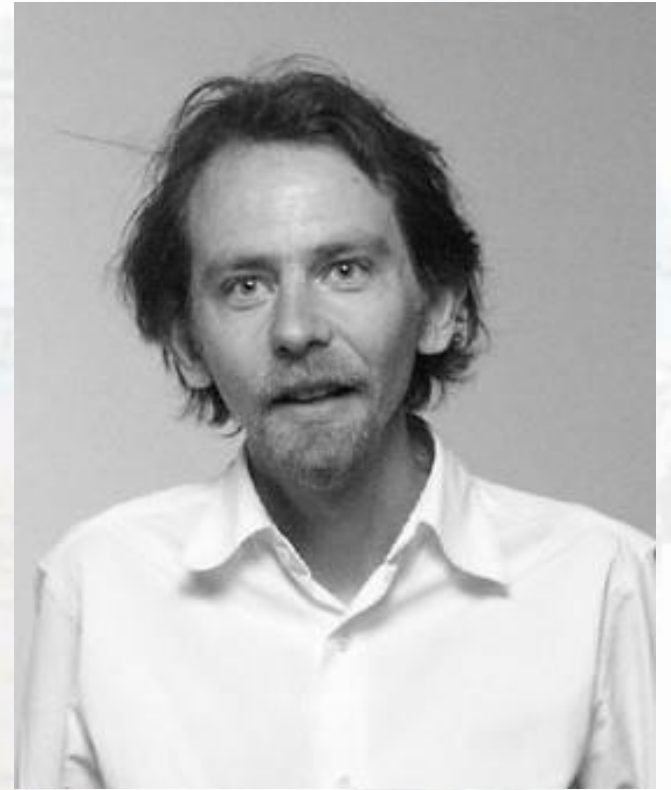
How do architects, neuroscientists, and philosophers correlate these three dimensions?

Which should be the target of this correlation?

We are complex biological, psychological, and sociopolitical beings that designers, neuroscientists, and philosophers have trouble understanding. On one hand, our conscious behaviors reveal us as unique creatures — genetically determined and constantly influenced by the affordances embedded in our environment; on the other, our nonconscious behaviors are more comparable among themselves. Architecture is a full-body activity made authentic through its atmosphere, which is the essence of affective qualities we feel in our surroundings, touching us on nonconscious, preconscious, and conscious levels. Atmosphere is an experiential medium through which we might better comprehend the correlation between emotions, memory, and the human environment. Understanding the existence of nonconscious perception is challenging: some studies claim to evince it by showing that unseen primes can affect behavior and elicit much more than motor responses. Atmosphere, the backdrop phenomenon par excellence, primes our emotional experience of space by influencing memory and affective disposition. Discussing our last experiment, designed and carried out at Kansas State University, will give some insights into how atmosphere matters by priming our emotional first impressions and tinting our medium-term memories of space.

JEAN FRANÇOIS DAURES

Architect



## **Plant-architecture sensory architecture that evolves in all four dimensions**

Architecture has always been able to develop its techniques in line with technological advances on the one hand and changing social customs on the other. A new formal register has become possible, where buildings can free themselves from the flatness of modern architecture; there are no longer roofs or walls, but we talk about an envelope. This new term introduces the notion of an "architectural skin", with its pores, transparency and capacity to breathe. The envelope itself becomes a veritable biotope "inhabited" by humans such as insects, amphibians, small vertebrates and birds. To find meaning in our existence and restore balance, mankind is once again drawing closer to nature, which is no longer the hostile, savage environment that our ancestors knew. To take advantage of these virtues, why not imagine a 'skin' for contemporary architecture that would be both living and plant-based? An architectural skin that would appeal to all the senses, to sight but also to touch and taste, and would appeal to both the register of emotions and that of memories? This envelope would bear witness to the seasons and the passing of time.

Plant matter is the opposite of static. Always in motion, it changes its appearance as the days and years go by. Surprising at times, it provokes memories and requires us to remember. The seasons are marked by successive floral appearances alternating with periods of vegetative rest. So, its appearance is neither boring nor habit-forming.

This plant material is consensual in terms of the wonder it inspires, while always remaining personal, as it changes its appearance according to the situation and the climate. Interactive, this new skin for architecture changes its appearance according to its users. Interactive firstly, because it's man who looks after the plant and ensures that it grows well; and secondly, because it's sensorial, releasing fragrances and offering the user a range of tastes.

