

Shared Behavioral Outcomes Linked to Brain Research

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“We design places, but we only know how to measure spaces” observed Upali Nanda of the A/E firm HKS on day one of the fourth International Conference of Academy of Neuroscience for Architecture (ANFA), held at Louis Kahn’s ever-inspiring Salk Institute in La Jolla. When it comes to examining how people experience built environments, what is it exactly that research scientists and designers can measure, and what might those measurements mean? For anyone looking for empirical research to help them understand the interface between building design and human behavior, this methodological question precedes nearly all others. Do we survey, observe and analyze brain cells firing? What would that tell us? Would we learn more by looking at the research of environmental psychologists and at studies in embodied cognition?

Some 300 attendees heard presentations and attended poster sessions offered by 110 designers and scientific investigators from the U.S., Canada, United Kingdom, Denmark, Germany, Switzerland, Italy, Kuwait, Russia and Brazil over 2 ½ days this past September, tilling the fertile terrain that lies between neuroscience and architecture. There is, noted Sergei Gepshtein, a neuroscientist at Salk Institute, even large gaps between how the scientist, the designer, and the user of a building comprehend space. Is space a subject-independent, mathematically defined reality? Or is it always *constructed*, phenomenologically, psychologically, and socially? Gepshtein’s careful analysis of the difference between mathematical and phenomenological space exemplified the methodological issues at stake during the conference at large. In actuality, space is both of these and more; it is physical, physiological, poetic, narrative, and imaginative all at once. That makes conducting a control study to test hypotheses difficult.

Despite the complexity of the methodological questions and social analyses on the interaction of human behavior in the environment, ANFA’s conference offered an inspiring array of possibilities and research questions that, taken as a whole, brought us one step closer to constructing a sturdier foundation for neuroscientifically grounded, evidence-based design.

Conscious or Unconscious Act

For Mehrdad Yazdani, a keynote speaker, the act of design “is a very messy process; it is not linear.” As Principal and Director of The Yazdani Studio of CannonDesign, he said that he constantly moves back and forth between the imaginary world and the real world; between poetry and data science; and between the ineffable and that concrete. Drawing, sketching and painting is his way of initially responding to programmatic needs and site specific constraints. For years, Yazdani was infatuated with potato chips – their simple geometries offer infinite possibilities for architectural space, such as in the firm’s Bollywood Museum in Mumbai. His creativity has also been influenced by his origin. As a child in Iran, Yazdani wrote in Arabic and his hand still naturally goes to drawing curves. In this age of rapidly changing technology, he feels that the traditional boundaries between client, architect, and scientist are blurred. As we consider new typologies, we must accept new collaborations.

Nature & Workplace

Biophilia, as Bill Browning of Terrapin Bright Green reminded the audience, started as a hypothesis propounded by the biologist, E.O. Wilson, in 1984. Browning, an architect, reviewed the subsequent studies that demonstrate the restorative and cognitive benefits that access to nature, natural views, nature-inspired art and more confers upon building occupants. Alex Coburn, from UC San Francisco School of Medicine, added to Browning's biophilic arsenal by demonstrating that scaling architecture incrementally with fractally-inspired patterns of leaves and ocean waves corresponds with improved memory and mood. Stephanie Park, a strategist at WeWork, spoke of how her company, with 287 locations in 23 countries, is documenting on a daily basis through surveys, interviews and sensors how customers are reacting to different office configurations and embellishes, nature included, in order to deliver the optimal experience.

In a research project called "Wellbuilt for Wellbeing," Casey Lindberg, a researcher at HKS and the University of Arizona Institute on Place, examined 230 people over three days and two nights, doing different work assignments across different sites and different offices. Research subjects wore mobile IEQ nodes to measure sound and CO2 levels, temperature & relative humidity, and their heart rate variability was detected using an ECG test. Subjects also responded hourly to a survey app. The study data found from recording heart electrical activity that there was a positive correlation between office participants feeling relaxed and experiencing a conference room conversation below ~ 51 decibels. Additionally, Lindberg and his team discovered that pre and post occupancy surveys may not represent what happens when you ask someone their opinion in 'real time.' Typically, a POE indicates that workers favor private offices. But his findings suggest that this bias is not present when workers are queried while sitting in either partitioned or open spaces.

