

Connecting to the World: Christopher Alexander's Tool for Human-Centered Design.

Abstract

Beauty connects us viscerally to the material universe. Life forms evolved to experience biological connectedness as an absolute necessity for survival. Starting one century ago, however, dominant culture deliberately reversed the mechanism responsible for deep connection. The resulting disconnection from the material world has long-lasting negative consequences for human wellbeing. Christopher Alexander describes how to revive the deep connecting process, creating conditions for human-centered design in our times. Deep connectedness arises from an organic projection of the designer's "self" onto the material reality of the object being designed, and its physical context. Exploring multiple scenarios using informational feedback avoids letting the designer's ego or imposed images exert a controlling influence. Implementing Alexander's connecting method could revolutionize design, with the potential to produce a new nourishing art and architecture. Recent developments in biophilia and neuro-design help to better understand Alexander's ideas, using results not available at the time when he was developing his theory.

Keywords

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Introduction

After an uncomfortably long lag, questions of beauty are coming up once again in general discussions.¹ A film entitled "Built Beautiful" addresses the origins of architectural beauty. It is the brainchild of architect Donald Ruggles,² and is directed by Mariel Rodriguez-McGill.³

¹ Rolf Reber, N. Schwarz and P. Winkielman, "Processing Fluency and Aesthetic Pleasure: Is Beauty in the Perceiver's Processing Experience?", *Personality and Social Psychology Review* 8, no. 4 (2004): 364–382, accessed July 18, 2020, https://journals.sagepub.com/doi/pdf/10.1207/s15327957pspr0804_3

² Donald H. Ruggles, *Beauty, Neuroscience & Architecture* (Denver, Colorado: Fibonacci Press, 2018).

³ *Built Beautiful*, motion picture directed by Mariel Rodriguez-McGill, produced by D. Ruggles, D. Zuckerman and B. Bridges (United States: Built Beautiful LLC, 2020), accessed July 19, 2020, <https://vimeo.com/434411431>

The film coincides with renewed interest from architects, designers, and others converging from many different professional orientations on a common concern. Namely, whatever happened to beauty as an essential factor in healing environments? Why did this feature of human-centered design disappear?

The simplified building shapes, and extensive use of smooth glass façades and other conspicuous consequences of prevailing modernist design ideals, have led to confusion about beauty in a wider sense. As the present study is concerned with architecture, it is essential to state at the outset why the canonical 20th century design tradition is inadequate. Donald Norman explains this point very well, describing how architectural design became focused on abstraction, formalism, and surface appearance to the exclusion of human adaptive factors:

“There was little emphasis upon the people for whom the objects were being designed, no discussion about practicality or everyday usage. Even in architecture, the emphasis was form, not the people who had to suffer living and working in the clean, sterile environment that the architects championed.”⁴

The British Government recently set up the “Building Better, Building Beautiful Commission”⁵ to re-align new building activity towards this goal. The extensive report linked beauty directly to human physiological and psychological well-being, to stewardship of the earth, and to an organic form of sustainability. Downplaying purely aesthetic questions, the report emphasizes that: “Beauty includes everything that promotes a healthy and happy life... It is not merely a visual characteristic, but is revealed in the deep harmony between a place and those who settle there.” Those goals and even the language used were unthinkable a few years ago.

Fortunately, we possess a method for creating beauty and implementing human-centered design. Architect and design theorist Christopher Alexander links beauty to the profound nature of inner feeling, to which we connect unconsciously.^{6,7} This experience cannot exist detached from the human perceptual system, since the effect depends upon sensory connection. At the same time, beauty is deeper than opinion-based aesthetics, and is even independent of humans because the configurations that turn out to be “beautiful” were present long before humans evolved. Those examples arise in nature from generative processes having to do with the organization of matter, and also from biological development.⁸

We focus on architecture, although the discussion might be useful to other design disciplines as well, as for example, industrial and product design. Alexander’s theory of human-environment connection and its background are outlined so as to enable architects and designers

⁴ Donald Norman, “Then and Now: The Bauhaus and 21st century design”, *bauhaus now* 1, no. 1 (2018): 18-21, accessed June 4, 2020, https://jnd.org/then_and_now_the_bauhaus_and_21st_century_design/

⁵ Sir Roger Scruton, N. Boys-Smith, G. Mayhew, M. Parsons and A. Penfold, *Living with Beauty – Report of the Building Better, Building Beautiful Commission* (London, UK: UK Government, 2020): 1, accessed April 8, 2020, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/861832/Living_with_beauty_BBBBC_report.pdf

⁶ Christopher Alexander, *The Nature of Order; Book 1: The Phenomenon of Life* (Berkeley, California: Center for Environmental Structure, 2001).

⁷ Christopher Alexander, *The Nature of Order; Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004).

⁸ Nikos Salingaros, “Beauty and the Nature of Matter: The Legacy of Christopher Alexander”, *New English Review* (1 May 2019), accessed June 4, 2020, <https://www.newenglishreview.org/custpage.cfm?frm=189673>

to understand and apply that theory in a practical manner. The method combines scientific, psychological, and at times mystical actions to achieve connectivity. Alexander's "Mirror-of-the-Self" test (described in a later section) supports the connecting process, because it gives consistent results for choosing between a pair of similar examples.^{9,10}

The objective is to set up a special emotional stage that privileges human-centered design over all other possible choices. Central aspects of Alexander's work in his book *The Nature of Order* are placed in the context of contemporary work on human-centered architectural design, as well as Norman's well-known work on emotional design. Deep connection automatically orients the design process towards human-centered design. As an underlying assumption, nourishing (not intellectual) beauty resonates with our body precisely because it is adapted to human biology. Different moods of the designer affect the ability to implement user-centered design.¹¹ Deep connection establishes a specific mood that focuses on design that adapts to human sensibilities, and consequently, a positive mood will be experienced by the users of the designed object.

The need for a new design discipline

Human-centered design relies upon beauty as a visceral phenomenon. The notion of beauty, however, does not fit into any established explanatory context. This omission occurs despite the effect playing a major role in our lives. Beauty linked to biology and the mechanisms necessary for life nourishes us when present, or degrades our existence when it's absent. Beauty in architecture needs its own model, related to but distinct from biology, physics, systems theory, etc. To consistently create a tangible feeling of "visceral beauty" in buildings and cities, we require a pragmatic theory for understanding the world based on observation and repeatability.

Although art historians have argued about beauty for centuries, discussions in the standard literature lack practical guidelines for today's design professionals. Empirical findings that underlie human-centered design have arisen instead in advertising and product design, outside official architectural and artistic theories of beauty.¹² Recent results from neurobiology validate practicing designers' intuitive understanding of which factors influence human-centered design.^{13,14}

As posited by Norman, creating useful products depends upon "Cognitive Design", which contains the means for implementing human-centered design of everything ranging from artifacts, to buildings, to cities.^{15,16} Cognitive design — relying upon how our brain engages

⁹ Christopher Alexander, *The Nature of Order, Book 1: The Phenomenon of Life* (Berkeley, California: Center for Environmental Structure, 2001): Chapter 8 "The Mirror of the Self", 313-350.