Each flowering or the appearance of fruit is experienced as a gift of nature received as a reward for all this attention. The relationship with the built environment is no longer impersonal and standardised, but becomes totally adapted to the personality of its users. This is the key to reconnecting city dwellers with nature.

The 'reward' offered to users by this plant material is not just expressed in terms of colour or appearance. It also translates into tastes for its edible part and the fragrances released by the mixture of scents exhaled by certain plants that make up the varietal palette. These are appointments that punctuate time, whose recurrence, sometimes disturbing, calls up memories, like Proust's madeleine. Plants have been with us since the dawn of time, and are a cultural, social and economic marker of our history. As Marcel Proust said, "Perfume is the most enduring of memories". So, the greening of buildings opens a wide door to designing new living skins for architecture. A new ergonomics in which all the senses, still little used today, would be mobilised, which could even have a therapeutic aspect.

In short, the interaction between architecture, plants and the emotions felt by Homo Sapiens is complex and multidimensional, since by integrating time, it is possible to speak of architecture in four dimensions.

FRANÇOIS PITTI

Director Strategic Foresight



## Emotions and usages-centric city representations for urban design

In an ever faster-changing urban environment answering social, economic, and environmental urban challenges requires new City representations.

Key in designing city projects is combining citizen-centricity - by having fine understanding of emotions and usages – and ensuring harmonious development of the urban fabric through respect of memory. Two key dimensions to consider in this respect are empathy and anticipation of citizen usages. This adaptative approach of city design can be laid out at all levels:

- Space-wise: from the building to the city through the districts or communities
- Time-wise:

Through a deep understanding of the history, culture and memory of the cities as a lever to project the urban fabric in the future.

For the projects themselves early in design, development then at later stages in implementation of projects and services.

- With a trans-sectorial, systemic approach- reconciling the built environment, energy, mobility, water and waste management, circular material management.

To help bring about these new approaches cities stakeholders need to learn from the living world and become adaptative.

The works of Alain Berthoz on the Brain and the notions of *Simplexity* and *Vicariance* are very interesting in this respect.

In “Simplexity” A. Berthoz (Ed. Odile Jacob, 2009) points out the importance of the memory as a key lever to interact with the current environment and to project oneself in the future. He emphasizes consequently the need to reduce this complexity of interactions between the past, present and anticipated future.

“*La vicariance*” (Ed. Odile Jacob, 2013) shows in turn the multiplicity of creative solutions to solve these and other challenges. The ability of the brain to come up with innovative approaches could be of great inspiration for city stakeholders. Players in the field of architecture, urbanism, construction and design are starting to experiment avatar-based “serious gaming” for key urban developments. These are co-design methodologies with a strong emphasis on the correlation between usages and spaces. A greater focus should be given in these approaches to the importance of interplay of spaces, emotions, and memory.

Shapes, colours, morphology and beyond the sensible emotional perception of the existing urban fabric is a key driver to think of its evolution addressing new usages and therefore fostering well-being in cities.



## LAURE RONDI-REIG

Doctor of Neuroscience Research Director (DR1) at CNRS & Sorbonne Université. | CNRS Research Fellow. Laboratoire de Physiologie de la Perception et de l'Action. UMR 7152 Collège de France - CNRS France Group leader at Sorbonne Université & Member of the board of the French Neuroscience Society"



## Navigate and remember in urban environments

“Au commencement était l’Acte” (Goethe, 1770).

«[...] *quelque part dans un recoin d’horizon infini, sans beaucoup d’astres au-dessus de lui ni de mains qui percent l’obscurité mais au contraire partout, toujours, la lumière allumée et, loin du silence des grottes, loin du fracas de l’océan, des bêtes, de la forêt, les grésillements des néons qui clignotent ça et là aux croisements sans fin des routes éclairées*» (Bruno Remaury, extrait du monde horizontal). Neuroscience and architecture are two seemingly distinct fields, but they share deep connections and offer valuable insights into understanding and designing the urban environment. Their connection lies in the way the human brain reacts and interacts with physical space, and how the environment influences our behavior when we discover a new environment and helps us to remember certain places that become not only familiar but also attractive.

