Cultivating a culture for Neuro-Architecture

Linking cognitive science to architectural experience in design education

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Can Cognitive Science inform Architectural Practice and Theory? How might advances in neuroscience provide a link to understanding the human experience of the built environment?

These questions serve as the basis for a Neuroscience & Architecture graduate seminar where architecture, planning, and landscape architecture students convene to examine neuroscience scholarship with implications for improving public health through the built environment. By gaining a greater awareness of the reciprocal relationship between humans and the environment, prospective designers have the ability to apply this knowledge, and methodologies which probe this relationship, to the design process.

This poster provides a conceptual model for integrating neuroscience into an architecture curriculum, and details advantages to studying potential links between neuroscience and architecture in design education.

Learning outcomes include:

- ***Understand*** **environment-based human needs and interactions using knowledge from the neurosciences**

A student will explore the body of knowledge that informs how humans perceive and respond to the environment, and will examine the ways in which settings influence individual and social behavior. The student will develop an awareness of and ethical disposition toward livability and inclusive design.

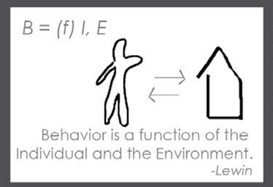
- ***Analyze*** **these needs and interactions by synthesizing cross-disciplinary research**

A student will be able to gather evidence to inform design by searching research manuscripts across disciplines , and distinguish between more and less robust studies in research design and methods. The student will be able to understand terminology, synthesize information, and compare/contrast relevant studies.

- ***Apply*** **appropriate responses to design**

A student will demonstrate an ability to correlate current research to potential applications in design with the result that the design performance is improved by the evidence provided.

Background & Significance



Evidence-based design

Clients are increasingly demanding research, and research is adding value to the design of their capital assets. Evidence-based practices originated in the medical field in the 1990's and were translated to the architecture realm by healthcare clients requesting that similar measures be applied in the design of their own (healthcare) buildings [1]. It has since percolated into the design of other building typologies including educational, justice, and aging facilities. Thus, there exists an emerging evidence-based design culture.

A Call to Action

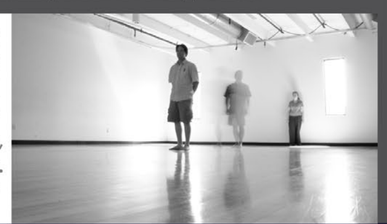
Design education needs to be reconsidered in order to better prepare future designers to respond to this cultural shift. The architectural profession can be *evolutionary* about this change and hand over its management to research specialists, or *revolutionary* about the future so that opportunities are created for designers to manage change in the profession. By creating a new culture of participation in collaboration with research experts, practitioners can enhance, not replace, the work force, and moreover, guide and contextually situate the application of research results so that the quality of the built environment is improved.

Why Neuroscience?

How might neuroscience knowledge inform evidence based design?
Lewin's equation, B = f (I, E) describes behavior as, "a function of the individual and the environment"; such that, behavior is the result of not only the person, but moreover of the environment in which they find themselves, whether it be a social or physical situation, real or imagined [2]. Assuming that the individual (I) experience of the environment (E) is largely based on sensation-perception, sensory and perception systems rooted in the brain and body serve as a foundation to understanding behavior, because perception and sensation govern and influence, and are themselves affected by more complex neuroscientific processes such as emotion, attention, and cognition. In this way, neuroscience can provide a vehicle to studying the dialogue between the human experience and the designed environment.

Recent discoveries in neuroscience suggest that the brain's plasticity is directly affected by the environment. As technology continues to advance, neuroscientists are able to characterize the functioning human brain and its response to environmental stimuli in a more precise way, allowing designers to more specifically support behavior having a greater understanding of the relationship between the individual (I) and environmental (E) variables.