¹⁰ Nikos Salingaros, *Unified Architectural Theory* (Portland, Oregon: Sustasis Press, 2013): Chapter 14 "Human Physiology and Evidence-Based Design", 81-85. Published online in *ArchDaily* (21 March 2015), accessed June 4, 2020, <https://www.archdaily.com/611788/unified-architectural-theory-chapter-9a/>

¹¹ P. Desmet, H. Xue and S. F. Fokkinga, "The Same Person Is Never the Same: Introducing Mood-Stimulated Thought/Action Tendencies for User-Centered Design", *She Ji* 5, no. 3 (2019): 167-187, accessed June 4, 2020, <https://www.sciencedirect.com/science/article/pii/S2405872619300577>

¹² Donald Norman, *The Design of Everyday Things* (New York, NY: Basic Books, 2013).

¹³ Sarah Robinson and Juhani Pallasmaa, eds., *Mind in Architecture: Neuroscience, Embodiment, and the Future of Design* (Cambridge, Massachusetts: MIT Press, 2015).

¹⁴ Darren Bridger, *Neuro Design* (London, UK: Kogan Page, 2017).

¹⁵ Donald Norman, *The Design of Everyday Things* (New York, NY: Basic Books, 2013).

¹⁶ Juval Portugali, "Information adaptation as the link between cognitive planning and professional planning", Chapter 10 of *Handbook on Planning and Complexity*, Edited by Gert de Roo, Claudia Yamu and Christian Zuidema (Cheltenham, UK:

with form and information — is successfully applied to product design, but has not so far influenced architecture. Three further and related directions of investigation are opening up new possibilities for human-centered design, which uses all of these findings:

- (i) Eye-tracking experiments and eye-tracking simulation software reveal what we find unconsciously engaging;^{17,18}
- (ii) geometrical rules for visual organization confirm which specific configurations attract our unselfconscious attention;^{19,20}
- (iii) biophilia creates an innate attraction to living structure and the geometry of biological forms.^{21,22}

In addition, human-centered design depends upon affordance, context, dimension, ergonomics, interaction, shape, signifiers, usability, etc., which require the designer to be extremely sensitive to a user's physiological requirements. Cognitive design together with recent scientific discoveries helps to select design typologies that lead to adaptation, and to identify its opposite — detached design based on abstractions — which ignores accumulated empirical evidence about human use.²³

Norman also points out that deciding among distinct design choices, especially if those seem equally sound, is based on emotion.²⁴ Applying logic and intellectual reasoning takes far longer and sometimes leads to a mental block of indecision. Emotional design is more efficient, but could go both ways; i.e. pulled towards branding and away from adaptivity. Alexander's deep connecting is emotion-based, yet it is effective because it is driven by identifying living structure in whatever is being designed. This focus selects a specific group of emotions to work with, otherwise designers get lost in their own sentimentality. Adapting to human needs prevents emotional decisions from being influenced by irrelevant factors such as what we think we like because of outside influences, or have been taught to prefer, etc.

Clearly, the present system of educating designers is in need of drastic overhaul, since it stubbornly continues to teach antiquated abstraction-based techniques established in the early years of the 20th century.²⁵ The effort of training a new generation of designers in deep connectedness and human-centered design parallels an equivalent reform of architectural

Edward Elgar Publishers, 2020): 203-219.

¹⁷ Ann Sussman and Justin B. Hollander, *Cognitive Architecture* (New York, NY: Routledge, 2015).

¹⁸ Nikos Salingaros and Ann Sussman, "Biometric pilot-studies reveal the arrangement and shape of windows on a traditional façade to be implicitly engaging, whereas contemporary façades are not", *Urban Science* 4, Issue 2: article number 26 (May 2020): 1-19, accessed June 4, 2020, <https://www.mdpi.com/2413-8851/4/2/26>

¹⁹ Nikos Salingaros, "Adaptive Versus Random Complexity", *New Design Ideas* 2, no. 2 (2018): 51-61, accessed June 4, 2020, <http://jomardpublishing.com/UploadFiles/Files/journals/NDI/V2N2/SalingarosN.pdf>

²⁰ Nikos Salingaros, "Symmetry gives meaning to architecture", *Symmetry: Culture and Science* 31, no. 3 (2020): 331-361, in press.

²¹ Stephen R. Kellert, Judith Heerwagen and Martin Mador, eds., *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life* (New York, NY: John Wiley, 2008).

²² Nikos Salingaros, "The biophilic healing index predicts effects of the built environment on our wellbeing", *JBU – Journal of Biourbanism* 8, no. 1 (2019): 13-34, accessed June 4, 2020, <http://zeta.math.utsa.edu/%7Eyvk833/BiophilicIndex.pdf>

²³ Donald H. Ruggles, "Beauty, Neuroscience and Architecture", *The Centre for Conscious Design, Science-Informed Architecture and Urbanism* (London, UK: Conscious Cities Anthology, 2019), accessed June 24, 2020, <https://theccd.org/article/beauty-neuroscience-and-architecture-beauty-and-homeostasis-as-a-model-for-architecture/>

²⁴ Donald Norman, *Emotional Design* (New York, NY: Basic Books, 2004): 12.

²⁵ Michael W. Meyer and Donald Norman, "Changing Design Education for the 21st Century", *She Ji* 6, no. 1 (2020): 13-50, accessed June 4, 2020, <https://www.sciencedirect.com/science/article/pii/S240587262030046>

education many persons around the world are calling for.^{26,27,28} Faculty in architecture schools declare that they already teach adaptive design, but they lack a system for organizing complexity. As a result, they can only connect to parts, and then usually to the least important parts. There is a powerful urge today to re-think how we shape the artificial environment to make it more adaptive to human use.

Connecting the “self” to the physical world

Creating living architecture — in the sense of directly experienced visceral beauty and emotional nourishment — is a process of connecting with our inner self. In biology, connectedness is an imperative for life: here we wish to link ourselves to a piece of the physical world. Alexander uses philosophical and poetic language to explain this process of discovering the “self” in whatever he is trying to make. He refers to establishing as deep and intuitive a connection to the emergent design and its physical context as possible. One’s emotions and deepest feelings have to focus on connectedness.

Before any design can be conceived as visual form, or even to consider its practical implications, Alexander looks for a vague but strongly-perceived emotional quality that will connect his own self with whatever he’s making. He delays making procedural decisions until some deeply felt connection has been established with the amorphous virtual object, which will subsequently guide the creative process. This very personal emotional link is essential because it helps to decide among the overwhelming range of possibilities faced at each step of the development cycle.