Neuroscience, and in particular the study of spatial navigation, focuses on understanding how the nervous system functions in relation to body movement including exploration of a new environment, while architecture seeks to create spaces that meet human needs in terms of functionality and aesthetics. When these two fields intersect, interesting possibilities emerge for designing environments that promote mobility, physical and mental health, and harmonious interaction between the individual and his or her urban setting. This symbiosis between movement neuroscience and architecture offers innovative prospects for improving people's quality of life, while stimulating creativity and the search for innovative architectural solutions.

In the context of this presentation, I will address the following three points:

- Senses and memory of space: using the multisensory information providing by both the environment and the displacement of the navigator, the brain is encoding a memory of space needed for efficient navigation. I will illustrate how the design of environment is modifying our memory and our subsequent exploration and/or exploitation of it.
- Mobility and accessibility: within an architectural vision that favors accessibility and the absence of barriers, neuroscience can study how the urban environment can influence people's mobility. Architects can use knowledge gained from neuroscience to design spaces that encourage mobility and physical activity. For example, they can design ergonomic buildings that minimize physical constraints, or create green spaces and parks that encourage physical exercise.
- Emotion and Wellness: Neuroscience is concerned with the effects of the environment on physical and mental health. An urban environment that fosters a connection with nature and reduces exposure to noise can contribute to people's wellbeing. Researchers can study how the layout of buildings, lighting, color and texture of surfaces affect our sensory and emotional experience of the environment.

In summary, neuroscience and architecture are interconnected in their common quest to improve the quality of human life. In this presentation, I will examine how the environment influences the construction of our internal representation of the world and how this changes our behavior and the memory we have of this environment. I will also discuss how understanding the neural mechanisms of human movement can guide the creation of spaces that are functional, accessible, while promoting the physical and emotional well-being of the individuals who explore them.

## PANEL III

### *Memory, Emotions, Places detected through Neuroscience*

Environmental psychologist, worked a consultant for the city of Pilsen. Now a PhD at TU/e, the Netherlands, studying the impact of urban lighting design on human environmental experience. IUAV NAAD former student at its first edition.



Chairman  
**Richard Jedon**

**November 24, 2023**  
H 9:30-13:30



**TAMAR FLASH**

Neuroscientist



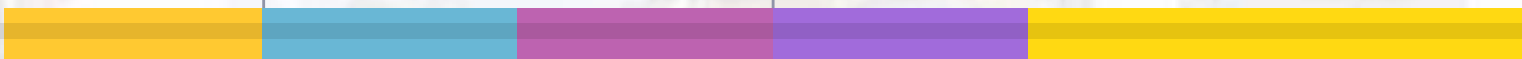
**GIOVANNI VECCHIATO**

Neuroscientist

09:30

10:30

1:30



Neuropsychiatrist

10:00

**SHAHAR ARZY**



Neuroscientist

11:00

**SILVIE TORDJMAN**



12:00

**FINAL DEBATE**





## SHAHAR ARZY

Director of the Computational Neuropsychiatry Lab and the lead neurologist of the Neuropsychiatry Clinic at Hadassah Medical Center. He received his medical degree and master's in cognitive science from the Hebrew University of Jerusalem and PhD from the Swiss Institute of Technology and the University of Geneva, he specialized in Neurology at Hadassah Medical Center and in Cognitive Neurology in Geneva University Hospital.

## What makes a life significant?

Throughout our lives, we encounter significant experiences that endure as meaningful memories. These memories are usually related to specific places, happened in a specific time, with, often with close-by people. It has been suggested that significant experiences can be described through four main subcomponents: affect, content, self-reflection and specificity. Nonetheless, the relative contribution of each subcomponent is unclear. To account for significant memories I will first evaluate the different subcomponents through their activity in the underlying brain system as reflected in functional MRI (fMRI) while people rate the four subcomponents for each such memory. I will show that significant experiences are mainly characterized by self-reflection (89%), as coded mainly in the superior temporal gyrus, retrosplenial cortex, precuneus and cingulate cortex. To a much lesser extent (11%), content was also found to code significant memories, mostly in the anterior cingulate cortex, fusiform gyrus and precuneus. No region represented information on similarity in affect and specificity. I will then correlate these results with scales of proximity in space, time and person. Finally, I will ask whether significant places are defined by the experiences that happened in them, people that are related to them or are having a significant value by themselves. I will show that these different components are dissociated in our brain. Taken together, the presented findings suggest that self-reflection is a crucial factor in the formation and maintenance of significance; cognitive distance is related to significance; and this is true for experiences/memories, places/city and people independently.