Every significant experience of architecture is multi-sensory; qualities of matter, space and scale are measured equally by the eye, ear, nose, skin, tongue, skeleton and muscle.
- Juhani Pallasmaa [3]



From form-centric to performance-based pedagogy

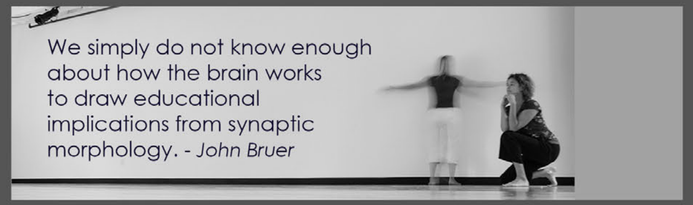
During the 2008 Accreditation Review, the National Architectural Accrediting Board (NAAB) received input from many sources for recommendations on its 'Conditions and Procedures for Accreditation' (2009) in order to address and adapt to the changing profession. Among the task groups reporting to NAAB to advise upon policy changes, the 'Trends in the Professions' group ranked 'Research/evidence based design' in their top five priorities of issues related to education as viewed from a professional point of view with the justification that, "Future design will be based upon the use of empirical data established through research and testing. Decisions will need to be factually based. This will link knowledge and aesthetics, bridging the gap between the qualitative/quantitative divide" [5]. In addition to other gains, upholding research as a priority to be addressed in education will create "a unifying currency between academe (seeking of knowledge) and practice (application of knowledge)" [5]. This stance is echoed by NCARB in their 'Position Paper for the 2008 Accreditation Review Conference' which acknowledges that "innovation and responsiveness in design is based upon a solid foundation of empirical knowledge and research in all applicable content areas that influence decision making" [6]. Of specific note are the following qualifying considerations determined by the NAAB task group for 'Research/evidence based design':

- "Particular consideration should be given to the pedagogy by which students seeking a first professional degree might interact with research, and might include an externship or internship requirement as well as fundamental skills in research methodologies" [5];
- "Research must advance the discipline not just create knowledge"; [5]
- "Does the school have a formal research program and how does this program elevate the first professional degree program? How does the research program engage the marketplace?" [Steidl, 2008, 4]

These provocations are timely and representative of the place for research in the changing professional culture.

A Conceptual Model

In the case of neuroscience and architecture, methods of knowing and learning about the environment lie at extreme ends of the research spectrum, and knowledge acquisition to become an expert in either field takes years of graduate study. The pedagogical shift from a form-centric to a performance-based strategy for design requires negotiating a balance between the rigor of academic-based research and the relevance of applied research. The goal is to preserve the positive attributes and mitigate the cons of both ends of the spectrum.

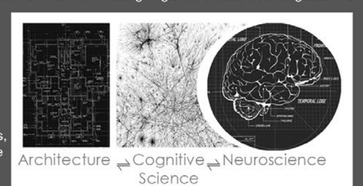


Is Neuroscience and Architecture "a bridge too far"?

This phrase is borrowed from John Bruer's 1997 publication speaking against "brain-based education and policy" which at that time was attempting to establish a direct correlation between neuroscience and education. It served as a warning to scholars that: "We simply do not know enough about how the brain works to draw implications from synaptic morphology" [4]. As an alternative, Bruer promoted a model which would triangulate knowledge using the discipline of cognitive psychology as an indirect bridge to link the two disparate disciplines. Similarly, in the case of neuroscience and architecture, the aim is to achieve ecological validity between an experimental situation and a natural situation, and we can implement a similar model using cognitive science to triangulate the disciplines.

An Interdisciplinary Approach

Cognitive science is interdisciplinary because it includes knowledge from neuroscience, as well as from fields such as psychology, artificial intelligence, linguistics, neuroscience, anthropology, and philosophy. As such, it allows scholars to study an issue by examining it using multi-disciplinary methods, and across various scales of experience. Through the interdisciplinary lens of cognitive science, designers can establish a relational understanding between neuroscience and architecture and arrive at a more holistic reading of the human-environment relationship.



