

4E Cognition for Symbiotic Architecture?

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Abstract

With the aim of reconsidering the very nature of architecture, we propose a conceptual tool to think of architectural apparatuses as actors within a continuum composed of both artificial and natural agents. For this, we look at the cognitive sciences, particularly the 4E cognitive (embodied, embedded, enactive, and extended). We use examples from contemporary architecture to test our hypothesis and thus attempt to define what symbiotic architecture could be.

Keywords

4E cognition, Embodied, Embedded, Enaction, Extended, Symbiotic, Architecture, Artificial, Natural

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Introduction

In this paper, we will explore a theoretical tool to think symbiotic architecture. To this end, we consider whether the transposition of the 4E cognition may be useful in describing the characteristics of what the symbiotic architecture might be. The paper is organized as follows: Firstly, we set the context and define the terms used, such as symbiosis and 4E cognition. Then we state our hypothesis of an analogy between 4E cognition and architecture. Next, we test this idea with examples of recent architectural apparatus, and we conclude.

Context

In 1960, as Gordon Pask stated in his theory of conversation, we moved from a functionalist world to a mutualist world. Today, in the context of the global crisis, nature is coming back into the loop. The ecocentric logic would reinscribe us in a network of multiple interactions and concrete connections with the milieu, engaged in a network of dependencies in a way of decentralized connections.¹ Nature and artifice are bound to co-evolve. Under these conditions architecture can certainly no longer be the static and fixed object of the moderns but a new type of artefact. Architecture may have entered the age of naturalization.²

Definitions

Etymologically, the term symbiosis comes from the Greek and means "living with." In biology, symbiosis refers to associations between hetero specific living organisms. There are three forms of symbiotic association: parasitism, commensalism and mutualism. It depends on whether the relationship is unidirectional or bidirectional and beneficial, neutral or harmful. Semiologists study these interactions. On the other hand, in the field of cognitive sciences, the 4E cognitive approach proposes a conception of cognition as an assembly of the brain, the body and the environment. The 4E approach is based on four concepts: embodied, embedded, enactive, and extended.

Embodied cognition is cognition produced in part by structures other than the neural system. Embodied cognition rejects Cartesian dualism, separating the body from the mind, and includes the body in the cognitive

system.³ The body is an integral part of the cognitive system, for example, we perceive relief thanks to the stereoscopic vision of our two eyes.

Embedded cognition is cognition coupled with the environment. Thought is not, as it were, secreted by the brain but by the environment.⁴ The extension of the body into its environment reduces loading and relieves the brain.⁵ Enactive cognition is cognition produced in part by actions.⁶ We note here the importance of movement in the process. Extended cognition, a cognition situated in the environment, is an externalisation of processes in our environment. In the context of digital technologies, cyberspace would become an extension of our brain.⁷

Hypothesis

Our hypothesis is the following: if architectural apparatus supported 4E cognitive activities, then architecture would become symbiotic. For this purpose, inhabitant/architecture/milieu has to constitute a form of dynamic coupling, connecting natural and artificial actors. To test our hypothesis, we present below an architectural project example for each of the four E categories.

Embodied architecture

The Urban Algae Folly, designed by EcoLogicStudio for the EXPO Milano 2015. (1) The microalgae cultures embedded in the architecture allow to control transparency and shading qualities of the membrane are the result of algae growth depending on the sunlight and the presence of visitors.

In this example, not only do the algae have the dual role of sensor-actuator, but they are distributed over the entire surface of the device. All parts of the building body are sensitive and responsive, intelligence is distributed, embodied in every square centimeter of the material.

Embedded architecture

HygroSkin, Meteorosensitive Pavilion by Achim Menges' team is part of the permanent collection of the Frac Centre since 2012. (2) This meteo-sensitive architecture is the result of research into materials that react to

variations in their environment. The device is inspired by the pine cone principle. The multi-layered wood reacts to humidity, the holes open and close depending on the degree of humidity in the air. The heterogeneity of the material allows the deformation of the surface, as each layer does not have the same expansion coefficient. In this example, the architecture is coupled to the environment in a unidirectional link that gives it shape.