## TAMAR FLASH

Israeli neuroscientist and control theorist whose research concerns biological motor control, including the motion of the human arm, the effects of neurological damage on motion, and the use of robotics to study biological motion.

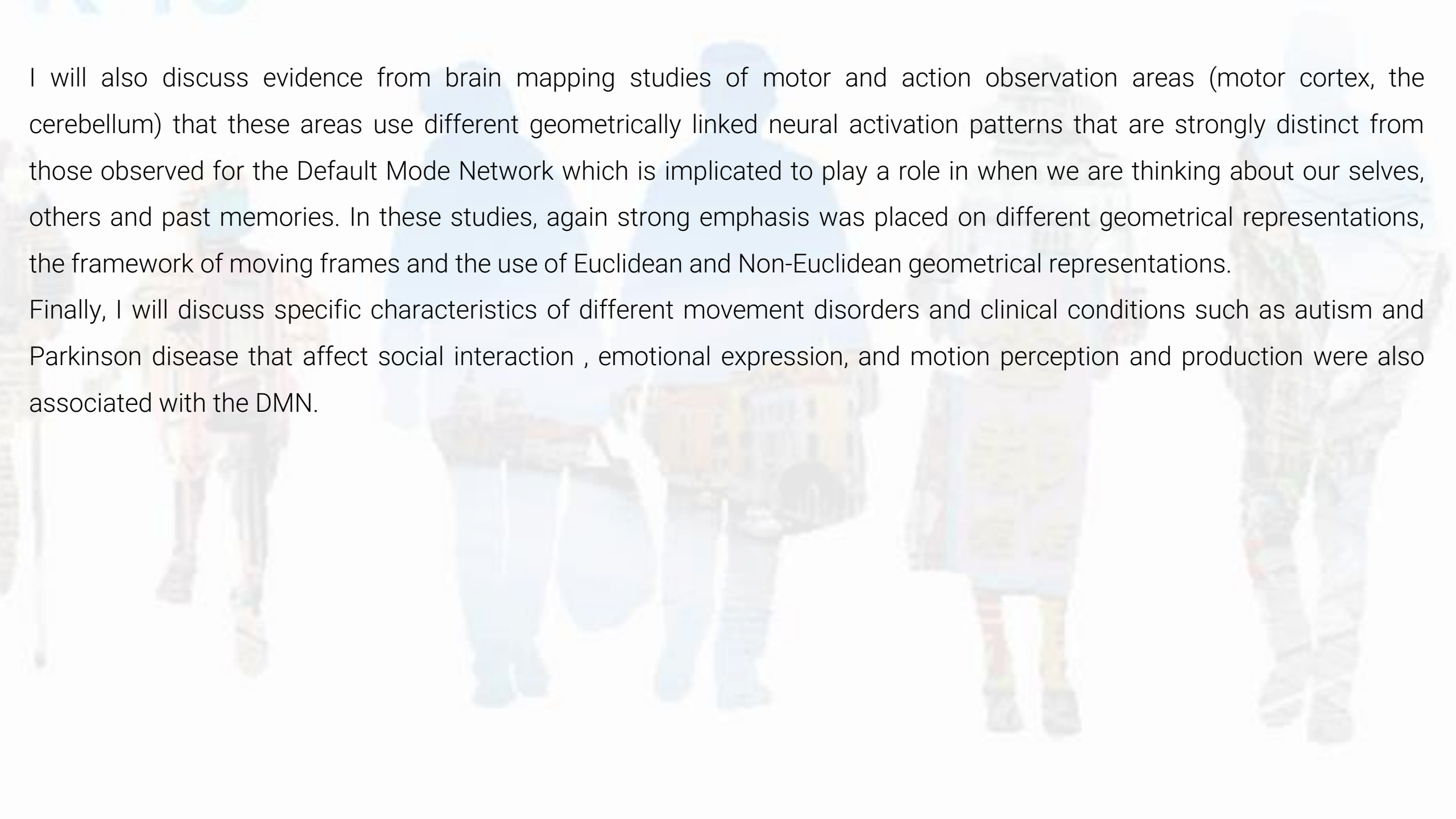




## Movement and emotions

Movements subserve not only means for achieving survival goals but play a very important role in social interactions and emotional expressions. Emotions were described focusing on several different movement attributes such as, speed, duration, force and effort as measures allowing to delineate between different emotions. Such attributes have also been used for example in the arts as in developing different dance notations (Laban, Eshkol-Wachman), with each notation employing and emphasizing different body movement attributes. These attributes, however, are particularly associated with different aspects of motion generation and control, such as motion planning, timing, movement kinematics and dynamics. Hence, in generating anybody or limb movement, be it emotionally neutral or expressing different emotions, the brain needs to control both kinematic and dynamic aspects of the movement.

