

Dreaming Architectural Spaces into Reality

A Digital Platform for Generating Architecture Form from Cognitive Responses

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I. EXTENDED ABSTRACT

The tools that we use to design architectural spaces have evolved dramatically over the past twenty-five years. The evolution in the technology of design tools has shifted the expected skills and expertise required in the architecture profession as well as shifting architectural aesthetics based on the evolving digital mediums.¹ Despite the many changes in technology, in both mechanical and digital paradigms, the use of our hands and sight have continued to play the most primary role in creating a design. A change in the emphasis in design from the mastery of fine motor skills to a post-handeye generative process that uses only a cognitive practice has the power to innovate the current aesthetic and functional norms of architecture.²

Quantifying the relationship between architecture and cognition for the purpose of innovating design processes is an evolution of the epistemological ideals of phenomenology and architecture that have been actively explored since the late nineteenth century by Heidegger, Husserl, Dreyfus, and Merleau-Ponty. The pursuit of evolving phenomenology to a more quantitative practice allows architectural design to be derived from an intentional creative process that removes itself from the often questionable happenstance of architectural form-making. The form-making manifesto of the "iconic" structure was a turn of the century ideal of the micro (individual) and the macro (citywide) level "brandscaping" agenda. The new architectural manifesto being realized today responds directly to the needs of society, through digital connectivity, social agency, and the functional improvement of existing environments. The digital realities of new technology and their rapid integration into society demand a reinterpretation of personal and social spatial "needs" that include improving existing environments as well as respond to the experiential values and the growing demand for systems of immediate materialization. A digital manifestation of phenomenological experiences is pertinent to a future generation whose social culture reflects a desire to visually define individualistic epistemological inquiry and address inevitable digital futures, while embracing the continued importance of real life experiences.

Using a cognition-based digital platform, designers of the future will have the ability to solely use the powerful human function of cognition to form a architectural space that creates a meaningful spatial experience for both the designer and user of an occupiable form. Emotional responses to existing environments and built architectural forms trigger brain activity which can be measured using portable EEG brain scanning or stationary fMRI equipment.³ Using the quantitative figures from cognitive responses to architecture in conjunction with eye tracking and visual recording technology, we can begin to map a taxonomy of existing forms which prompt particular emotional recourses.

Using this architectural categorization of emotion evoking forms, we can create a computational framework which uses a series of pre-formulated shape grammars and successive geometries to create individual architectural manifestations which are formed from EEG brain activity data engendered by spatial occurrences or emotional experiences of a user. The digital manifestation of a psychological experience mediates between a personalized existential realization and the real life experience of one's surroundings. The architectural result of the cognitive tool acts as a intermediary between an emotional experience and the physical space which might inspired those thoughts.

The cognitive design tool is developed using a historical taxonomy of forms connecting neural activity with spatial conditions.⁴ Human subjects are then used to collect EEG and visual tracking data from a controlled set of experiences. Test subjects re-watch their set of experiences and self-report on their emotional thoughts at specific moments in order to combine both quantitative data from EEG scanning with the qualitative data of self-reporting on emotional activity. This data is used to quantify spatial instances that are captured using the visual tracking eyewear. The data from this phase is used to create the taxonomy of architecturally specific forms which link particular emotions with specific spatial conditions.

Computationally programming a series of shape grammars and progressive geometries combining the elements of the architectural form taxonomy with the multitude of complex series of emotional states provides the digital tool will a library of optional instances that are produced by a combination of neural activity. The design tool produces a 3D model of the combined architectural forms as a result of a brief timeline of cognitive activity.

The intention of this cognitive design tool is to: a) transform our notion space by developing an entirely new tool for realizing architectural design; b) train designers to have more diligent control of their cognition by assigning form making algorithms associated with neurological stimulation; c) create meaningful and unique spaces that have not been created before due to learned aesthetics in the architecture practice today; and d) open up the practice of design to those who are limited from using their hands or sight in the design process.

The results of this design inquiry can be used to initiate a series of individualized experiences of architectural sites which respond to the visitors emotional states. This cognitive design tool is only a stepping-stone to visually articulate architecture which is responsive to the constant fluctuations of human thought and emotion.

2. REFERENCES

¹ Picon, A. (2010). Architecture and the Virtual. In Constructing a New Agenda: Architecture Theory 1993-2009 (1st ed., pp 268-289). New York: Princeton Architectural Press.

² Goulthorpe, M. (2010). Parametric Profligacy, Radical Economy. In Building (in) the future recasting labor in architecture (pp. 44-59). New York: Princeton Architectural Press.

³ Arbib, M. (2015). Toward A Neuroscience of the Design Process. In Mind in Architecture: Neuroscience, Embodiment, and the Future of Design (p. 82). Cambridge: The MIT Press.

⁴ Mothersill, P. (2014). The Form of Emotive Design (Master's Thesis). Retrieved from http://emotivemodeler.media.mit.edu/images/Mothersill_The%20Form%20of%20Emotive%20Design%20Thesis.pdf