Enactive architecture

In 2003 Kas Oosterhuis/ONL agency was invited to create an installation for the exhibition Non-Standard Architecture. (3) The NSA Muscle is a pneumatic interactive device composed of 72 muscles programmed to be 72 independent members of a single swarm. The 72 inflatable muscles are controlled by individual valves. The device is programmed to have its own behavioural cycle, but also to react instantaneously to an external stimulus. In this way, ONL materialises the concept of two-way communication in real time linking two active elements, in this case, the inflatable device and the users. The users interacting with the Muscle quickly learn how the Muscle reacts to their actions, and a game is established in this communication.⁸ We are in a case of bidirectional relationship, in which the movements of each of the protagonists (human and non-human) are part of the same process.

Extended architecture

Hylozoic Ground by architect and sculptor Philip Beesley was selected to represent Canada at the 2010 Venice Biennale in Architecture. (4) Beesley's installations are immersive environments that question the boundaries between the natural and the artificial, the human and the non-human. These hybrid devices are micro creatures, half environments, half mechanical, half biological. The visitor, by his presence, movement and breathing, activates a wave of reactions from the device. He is thus inscribed in a respiratory cycle and through his interactions becomes one with the installation within the same metabolism.

The environment supports a mutual empathic relationship that initiates a reactive movement, an exchange of particles and an air cycle between the system and the visitor. The visitor's own body limits are questioned. Philip Beesley named this type of behaviour: diffusive architecture.

Conclusion

The opposition between the living and the artefact is replaced by an isochronism of natural and artificial phenomena that continues to hybridize. Symbiotic architecture could be seen as a cyber-physical-human system within the natural artificial continuum. The opposition between the living and the artefact is replaced by an isochronism of natural and artificial phenomena that continues to hybridize. With these four examples, we have seen that architectural devices can support relational processes at different scales (within the material itself or with external elements), in a unidirectional or bidirectional way, beneficial to a single actor or to several. What the 4E approach shows is that architectural symbiosis needs to be based on a multiplicity of interactions and actions. Borrowing the concept of the 4 E's (embodied, embedded, enactive, and extended) from the cognitivians, we wanted to sketch a reading and writing grid for architectural design, our next research object. It would allow gathering under one concept the different current appellations such as dynamic, flexible, sensitive, transformable, adaptable, interactive, intelligent and moreover.

- (1) <https://www.ecologicstudio.com/projects/urban-algae-folly-2-0>
- (2) <https://www.icd.uni-stuttgart.de/projects/hygroskin-meteorosensitive-pavilion/>
- (3) <https://www.oosterhuis.nl/nsa-muscle-centre-pompidou-paris/>
- (4) <https://www.philipbeesleystudioinc.com/sculpture/hylozoic-ground-venice-biennale/>

References

- 1 C. Larrère, R Larrère, *Du bon usage de la nature : Pour une philosophie de l'environnement*, Flammarion, 2009.
- 2 M-A. Brayer, F. Migayrou, *Archilab 2013 : Naturaliser l'architecture, Vol. Rencontres internationales d'architecture Orléans*, Editions HYX, 2013.
- 3 A. R. Damasio, *L'erreur de Descartes : La raison des émotions*, M. Blanc (trad.), Editions Odile Jacob, 2010.
- 4 A. Prochiantz, *Machine-esprit*, Editions Odile Jacob, 2000.
- 5 P. Haselager, J. Van Dijk, I. Van Rooij (s. d.), "A Lazy Brain? Embodied Embedded Cognition and Cognitive Neuroscience", In *Handbook of Cognitive Science*, 273-290.
- 6 E Couchot, *La nature de l'art : Ce que les sciences cognitives nous révèlent sur le plaisir esthétique*, Hermann, 2012.
- 7 M. Serres, *Petites poucettes*. Editions Le Pommier, 2012.

8 V. Parlac, Surface Change : Information, Matter And Environment. In R. Stouffs & P.Janssen... (éd.), *Proceedings of the 18th International Conference on Computer-Aided Architectural Design Research in Asia, CAADRIA*, 2013.