Moreover, there are quite a considerable number of brain areas and brain networks which are involved in many aspects of movement generation, motion perception, movement imitation, social interactions and also expressing or sensing one's or others emotions. In my talk I will discuss several issues related to the expression of emotion focusing on different topics such as motion timing, energetics, body space and coordinate frames. I will also present evidence that indicates how motor invariants and attributes that are related to body configuration, intersegmental coordination and task level trajectory planning as well as spatiotemporal scaling were used to investigate how these parameters and features are modulated and tuned to express different emotions.

A blurred background image showing a group of people walking. The image is out of focus, showing the lower halves of people in various clothing, including jeans, skirts, and trousers. The colors are muted and the overall scene is indistinct.

I will also discuss evidence from brain mapping studies of motor and action observation areas (motor cortex, the cerebellum) that these areas use different geometrically linked neural activation patterns that are strongly distinct from those observed for the Default Mode Network which is implicated to play a role in when we are thinking about our selves, others and past memories. In these studies, again strong emphasis was placed on different geometrical representations, the framework of moving frames and the use of Euclidean and Non-Euclidean geometrical representations.

Finally, I will discuss specific characteristics of different movement disorders and clinical conditions such as autism and Parkinson disease that affect social interaction , emotional expression, and motion perception and production were also associated with the DMN.

## SILVIE TORDJMAN

Professor of Child Psychiatry, Integrative Neuroscience and Cognition Center (INCC), CNRSUMR 8002 et Université Paris Cité, Paris, France.



## Interactions between changes of locations, emotion, and memory in the processes of mental representations: new therapeutic perspectives for mobile teams in child and adolescent psychiatry

Changes of locations lead to changes in spatial perspectives with changes of point of view that facilitate the mobilization of mental representations. Also, changes in spatial environment with patients in child and adolescent psychiatry provoke a surprise effect and decrease resistances which facilitate the emergence of emotions. Furthermore, emotions ensure the transition from sensations to the elaboration of mental representations. Emotions reinforce indeed mental representations by facilitating the integration of cross-modal sensory information. In addition, emotion facilitates other cognitive processes, such as memory and attentional processes. Concerning memory processes, emotions enable us to “fix” events, just as a photographic fixing agent sets images (Tordjman, J. *Physiol.*, 2010). Emotions associated with the bodily experience of sensations resulting from cross-modal perception play an important part in this process of “event fixing” and the formation of the memory trace. Emotion–memory interaction occurs at various stages in information processing, from the initial encoding and consolidation of memory traces to their long-term retrieval. Taken together, we can hypothesize that changes of locations and spatial perspectives associated with emotion enhance the mobilization and new elaboration of mental representations with the formation/consolidation/retrieval of the memory traces of these mental representations. The interplay between change of spatial perspectives, emotion and memory in the mobilization and new formation of mental representations will be discussed with regard to therapeutic perspectives of mobile teams in child and adolescent psychiatry allowing changes of locations.

## GIOVANNI VECCHIATO

Post Doc Researcher at the Institute of Neuroscience of the National Research Council of Italy in Parma.



## The dynamic architectural experience modulates the EEG theta oscillation during the observation of body expressions in virtual reality

The built environment represents the surrounding stage of our everyday social interaction. However, little is known about architecture's role in influencing our perception of others' affective states, potentially shaping social interactions.

To bridge this gap, we combined virtual reality (VR) and electroencephalography (EEG) and recreated a naturalistic paradigm in which participants observed avatars' body expressions at the end of a promenade in virtual architectures. They dynamically experienced high- and low-arousing architectures and then judged avatars' body expressions' arousal (low, middle, high). High-density EEG was continuously recorded to investigate how the dynamic architectural experience modulates brain oscillations. The observation of high- and low-arousing body expressions elicited a higher alpha desynchronization when compared to middle ones, highlighting an inverted v-shaped relation between the alpha power and the subjective arousal scores. Interestingly, we found an earlier higher theta synchronization when participants observed the body expressions within low-arousing architectures compared to high-arousing ones.