On the other hand, lacking such a deep connection leads the design process astray. When designers have no aid to guide them in taking sequential design decisions, they default to a facile one-step standard, which is to copy from a pre-existing vocabulary of forms. Those ready-made solutions may either be barely adequate, or totally inappropriate, but can never truly adapt to the specific requirements of the current problem.²⁹ Yet that’s what has been happening for the past century. A generic design process has no step-wise selection, thus automatically ruling out any adaptation. It does not bring us any closer to connecting emotionally to the finished result.

Not mentioned in this paper is that it is absolutely essential to have a system of practical constraints in place to guide and underlie all of design. We should not be misled to believe that we are creating pure fine art. In architecture, such a system for organizing complexity exists in the “Pattern Language”, which helps to implement already discovered solutions.^{30,31}

²⁶ Nicholas Boys-Smith and Sir Roger Scruton, “Beauty and Sustainability in Architectural Education”, *ArchNewsNow* (22 August 2019), accessed June 4, 2020, <http://www.archnewsnow.com/features/Feature583.htm>

²⁷ Nikos Salingaros, Mathias Agbo, Jr., Nicholas Boys Smith, Duo Dickinson, Paul F. Downton, Michael W. Mehaffy, Yodan Rofè, Catherine Ryan Balagtas, Ann Sussman and A. Vernon Woodworth, “Architecture Programs Need a Change: Put People First—Not Art”, *The James G. Martin Center for Academic Renewal* (6 November 2019), accessed June 4, 2020, <https://www.jamesgmartin.center/2019/11/architecture-programs-need-a-change-put-people-first-not-art/>

²⁸ “Pune Declaration on the State of Architecture in India”, *Architexturez* (January 2020), accessed June 4, 2020, <https://patterns.architexturez.net/doc/az-cf-193563>

²⁹ Michael W. Mehaffy and Nikos A. Salingaros, *Design for a Living Planet* (Portland, Oregon: Sustasis Press 2015): Chapter 15 “Computational Irreducibility”, published online by *Metropolis* (12 January 2012), accessed June 4, 2020, <https://www.metropolismag.com/ideas/frontiers-of-design-science-computational-irreducibility/>

³⁰ Christopher Alexander, S. Ishikawa, M. Silverstein, M. Jacobson, I. Fiksdahl-King and S. Angel, *A Pattern Language* (New York: Oxford University Press, 1977).

³¹ Michael W. Mehaffy, Y. Kryazheva, A. Rudd and N. A. Salingaros, *A new pattern language for growing regions: Places, networks, processes* (Portland, Oregon: Sustasis Press and Stockholm, Sweden: Centre for the Future of Places KTH Royal

Interacting design patterns distill proven solutions that can be re-used with adaptive changes according to the situation at hand. Without some such ordering framework, our emotions could lose us in impractical excursions that work against functionality.

To summarize the procedure: Alexander proposes that a designer establish an intuitive connection with the imagined product as a precondition to design. The method is a mental exercise that engages an experience of physical healing. An emotional link will then help to guide each subsequent step in the actual design, using one's feelings triggered by deep connection to check the sequence of design decisions. The feedback should not be towards establishing some image that the designer "wants" but rather to allow the design to develop based on deep connectivity. This approach helps to keep the designer from making choices that lead away from human-centered design, as it insulates the process from imposed fashionable or formalistic influences.

The personal connection to buildings with life

Buildings that have "life" embedded in their geometry are able to trigger a deep connection with the user.^{32,33} Even as the connective process is shared among people of all backgrounds, each individual experiences a specifically personal connection. Connecting occurs through feeling that is triggered by the geometry and color of the existing detail or place, sequence of spaces, pattern of light and dark, etc. As discovered by Alexander, all persons, regardless of origin or education, have in them the inborn ability and urge to connect to the physical world in this manner. They may *choose* not to do so, but that is an intellectual decision that consciously overrides their innate physiology.

Let's focus on the primary visual connection while neglecting for the present discussion other sensory dimensions (proprioception, smell, sound, touch, etc.) through which we connect to our environment. What do you see in your mind's eye for the proposed design, and present in the physical setting, that can be identified as points to connect with?³⁴ Component elements are typically a complex combination of color, contrast, curvature, detail, balanced shape, interacting scales, touchable surface, symmetries, etc. Neurologically healthy people respond individually and positively to each of these factors. Moreover, we connect strongly to face-like structures, since our brain has specific face-recognition cells.^{35,36} This is part of the evolved connective apparatus that biological organisms possess.

Deep connection to the world is a primary unconscious mechanism for animals to be able to inhabit and negotiate their environment. Connectedness is imperative for life because mammals feel safe through attachment. A large body of experimental evidence reveals the

Institute of Technology, 2019).

³² Christopher Alexander, *The Nature of Order; Book 1: The Phenomenon of Life* (Berkeley, California: Center for Environmental Structure, 2001), Appendix 6 "Calculating degree of life in different famous buildings: a first approximation to a fuller mathematical treatment", pages 469-471.

³³ Nikos Salingaros, "Life and Complexity in Architecture from a Thermodynamic Analogy", Chapter 5 of *A Theory of Architecture*, 2nd Edition (Portland, Oregon: Sustasis Press, 2014): 105-128.

³⁴ Christopher Alexander, *The Nature of Order; Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004): 50.

³⁵ Donald H. Ruggles, *Beauty, Neuroscience & Architecture* (Denver, Colorado: Fibonacci Press, 2018), Chapter 6: "Origins: Emotional Bonding", 77-87.

³⁶ Ann Sussman and Justin B. Hollander, *Cognitive Architecture* (New York, NY: Routledge, 2015), Chapter 3: "Patterns Matter: Faces and Spaces", 56-106.

geometrical factors responsible for this connection.^{37,38} It seems that specific types of symmetry about a vertical axis play a deciding role.^{39,40} Those symmetries are found in traditional human artifacts, constructions, and ornamentation. Further specialization occurs into the particular symmetry of animal faces, which evolution has fixed into animal and human perceptive systems.⁴¹ Such symmetries drive our attention.

Here we wish to link ourselves to a piece of the physical world. Alexander believes that this deep connection lies in the nature of matter, and is not merely an invention of the human mind. As explained later, it is not enough to interpret a connective effect exclusively through neuroscience, because that greatly limits it. Alexander's goal is to find meaning while connecting to the structure of the universe, so that whenever we create such a structure ourselves, however small in scale, we actually endow the world with meaning. Shaping physical matter — as for example creating an artifact such as construction detail, ornament, or tool, a building, or place — is a physical and not neurological process.

Beyond biophilia: the existence of the “I”

Alexander re-introduces an ancient concept to describe something for which we have no adequate vocabulary.⁴² Visual details, pieces of matter, places, and portions of nature possess a discernible quality to which we can connect on a deeply personal level. This quality is termed the “I” of whatever we connect to, even though it may be inanimate.⁴³ Getting over the strangeness of the initial concept helps in describing the deep connection as akin to that occurring between two living beings, which is easier to grasp.