Course Content

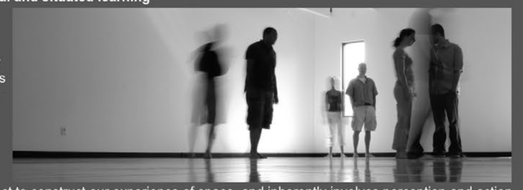
Learning Outcome: Understand environment-based human needs and interactions using knowledge from the neurosciences

Experiential learning and case study activities supplement lecture content to help students test and explore relationships between neuroscience and the environment. Course topics include:

Creativity and social creativity | Perception & Sensory Systems | Cognition | Emotion
Art and Aesthetic perception/cognition | Learning | Navigation & Wayfinding | Memory |
Inclusive Design | Blindness and low vision | ADHD, Autism and Dementia | Movement & Kinesthesia

Lessons rooted in experiential and situated learning

- *Embodied cognition*



The theory of embodied cognition proposes that cognitive processes are deeply rooted in the body's interactions with the world, that cognition is a situated activity taking place in the context of a real-world environment and based upon interactions with the environment. It describes how the mind, brain and body interact to construct our experience of space, and inherently involves perception and action. As a means of triangulating readings and lecture material on embodied cognition, students participate in a movement workshop working together as an ensemble in a series of physical exercises cultivating spatial awareness through the body's temporal, kinesthetic and shape response.

Modeled after an exercise created by Wendell Beavers, Naropa University, "Experiencing space and time through the Viewpoints: An Inquiry into the Relationship between Experiencing, Conceiving, and Creating".

- *Inclusive Design*

Inclusive design, specific to cognitive ability, is a timely issue for designers because research emerging from the neurosciences can inform how cognitively accessible certain environments, or features within the environments, are for the populations using them. Existing design guidelines for cognitive accessibility are not widely recognized in the same way which guidelines for physical accessibility are. The Denver Art Museum, an environment which is reported to create unintended perceptual challenges for some users, served as a case study to frame a debate on ethical issues surrounding design and cognitive accessibility.

Learning Outcomes: *Analyze* these needs and interactions by synthesizing cross-disciplinary research
Apply **appropriate responses to design**

Course Projects

To achieve learning objectives correlating research and application, the students first perform scholarly research (literature searching) using a range of disciplinary sources (neuroscience, psychology, philosophy, business management, e.g.) in order to understand various approaches and methods of inquiry on a topic of their choosing. Secondly, the students apply this research evidence to an existing case study environment by performing an "environmental audit" which assesses an aspect of human performance in a designed environment. They create a set of proposed design guidelines, criteria or modifications, grounded in research, for the existing designed environment which would support the human condition and desired behaviors being explored.

Example Part 1, Literature Review (Carrie Hadley, June 2011):
Ambient Color and the Environment: Does ambient color affect mood, emotion and behavior?
It has been well documented by psychologists and business marketers that color in an environment can lead to emotional and behavioral response. Unfortunately, these studies just analyze behavior and subject responses, leaving scientists wondering if there is a brain response to ambient color. With the help of fMRI technology a collaborative group in Switzerland has studied neuro responses to ambient color. The following will review and compare neurological and environmental studies that have been conducted on human response to ambient color.

Example Part 2, Environmental Audit (Carrie Hadley, June 2011):
King Soopers versus Whole Foods: How color in the environment affects customers' perception of health
Using research evidence gleaned in Part 1, in this environmental audit the lighting and color variables in the produce departments of two local grocery stores were compared in order to propose design guidelines which address consumer behavior associated with perceptions of quality and nutrition.

References

[1] Griffiths, R. (2004). Knowledge Production and the research-teaching nexus: the case of the built environment disciplines, *Studies in Higher Education*. vol. 29, 6, 709-726.
[2] Lewin, K. (1936). *Principles of topological psychology*. New York: McGraw-Hill.
[3] Pallasmaa, J. (1996). *The Eyes Of The Skin: Architecture and the Senses*. London: Academy Editions, 28.
[4] Bruer, J. (1997). Education and the Brain: A Bridge Too Far. *Educational Researcher*. 4-16.
[5] Steidl, D. et al. (2008). Report of Trends in the Professions Task Group. Presented to the National Architectural Accrediting Board, Winter Board Meeting February 29 – March 1, 2008. Retrieved November, 24, 2008 from www.naab.org/accreditation/2008_accreditation.aspx.
[6] NCARB. (2008). NCARB Position Paper for the NAAB 2008 Accreditation Review Conference. Retrieved November 24, 2008 from www.naab.org/accreditation/collaterallinks.aspx.
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