These results shed light on the theta brain rhythms modulation during the perception of body expressions in architecture, possibly linked to the alteration of attentional mechanisms. Findings highlight a straight link between social and space cognition, paving the way for the design of architectures to support human social cognition in the real world.

## PANEL IV

# *Intertwining Neuroscience, Architecture and Philosophy*

Architect, Architecture PhD student (Architettura. Teorie e Progetto) at the University of Rome Sapienza. In 2018, he obtained the Naad - Neuroscience applied to Architectural Design - International Master, at the IUAV.



Chairman  
**Nour Tawil**

November 24, 2023  
H 14:30-19:00



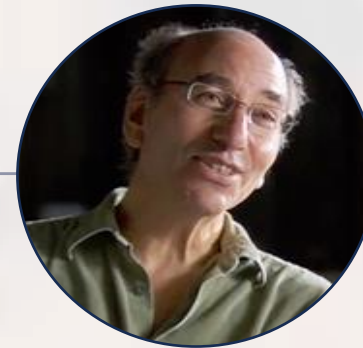
**JOERG FINGERHUT**

Neurourbanist



**SARAH ROBINSON**

Architect



**DAVID KIRSH**

Neuroscientist

15:00

16:00

17:00

14:30

15:30

16:30

17:30

Architect

Philosopher

**ALAN PENN**

**JOHN SUTTON**

**FINAL DEBATE**





## JOERG FINGERHUT

Joerg Fingerhut (Ph.D.) is a philosopher of mind and principal investigator/speaker of the *Research Platform Neurourbanism*. He is also the head of the *Arts and Minds Lab* at the Berlin School of Mind and Brain, Humboldt University Berlin.



## Aesthetic emotions and the city

I will present a 4E (embodied, embedded, extended, and enactive) cognition perspective on architecture and urban design. First, I will provide a brief foundation of the 'urban mind' as based in memory inscribed into our embodied habits and skills through which we bring forth novel experiences.

Second, I will introduce affect-aesthetic categories (such as beauty and interest) as central for the evaluation of public spaces or a particular building we encounter. Our studies have shown that, for example, beauty ratings of spaces strongly correlated with our participants' willingness to meet others in these spaces. In other words, beauty could serve as a catalyst for social cohesion. Furthermore, how interesting our participants found these spaces correlated with their willingness to explore them further. This affective-aesthetic measure could potentially serve as a predictor of the propensity to engage with the public, which could be regarded as a desirable outcome of urban design. Interestingness and beauty also seem to correlate with measures of well-being. Third, I will discuss urban interventions. These encompass performances, displays, challenging architectures, public art, etc. Here emotions such as wonder (a strong form of interest), intense feelings of beauty, and even negative emotions - may play a significant role. I will propose that these are aesthetic emotions interrupt our urban habits, thereby potentially altering the perspective on both the city and ourselves. The focus in this more speculative part is on the future-oriented and transformative. In closing, I will suggest two frameworks to capture these potentially transformative effects within the emerging field of neurourbanism.

## ALAN PENN

Professor of Architectural and Urban Computing at The Bartlett School of Architecture, UCL in London.



**Sharing memory: A putative role of the built environment in providing an intersubjective exosomatic 'memory' may help explain the rapid acceleration in human social, cultural, and technological evolution after the Holocene transition**

I have previously proposed a series of processes through which social forms might become embedded in the built environment (Penn 2022, IAS Paris). I suggested that these processes were emergent and depended not only on the logic of what it is possible to construct in the built environment, but also on the economic and social outcomes of human movement and occupancy. I showed how it was possible that these processes might give rise to regularities in features of the environment, and that these features these might co-vary so that perception of one could allow inference of another and so allow the world to be learnable or intelligible to human subjects. Since the processes involved in the creation and occupation of the built environment were social and economic, the structures of society and economy might also be inferred.

I suggest that this form of 'storage' and 'retrieval' of information about social, cultural, and economic forms may play a role in making these forms heritable – that is in extending their scale of influence beyond the immediate social group involved in their construction as well as beyond the contemporary, to influence future generations. If major evolutionary transitions in biology are defined by 'a change in the way that heritable information is stored and transmitted' (West et al, 2015; Szathmáry & Maynard Smith, 1995), then the invention of dense protourban settlements in the ancient near east may mark one such transition.