The “I” is not the self of the designer, but resides instead in the object to which one connects. Whether this term is the best one to use or not, Alexander's idea endows an imagined living presence in an object so that a person can connect to it more-or-less on an equal level, and not as a human imposing his/her will upon dead matter. This presupposes a respect for life-enhancing qualities that develop and exist outside our own body. Indeed, the ego of the architect or creator must be diverted, otherwise it will forcibly shape the result according to power and the desire for glory. That self-centered motivation, which predominates in today's buildings, can never lead to human-centered design.

Deep connectedness agrees with biophilia, which, as developed by Edward O. Wilson and Stephen Kellert, is due primarily to the presence of life forms and representations of the

³⁷ Alexander Coburn *et al.*, “Psychological responses to natural patterns in architecture”, *Journal of Environmental Psychology* 62 (2019): 133–145, accessed July 15, 2020, <https://doi.org/10.1016/j.jenvp.2019.02.007>

³⁸ Scott O. Murray *et al.*, “Shape perception reduces activity in human primary visual cortex”, *Proceedings of the National Academy of Sciences USA* 99, no. 23 (2002): 15164–15169, accessed July 15, 2020, www.ncbi.nlm.nih.gov/pmc/articles/PMC137561/

³⁹ Nikos Salingaros, “Symmetry gives meaning to architecture”, *Symmetry: Culture and Science* 31, no. 3 (2020): 331-361, accessed 18 July 2020.

⁴⁰ Christopher W. Tyler *et al.*, “Predominantly extra-retinotopic cortical response to pattern symmetry”, *Neuroimage* 15, no. 24 (2005): 306–314, accessed July 15, 2020, <https://christophertyler.org/CWTyler/TylerPDFs/TyleretalfMRISymmetryNI2005.pdf>

⁴¹ Le Chang and D. Y. Tsao, “The code for facial identity in the Primate Brain”, *Cell* 169, no. 6 (2017): 1013–1028, accessed July 15, 2020, [www.cell.com/cell/pdf/S0092-8674\(17\)30538-X.pdf](http://www.cell.com/cell/pdf/S0092-8674(17)30538-X.pdf)

⁴² Christopher Alexander, *The Nature of Order; Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004): 58, 69.

⁴³ Christopher Alexander, *The Nature of Order; Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004), Chapter 3 “The Existence of an I”, 49-72.

organic geometry of nature.^{44,45} People connect with other organisms instinctively, and this exposure proves to be physically healing.^{46,47} When implementing biophilic design into the structure of a building, a connective architecture may be successfully achieved through a vocabulary of forms and patterns coming from biological structure. While this is a promising step away from non-adaptive abstractions, some architects abuse it by copying the superficial appearance of biological forms. That fails to connect deeply.

Alexander anticipated biophilia as the *Nature of Order* was being written starting in the early 1980s. Nevertheless, he goes much further than biophilia in trying to reach the spiritual sense of connectivity as envisaged by pre-industrial peoples.⁴⁸ In those societies, it was perfectly natural to identify the “I” as the living spirit of an animal, a bush, a tree, or even a portion of a stream. An individual could easily imagine connecting with that object or living form on an organic level. Although a scientific explanation for this effect is lacking, the experience can be very intense and affect one’s emotional and physiological state profoundly. Jiang has approached this phenomenon from a scientific perspective, which hopefully signals the beginning of a research effort.⁴⁹

This discussion now enters into the deeply mystical aspect of religions, something that makes designers (and most contemporary people) uncomfortable because they don’t know how to handle it within the current technological worldview. Today, talking about such deep connections appears absurd and quaint. Worst of all, referring to the practices of pre-industrial peoples is enough to condemn an idea in the eyes of those who consider themselves “modern”. Yet what is described here is backed, in part, by very recent findings from modern science.

The “Mirror-of-the-Self” test

In *The Nature of Order*, Alexander offers an interesting tool that helps to choose between two similar objects or settings by using deep connectedness. Alexander asks which of two objects provides a better picture of one’s “self”.^{50,51} To use this tool, we have to project our personality onto each of the two objects being experienced. The method requires imagining our emotions, our humanity, and all of our character strengths and weaknesses as somehow embedded in either of the two alternatives. What is remarkable is that those who apply this test make fairly uniform choices.⁵²

⁴⁴ Edward O. Wilson, *Biophilia* (Cambridge, Massachusetts: Harvard University Press, 1984).

⁴⁵ Stephen R. Kellert, *Nature by Design* (New Haven, Connecticut: Yale University Press, 2018).

⁴⁶ Stephen R. Kellert, Judith Heerwagen and Martin Mador, eds., *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life* (New York, New York: John Wiley, 2008).

⁴⁷ Nikos Salingaros, “The biophilic healing index predicts effects of the built environment on our wellbeing”, *JBU – Journal of Biourbanism* 8, no. 1 (2019): 13-34, accessed June 4, 2020, <http://zeta.math.utsa.edu/%7Eyvk833/BiophilicIndex.pdf>

⁴⁸ Christopher Alexander, *The Nature of Order; Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004): 58, 69.

⁴⁹ Bin Jiang, “Living Structure Down to Earth and up to Heaven: Christopher Alexander”, *Urban Science* 3, no. 3 (2019): 20 pages, accessed July 15, 2020, doi: <https://doi.org/10.3390/urbansci3030096>.

⁵⁰ Christopher Alexander, *The Nature of Order; Book 1: The Phenomenon of Life* (Berkeley, California: Center for Environmental Structure, 2001): Chapter 8 “The Mirror of the Self”, 313-350.

⁵¹ Nikos Salingaros, *Unified Architectural Theory* (Portland, Oregon: Sustasis Press, 2013): Chapter 14 “Human Physiology and Evidence-Based Design”, 81-85. Published online in *ArchDaily* (21 March 2015), accessed June 4, 2020, <https://www.archdaily.com/611788/unified-architectural-theory-chapter-9a/>

⁵² Christopher Alexander, *The Nature of Order; Book 1: The Phenomenon of Life* (Berkeley, California: Center for Environmental Structure, 2001): Chapter 8 “The Mirror of the Self”, 313-350.

Which one of the pair is a more faithful representation of your own “self”?

It is important here to project an honest assessment of our “self” as a living entity, and not some idealized version or pretended image of self that we aspire to. Deep connecting tries to sidestep artificiality and false appearances, which can only sabotage the test. Accepting life’s imperfections and realities brings us down to earth and makes the connecting method more useful in the comparison. As I understand from both neurobiology and Alexander’s work, a healthy “self” is hard-wired to seek connectedness with another being, thus validating the personal connective approach for judging design and form.