Urban Space & Place-making

In *Beyond Culture* (1976), Edward Hall asserted that "the sophisticated architect pays lip-service to the man-environment relationship and then goes right on with what he was doing anyway." Andrew Brown, Research Director for the Van Alen Institute in New York City, began with Hall's quip to say that today, urban planning and design can be more accountable, owing to the development of metrics on human behavior. Presenting data from research projects in West Palm Beach, FL and London revealed relatively low-tech ways to conduct such research. Further examples were given by Robin Mazumder, a former occupational therapist and a current Ph.D. student at the University of Waterloo, but with a twist. Mazumder explained that after completing his studies, there were no significant results measured by either a Positive & Negative Affect scale or Mood/Arousal test. In science, this is called a null hypothesis. Yet this experience has led him to asking better questions. More successfully, Rachel Zuanon from Sao Paulo, reported on how she has measured for the possible connections between historically significant building sites visited by her study subjects and their neurophysiological places of memory.

Stress & Restoration in Corrections

Solitary confinement changes the activity of neurons. Dr. Huda Akil, former president of the Society for Neuroscience and current research professor at the University of Michigan, discussed how effects such as lack of control, predictability and depression over many days can reduce the size of a prisoner's brain. If behavioral reform is the intended outcome, Akil continued, complexity, enrichment and novelty in the design of correctional facilities is imperative. Natural light and sleep cycles are also critical. Professor Satchin Panda of the Salk Institute demonstrated that long term disruption to people's natural circadian rhythms (inmates as well as guards) is likely in the long run to lead to PTSD, delirium, psychosis and Alzheimer's disease.

Environments that Support Learning

What child dislikes exploring? Marianne Halblaub and Maria Ustinova from the University of Darmstadt introduced software for iPads & Tablets which allows primary school children to capture the environment around them for class driven learning exercises. DLR Group with consultant INSYNC presented a post-occupancy study for a recently completed high school population of 3945 students and 523 teachers. Based on self-reported, statistically significant data, alpha, beta, and omega testing revealed that students greatly valued their physical environment, and their engagement and performance increased with better-designed buildings and outdoor spaces.

A team from the ETH Laussane concluded, from classroom volunteers who wore glasses equipped with spectrometers and headbands measuring RGB primary colors, vertical luminous and radiance, that red-impooverished light is more effective in stimulating childrens' attention than neutral daylight (due to a concentrated blue, short-wavelength of light that suppresses the hormone melatonin).

Safety in schools is a rising concern, particularly in the United States. Perkins Eastman Partner Betsey Dougherty led a panel discussion on designing 'safe' buildings. "Transparency, adjustability and interconnected spaces" work better than "opacity, separation and controlled spaces" according to John Dale, a Pre-K-12 Studio Leader for Harley Ellis Devereaux. Fear rewrites a person's memory by triggering proteins in the brain, but it is possible to change the context from negative arousal to emotional comfort through spatial design, noted Dr. Akil. Dr. Tom Albright of Salk Institute cautioned that designers need to find ways to physically control without sending the wrong message -- a feeling of threat can be elicited through 'associative learning' when bars and gates are introduced.

Exploring the areas where cognitive scientists and built environmental designers overlap remains a bit of a dating game. A growing group of practitioners and researchers from each field are demonstrably interested in their counterparts, but also recognize that they have insufficient command of the other's capabilities and disciplinary view. Still, this year's ANFA conference conclusively demonstrated that there's enough interest and productive research on both sides to keep the conversations growing.

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