The question this raises for cognitive and neuroscience is what were those structures in human cognition that must already have been present to allow for this transition to take place?

There are several aspects to this:

- The importance of emotion in setting a direction for human development; both the things we seek to attain and those we seek to avoid. I will suggest that prospect and refuge are likely to have been involved;
- The importance of our ability to consider relations as well as objects seems central to many other capacities including or ability to reason about causality;
- The importance of our ability to develop an allocentric understanding. This may relate to our capacity for empathy or theory of mind, but in an important sense to consider this not only from a single 'other' point of view, but from 'all' other points of view;
- The ability to conceive of space and time at different scales is closely related since 'all other points of view' span both temporal and spatial scales;

Approaching these questions from the perspective of architectural research, and bringing empirical examples from research will bring questions for cognitive and neurosciences rather than answers but may help the discussion in Venice.



## SARAH ROBINSON

Architect, writer and educator. She was the founding president of the Frank Lloyd Wright School of Architecture Board of Trustees, is Adjunct Professor in Architecture, Design and Media Technology at Aalborg University, Denmark, teaches and is a member of the scientific board of NAAD, Neuroscience Applied to Architectural Design at IUAV, Venice and an Advisory Board Member of the Academy of Neuroscience for Architecture at the Salk Institute. Her most current project, the documentary short film, What Design Can Do, will premiere at the Intentional Spaces Summit in Washington DC this autumn.

## Memory and Resonance

This talk is a reflection on the kind of memory of place that Bachelard describes in the *Poetics of Space*: «*The house we were born in is physically inscribed in us. It is a group of organic habits. [ . . . ] The feel of the tiniest latch has remained in our hands*». And explores how this sort of muscular memory is situated and practiced and can be understood in terms of a theory of resonance. Resonance is considered here as both synchrony and amplification, and as both a metaphorical and mechanical process. And then asks the very practical design question—how can we design memorable places that appeal not as monuments or landmarks, but that reverberate and move us on a visceral level? Or, as Bachelard would put it—places that we can experience in their “*intimate immensity*?”

A background illustration showing several stylized figures of people walking. The figures are rendered in a light, sketchy style with various colors like blue, orange, and grey. They are walking from left to right across the frame. The overall tone is soft and artistic.

## JOHN SUTTON

Professor Emeritus Professor at Macquaire University Sydney, Department of Philosophy  
Centre for Ageing, Cognition, and Wellbeing Centre for Elite Performance Expertise and  
Training (CEPET): Application University Research Centre for Agency, Values and Ethics  
(CAVE).