An alternative prompt is to couch the comparison using the futurist concept of “mind uploading”. (Certain wealthy transhumanists fantasize storing their brain’s information onto an external memory so they can continue to be “alive” in some sense after their physical body dies.) By forcing ourselves to evaluate the geometry of an object viscerally, this question triggers surprising sensibilities that in turn help to motivate the “Mirror-of-the-self” test.

Suppose you had to upload your sentient, thinking self onto either one of these two objects — which one would you feel more comfortable inhabiting, making a better match to your “self”?

Gabriel and Quillen (both of whom worked with Alexander) discuss the “Mirror-of-the-self” test in detail.⁵³ The choices resulting from this exercise are fairly uniform, as people pick the more adapted and meaningful alternative from each pair. Individuals without any expert training consistently select the “better” of the two examples. For instance, when choosing between two oriental carpets using the “Mirror-of-the-self” test, untrained persons invariably pick the more valuable carpet as measured by age, scarcity, and antique value according to professional authorities.⁵⁴ When everyday utilitarian objects are compared pairwise people usually select the more human-centered design that better fits our biology.

Unknown so far to most industrial and product designers, even those who apply cognitive design, the “Mirror-of-the-self” is an essential and useful tool for selecting between a pair of alternative variants during the evolution of a design. This is invaluable since it can be applied again and again to choose between pairs of possibilities in a long sequence of design decisions. Performing the “Mirror-of-the-self” test helps to train an individual in the practice of deep connection, which can then be used in guiding the design process. It is in fact the best empirical proof we have so far that connectedness leads to consistent and practical results.

A simple comparison experiment

Two wooden carvings of the same size (approximately 13 cm square) were presented in an online “Mirror-of-the-self” survey (Figure 1). The results were comparable. Out of 50 responses, 56% favored the one on the left, whereas 44% chose the one on the right. This

⁵³ Richard P. Gabriel and J. Quillien, “A Search for Beauty/A Struggle with Complexity: Christopher Alexander”, *Urban Science* 3, no. 2: article 64 (2019): 32 pages, accessed July 15, 2020, doi: <https://doi.org/10.3390/urbansci3020064>

⁵⁴ Christopher Alexander, *The Nature of Order; Book 1: The Phenomenon of Life* (Berkeley, California: Center for Environmental Structure, 2001): 323-324.

balanced response is understandable, given the intensely human qualities of both pieces. The older piece contains many more nested symmetries, which are probably responsible for its slightly greater attraction. The point of the exercise was not to distinguish between two very nice artifacts, but to engage the viewer in deep connecting. Performing this test sharpens an individual's sensitivity to environmental structure that possesses organized complexity.



Figure 1. Two wooden carvings were compared using the “Mirror-of-the-self” test. Left: 18th Century Portugal; right: 20th Century India. Copyright © 2020 Nikos Salingaros.

An interesting analysis in the following section shows that the pre-attentive visual response during the first 3–5 seconds (before conscious vision begins) is reinforced after spending 6–150 seconds comparing the two carvings. This process can be understood using Alexander’s arguments as presented in this paper. While certain organic visual cues draw our interest almost instantly, it takes some time for our perceptual system to discover the deeper structure and nested symmetries in each example. To prevent subjective bias from influencing those taking the survey, neither the age nor the provenance of the two pieces were revealed.

Eye-tracking studies and simulation software

Decades after Alexander wrote about the deep connection mechanism, scientific results are validating his insights. Because more than half the information coming into the brain is visual, then naturally, optical signals play a dominant role. Eye-tracking studies measure our attention to different parts of a scene, whether it be an actual physical setting, a 2-dimensional visual image, or a dynamic representation using virtual reality. Sophisticated tools reveal the points where we look during the first few seconds of a gaze. Those “pre-attentive” fixations unconsciously determine whether our body pays attention or not.

A powerful conclusion follows: eye-tracking experiments or simulations thereof reveal if a viewer connects to an object or scene visually.⁵⁵ This cognitive process occurs without conscious control, and is independent of training in architecture, art, or design. After the initial unconscious fixations, we could override where we focus only by forcing our attention onto visual regions that were at first avoided (in architecture, we are given no choice). But this action could have negative consequences because it may generate a fight-or-flight

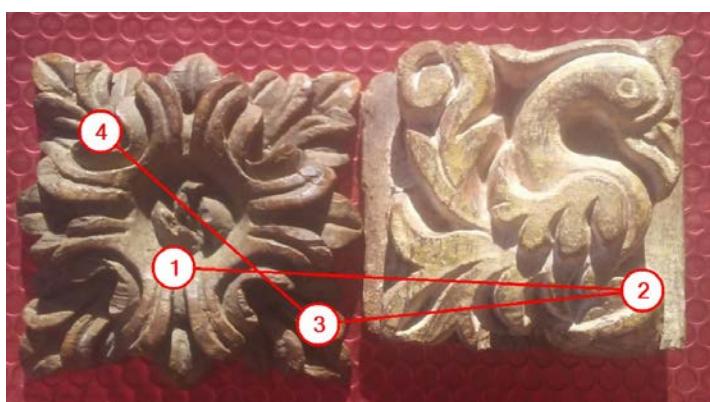
⁵⁵ Nikos Salingaros and Ann Sussman, “Biometric pilot-studies reveal the arrangement and shape of windows on a traditional façade to be implicitly engaging, whereas contemporary façades are not”, *Urban Science* 4, Issue 2: article number 26 (May 2020): 1-19, accessed June 4, 2020, <https://www.mdpi.com/2413-8851/4/2/26>

reaction, which induces distress in our body.^{56,57} One dramatic example is monotonous repetition on the large scale (either horizontally, or vertically), which generates headaches.^{58,59}

Although eye-tracking does not answer all the questions about deep connection, it identifies the crucial primary step in that process. Something has to first attract us unconsciously to look at it before we can connect to it deeply. Triggers for visual attraction are hard-wired to evaluate possibilities of danger, food, or reproduction. If, on the other hand, the object or scene is disengaging for whatever reason (i.e., we do not fix our eyes on it immediately), then it lies outside any possibility of deep connection. Psychological and visual reactions to a design are typical reasons for disengagement.

In a remarkable way, this finding clarifies the process of connecting. It also discredits “architectural theory” as taught in our schools, which is incapable of predicting how humans will react to forms and surfaces.⁶⁰ A very simple test — pre-attentive eye fixations — is sufficient to rule out objects, buildings, and places to which we can never connect deeply. Any theoretical explanation offered to explain or justify the design of such disengaging cases can never nullify *a priori* disconnection. Establishing primary engagement leaves only the remaining connective factors to figure out. Those could lead to relative degrees of deep connection. Research effort should concentrate on “engaging” design and not waste time with situations that are disengaging to begin with.

Going back to the two wooden carvings shown in Figure 1, Visual Simulation (eye-tracking) Software by 3M company was used to compare them.⁶¹ The results are displayed in Figures 2 and 3. We see that the eye is immediately attracted to details on the symmetric figure on the left and by organic features on the stylized bird’s body on the right.



⁵⁶ Andréa de Paiva and Richard Jedon, “Short- and long-term effects of architecture on the brain: Toward theoretical formalization”, *Frontiers of Architectural Research* 8, no. 4 (December 2019): 564-571, accessed July 15, 2020, <https://www.sciencedirect.com/science/article/pii/S2095263519300585>

⁵⁷ Donald H. Ruggles, *Beauty, Neuroscience & Architecture* (Denver, Colorado: Fibonacci Press, 2018): 101.

⁵⁸ A. J. Wilkins, “A physiological basis for visual discomfort: Application in lighting design”, *Lighting Research & Technology* 48, no. 1 (2016): 44-54, accessed July 15, 2020, <https://journals.sagepub.com/doi/full/10.1177/1477153515612526>

⁵⁹ A. J. Wilkins, “Looking at buildings can actually give people headaches”, *The Conversation* (5 July 2018), accessed July 15, 2020, <https://www.cnn.com/style/article/why-looking-at-buildings-can-give-people-headaches/index.html>

⁶⁰ Nikos Salingaros, *Unified Architectural Theory* (Portland, Oregon: Sustasis Press, 2013): Chapter 5 “Architectural Theory”, 26-33. Published online in *ArchDaily* (10 October 2013), accessed July 18, 2020, <https://www.archdaily.com/433898/unified-architectural-theory-chapter-2a>

⁶¹ 3M, “Visual Attention Software” (Saint Paul, MN, USA: 3M Corporation, 2020), accessed July 17, 2020, https://www.3m.com/3M/en_US/visual-attention-software-us/

Figure 2. Eye-tracking simulation performed using 3M's Visual Attention Software (VAS), which determines the four most likely pre-attentive fixation spots for our eyes. This scanning sequence estimates where our gaze first lands — without conscious awareness — and how it successively jumps to take in the rest of the image. Result by Ann Sussman, used here with permission.

The eye-tracking experiment estimates unconscious visual fixation during the first 3-5 seconds of gaze. Both carvings are equally noticed to begin with. Contrast the brief time in pre-attentive viewing (3–5 sec) as compared to the “Mirror-of-the-self” test carried out in the preceding section, where viewers need much more time to familiarize themselves with the complex geometric structure of each piece. The “Mirror-of-the-self” test principally occurs during conscious visual processing. In fact, the online survey reveals that respondents spent up to 151 seconds before reaching a decision. Note, however, that no period of viewing will “redeem” a case that proves to be disengaging in the first few seconds.

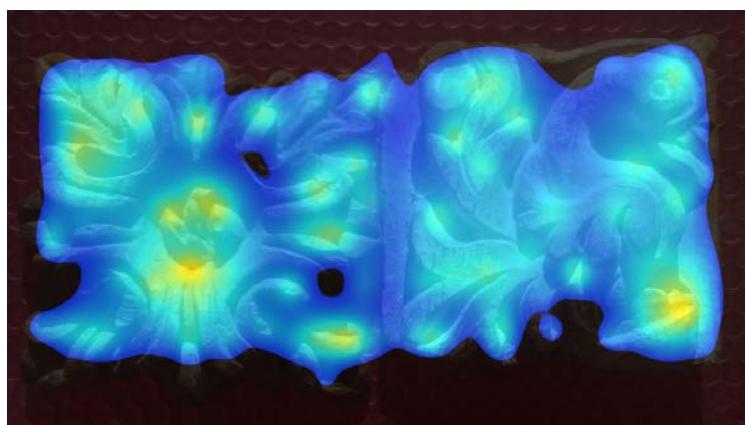


Figure 3. Heatmap showing the likely distribution of visual attention during pre-attentive gazing, that is, during the first 3-5 seconds. The yellow spots indicate those regions most likely to attract our eye’s attention. Result by Ann Sussman using 3M's Visual Attention Software (VAS), used here with permission.

Supporting the “Mirror-of-the-self” survey, the eye-scanning simulation results indicate a fairly balanced distribution of visual attention between the two wooden carvings (Figure 3). By counting the yellow regions of more intense interest, there is a slight preference for the panel on the left, consistent with the documented viewers’ preferences.

Enjoying life’s freedom by belonging to the world

In *The Nature of Order*, Alexander advances the thesis that the geometry of the environment influences our life either negatively or positively. Whenever spaces and surfaces possess the correct affordance, then we perform all of life’s activities fluently without noticing the environment at all. Nevertheless, those actions are enabled because — and only when — we connect to surrounding details and dimensions, which boost our physiology and thought. This process is unconscious. If, by contrast, we find ourselves in a psychologically hostile environment, that impacts on our actions and we have to force ourselves to accomplish even the most basic everyday functions under a condition of stress.

The *active* connecting method introduced above as a deliberate design tool underlies the *passive* mechanism by which we unconsciously experience our immediate environment. It

therefore extends to encompass all aspects of human life. Our surroundings determine whether we sense if we “belong” in a particular setting, and are thus able to carry on life’s functions without distress.⁶² An action could be as simple as sitting and thinking: yet how many contemporary places do we know that truly enable this? Our life and unconscious thinking processes are significantly affected by where we happen to be. We feel more alive in settings that elicit a sense of belonging and comfort.

The Nature of Order details how to attain a relaxed coexistence with our environment. Alexander defined this process in his earlier book *The Timeless Way of Building* as responding to the “Quality Without A Name — QWAN”.⁶³ Neuroscience and environmental psychology provide cumulative evidence of how the immediate environment influences our state of health and mind. This starts with a basic need for the physical presence of graspable “handles”, or their mere suggestion, in our close surroundings.⁶⁴ It extends to include the list of attractive biophilic criteria that help us connect unconsciously.^{65,66} Finally, eye-tracking experiments and simulations reveal where our visual attention is drawn, versus what portions of our environment are disengaging.^{67,68} Together, these factors either catalyze life’s activities, or conversely, inhibit them.

The dark side to this is that environments in which we feel anxiety or insecurity due to their geometry will prevent psychological coexistence. Those places limit our life by hindering our freedom to live to our fullest extent. Unnatural physical details and spaces can make us feel less “alive”, although the effect may be subtle and only accumulate long-term. The present discussion opens up profound concerns about our emotional serenity: could architectural style inhibit a person’s existence and liberty of the senses? Alexander suggests that accepting minimalist architecture restricts much of the world’s population into an inadequate experiential state.⁶⁹

Fighting a culture of disconnection

Human-centered design through beauty achieves a profound connectedness between the physical surroundings and one’s self (which exists in an interior realm). A person who seeks this state has to learn and practice an unfamiliar way of linking one’s inner world to the outer world. But there exists an institutionalized obstacle to achieving this union. Connectedness is hampered by external ideas that authorities, experts, and society impose on us, which lead to

⁶² Christopher Alexander, *The Nature of Order; Book 3: A Vision of a Living World* (Berkeley, California: Center for Environmental Structure, 2005), Chapter 2: “Our belonging to the world”, pages 41-66.