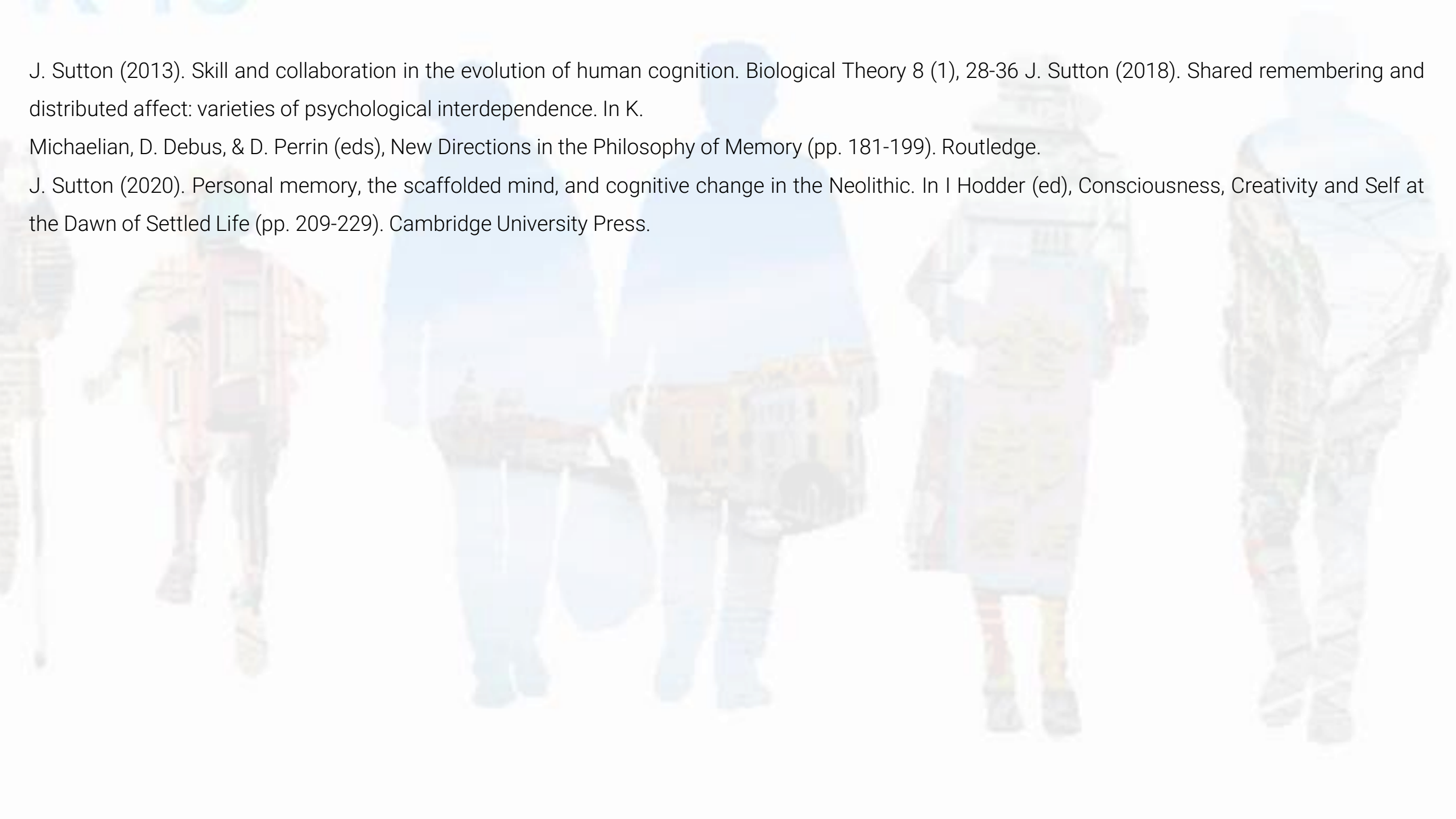


## **Moving Memories: social and distributed emotion-regulation in the city**

As Alan Penn and others argue, urban environments have since the Neolithic transformed demands on our neural and cognitive processes, driving the cultural evolution of 'exosomatic memory' or 'exograms' (Penn 2018; Sutton 2010, 2020). Through new forms of material information-transmission and increased social interaction, relative both to non-human animals and to smaller Palaeolithic human communities, we became a species apt to incorporate artifacts and resources from our natural and built environments into distributed cognitive systems spanning brains, bodies, and world (Clark 2008), with brains tuned to guess, predict, and shape our surroundings (Clark 2023). I apply this framework to two issues about memory and emotion in modern urban settings – how memories literally move us in rich interaction with affective and motor processes. I examine studies of expert populations in urban navigation, probing the effects of familiarity and the nature of deep place knowledge of cities (cf Penaud et al 2022). And I survey research on individual and social uses of built environments in managing emotions over time, suggesting that distributed cognition offers a fruitful lens for understanding the integration of past and present emotions in the city.

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A faded, low-angle photograph of a group of people walking away from the camera on a sidewalk. The image is semi-transparent and serves as a background for the text. The people are dressed in casual, everyday clothing, and their forms are slightly blurred, suggesting movement. The lighting is soft, and the overall tone is muted and historical.

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## DAVID KIRSH

Professor, Past Dept Chair, Cognitive Science. UCSD, La Jolla. President: Academy of Neuroscience for Architecture. Director, Interactive Cognition Lab. He received a D. Phil.(Oxford), did post-doctoral work at MIT (AI Lab). He is Adjunct Professor at Trinity Laban Conservatoire of Music and Dance.



## Atmospheres

I will review, at high-speed, the promises and challenges of identifying the atmosphere of an architectural space. By unifying older technologies and adding new ones there is hope of developing near real-time reading of emotions. But there are deep obstacles preventing inference to the architectural features that might be the cause of an emotion or a mood. I will review these obstacles as well as describe the methods that might be used for near real-time emotion detection and draw some conclusions about the near-term direction of research.