⁶³ Christopher Alexander, *The Timeless Way of Building* (New York: Oxford University Press, 1979).

⁶⁴ Nikos Salingaros, “Why we need to ‘grasp’ our surroundings: object affordance and prehension in architecture”, *Journal of Architecture and Urbanism* 41, no. 3 (2017): 163-169, accessed June 9, 2020, <http://zeta.math.utsa.edu/%7Eyuk833/Whyweneedtograsp.html>

⁶⁵ Nikos Salingaros, *Biophilia and healing environments* (New York: Terrapin Bright Green LLC and Amherst, Massachusetts: Levellers Press, 2015), accessed July 18, 2020, <https://www.terrapinbrightgreen.com/wp-content/uploads/2015/10/Biophilia-Healing-Environments-Salingaros-p.pdf>

⁶⁶ Nikos Salingaros, “The biophilic healing index predicts effects of the built environment on our wellbeing”, *JBU – Journal of Biourbanism* 8, no. 1 (2019): 13-34, accessed June 4, 2020, <http://zeta.math.utsa.edu/%7Eyuk833/BiophilicIndex.pdf>

⁶⁷ Ann Sussman and Justin B. Hollander, *Cognitive Architecture* (New York, NY: Routledge, 2015).

⁶⁸ Nikos Salingaros and Ann Sussman, “Biometric pilot-studies reveal the arrangement and shape of windows on a traditional façade to be implicitly engaging, whereas contemporary façades are not”, *Urban Science* 4, Issue 2: article 26 (May 2020): 1-19, accessed June 4, 2020, <https://www.mdpi.com/2413-8851/4/2/26>

⁶⁹ Christopher Alexander, *The Nature of Order; Book 3: A Vision of a Living World* (Berkeley, California: Center for Environmental Structure, 2005), Chapter 2: “Our belonging to the world”, pages 41-66.

disconnection. Dominant culture replaced direct physical experience with an abstract substitution for reality, while a “ritual of modernity” feeds this simulation.

Alexander describes situations and settings where he feels connected.⁷⁰ Many of us can identify with the truth of those examples, having experienced deep connection with animals, artifacts, buildings, dance, music, people, ornamental details, urban spaces, etc. Unfortunately, for someone stuck inside dominant culture’s isolating cognitive box, those examples may only seem romantic or even fantastic. Persons who have been conditioned to disconnect remain unconvinced. It is very difficult to teach something like this using visual or verbal descriptions: the only way to do it successfully is through a powerful visceral experience.

The remainder of this paper tries to explain why connecting in Alexander’s sense no longer forms part of architecture and design. In his last book *The Battle for the Life and Beauty of the Earth: A Struggle between Two World-Systems*, however, Alexander and his coauthors expose the fierce opposition encountered while building a campus in Tokyo, Japan.⁷¹ That story serves Alexander as the occasion for analyzing what he sees as the wrong turn that architectural education and practice have taken, together with the building and construction industries. His criticisms inform my own polemic arguments that follow.

Education compartmentalizes connection in our minds: it permits us to connect emotionally to a pet animal or another human being, but does not allow the same for a building, artifact, or piece of ornament. A form of psychological conditioning makes us feel self-conscious about experiencing the joy of connecting to artificially-created beauty. Apologists of modernism use the false excuse that this emotional nourishment is somehow “unmodern”, which discourages people from connecting viscerally. Eventually, everybody aligns their sentiments to comply with a severe unemotional existence.

Almost everything being created today reinforces universal physical and visual disconnection. People hardly question the restricted design techniques that everywhere replaced traditional human-centered design.⁷² At the beginning of the 20th century the intelligentsia imposed rules for disconnecting based on a set of abstractions, yet backed by potent economic and societal forces.⁷³ Shallow design ideals adopted by the global elite replaced a millennial foundation of connecting, formerly anchored within socially-shared life priorities. Society continues to accept those diktats as universal truths. This is the dominant design style we have grown up and learned to live with.

It helps to leave aside global consumerist culture and pay attention to life occurring at its edges, where people have to create things for themselves. Institutionalized power may suppress the innate human habit of connecting, yet many people around the world need to create things and environments that have life. Opposing top-down economic and political pressures, local groups apply more humane systems of construction and production. It is here,

⁷⁰ Christopher Alexander, *The Nature of Order, Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004).

⁷¹ Christopher Alexander, H. Neis and M. M. Alexander, *The Battle for the Life and Beauty of the Earth: A Struggle between Two World-Systems* (New York: Oxford University Press, 2012).

⁷² Michael W. Mehaffy and Nikos Salingaros, “Geometrical Fundamentalism”, Chapter 9 of *A Theory of Architecture*, 2nd Edition (Portland, Oregon: Sustasis Press, 2014), 172-194, accessed June 4, 2020, https://www.academia.edu/5074196/Geometrical_fundamentalism

⁷³ James Stevens Curl, *Making Dystopia: The strange rise and survival of architectural barbarism* (Oxford: Oxford University Press, 2018).

in informal settlements or away from the hegemony of the design establishment, that we find deep connecting to be alive and well. Wherever a counterculture learns to rely on its own resources, the people are not afraid to practice deep connection.

Design leaders who wanted to disconnect people

Why did dominant design culture work on disconnecting the individual from the world? One explanation is that this was not planned, but arose as a consequence of adopting a minimalist design style. A group of designers desperately sought innovation, and visual disconnection was certainly an effective tactic in achieving a novel “look”.⁷⁴ The design community and its leading figures may not have realized the deeper implications of implementing an unnatural style. But even if they did so, they successfully promoted this design movement as it eventually acquired a momentum that now proves impossible to stop.^{75,76}

Consider that for almost a century, it has been nearly impossible to connect in a visceral manner to a building designed according to a dominant “high” style. The building’s color, geometry, and surfaces simply do not allow it.^{77,78} The same is true for artifacts and everyday utensils that give the impression of being designed to disconnect us from the material world. A sensitive individual has to go to a lot of trouble to find everyday objects and environments that are not intentionally made crude, ill-fitting, or jarring: the implementations of abstract design precepts.⁷⁹

Fortunately, there still exist select objects, places, and structures that help us to achieve a deep connection. Dominant culture fails to value them, and in many cases calls for their elimination. We face an intolerance whereby objects and places that trigger deep connection are labeled as morally-forbidden kitsch, old-fashioned, and even dangerous for economic progress.⁸⁰ An implanted polarization divides what our body seeks from what contemporary society approves and promotes. Stuck in ideology, schools justify this prejudice by claiming that it produces “modern” designers. Our educational system and media are burdened by a century of obsolete cultural baggage.

Another, lesser-known explanation for why dominant culture pursued disconnection is because the “founding fathers” of industrial-modernist design could not handle environmental stimuli normally.^{81,82} Le Corbusier’s documented response to visual complexity is totally

⁷⁴ Nikos Salingaros, *A Theory of Architecture*, 2nd ed. (Portland, Oregon: Sustasis Press, 2014).

⁷⁵ James Stevens Curl, “Building Bad”, *Inference* 5, Issue 1 (December 2019), accessed June 4, 2020, <https://inference-review.com/letter/building-bad>

⁷⁶ James Stevens Curl, “Modernist Ideology Contributed To Unhealthy Architecture”, *The American Conservative* (May 8, 2020), accessed July 19, 2020, <https://www.theamericanconservative.com/urbs/modernist-ideology-spawned-dangerous-and-unhealthy-architecture/>

⁷⁷ Ann Sussman and Justin B. Hollander, *Cognitive Architecture* (New York, NY: Routledge, 2015).

⁷⁸ Ann Sussman and Janice M. Ward, “Game-changing eye-tracking studies reveal how we actually see architecture”, *Common Edge* (27 November 2017), accessed June 4, 2020, <https://commonedge.org/game-changing-eye-tracking-studies-reveal-how-we-actually-see-architecture/>

⁷⁹ Donald Norman, *The Design of Everyday Things* (New York, NY: Basic Books, 2013): 132-142.

⁸⁰ Sir Roger Scruton, “A Point of View: The Strangely Enduring Power of Kitsch”, *Ethics and Public Policy Center* (December 12, 2014), accessed June 4, 2020, <https://eppc.org/publications/a-point-of-view-the-strangely-enduring-power-of-kitsch/>

⁸¹ Ann Sussman and Katie Chen, “The Mental Disorders that Gave Us Modern Architecture”, *Common Edge* (22 August 2017), accessed June 4, 2020, <https://commonedge.org/the-mental-disorders-that-gave-us-modern-architecture/>

⁸² Ann Sussman, “Walter Gropius, the Horror of War, and How Modern Architecture Mirrors Traumatic Brain Injury”, Chapter in Ann Sussman and Justin Hollander, eds., *Urban Experience and Design: Contemporary Perspectives on*

opposite to that of neurotypical people, and confuses two informationally antithetical situations: “The uniformity of the innumerable windows in this vast wall on the Piazza San Marco gives the same play as would the smooth side of a room”^{83,84} While Le Corbusier is known to have been blind in one eye while hardly able to see anything out of his functioning eye, his statement indicates a deeper cognitive brain dysfunction.

Separately, the Bauhaus design ideals link to pathologies of the eye-brain system such as cataract, Carbon Monoxide poisoning, cerebral achromatopsia, cortical lesions, macular degeneration, retinal detachment (which Le Corbusier had, and led to his losing sight in one eye), and visual agnosia.⁸⁵ Modernist design pioneers introduced and ceaselessly promoted their vision of a depressing, grey, and lifeless world.⁸⁶ “Reality” is strongly influenced by internal conditions we may not realize we carry. Why impose sensory deprivation on all neurotypical people, no different from “white torture” techniques inflicted on political prisoners?⁸⁷ And how did this informationally-restrictive design style become modernity’s founding myth?

Although there is strong evidence of the blankness of architectural minimalism being a direct expression of trauma, the individuals who introduced that style were never diagnosed during their lifetimes. There is a good case for recognizing early 20th century design “innovations” as nothing other than reactions to post-traumatic stress disorder following horrific military experience during World War I.^{88,89} We now know that survivors lose the ability to process visual detail, which might help to explain the insistence on an empty and featureless style. They also find empathic connection and emotional mirroring — the topic of this paper — very difficult if not painful, and avoid it for this reason.

This hypothesis is conjectural and cannot be fully justified here. After World War II, architectural culture chose disengaging over engaging and soothing environments and favored ill-fitting and sometimes inhuman spaces, such as oppressively low ceilings.⁹⁰ This precocity in applied carelessness towards humanity raises the possibility of biological or neurological deficits among those individuals who decided.

Bessel van der Kolk, a specialist in treating post-traumatic stress disorder (PTSD), describes how traumatized individuals react very differently from neurotypical persons:

Improving the Public Realm (London and New York: Routledge, 2020), in press.

⁸³ Le Corbusier, *The City of Tomorrow and its Planning* (New York: Dover, 1987): 69.

⁸⁴ Nikos Salingaros, “Architecture, Patterns, and Mathematics”, *Nexus Network Journal* 1 (1999): 75–86; reprinted as Chapter 6 in *A Theory of Architecture*, 2nd ed. (Portland, Oregon: Sustasis Press, 2014): 129-143.

<https://link.springer.com/content/pdf/10.1007/s00004-998-0006-0.pdf>

⁸⁵ Nikos Salingaros, “The Sensory Value of Ornament”, *Communication and Cognition* 36 (2003): 331–351; reprinted as Chapter 4 in *A Theory of Architecture*, 2nd ed. (Portland, Oregon: Sustasis Press, 2014): 84-104.

⁸⁶ Ingrid Fetell, “Unhappy Hipsters: Does modern architecture make us gloomy?”, *Psychology Today* (February 6, 2010), accessed July 19, 2020, <https://www.psychologytoday.com/us/blog/design-and-the-mind/201002/unhappy-hipsters-does-modern-architecture-make-us-gloomy>

⁸⁷ Jodi Smith, “White Torture Is A Sensory Deprivation Method That Erases All Sense Of Reality”, *Ranker* (September 3, 2019), accessed June 28, 2020, <https://www.ranker.com/list/extreme-white-torture-facts/jodi-smith>

⁸⁸ Ann Sussman and Katie Chen, “The Mental Disorders that Gave Us Modern Architecture”, *Common Edge* (22 August 2017), accessed June 4, 2020, <https://commonedge.org/the-mental-disorders-that-gave-us-modern-architecture/>

⁸⁹ Ann Sussman, “Walter Gropius, the Horror of War, and How Modern Architecture Mirrors Traumatic Brain Injury”, Chapter in Ann Sussman and Justin Hollander, eds., *Urban Experience and Design: Contemporary Perspectives on Improving the Public Realm* (London and New York: Routledge, 2020), in press.

⁹⁰ Nikos Salingaros, “Why Do Some People Choose Oppressive Environments?”, *Metropolis* (December 15, 2015), accessed July 19, 2020, <https://www.metropolismag.com/uncategorized/why-do-some-people-choose-oppressive-environments/>

“Traumatized people have a tendency to superimpose their trauma on everything around them and have trouble deciphering whatever is going on around them... We also learned that trauma affects the imagination... they were not displaying the mental flexibility that is the hallmark of imagination. They simply kept replaying an old reel.”⁹¹

I interpret this statement as explaining how architects, historically among the world’s most creative professionals, can be fixated on glass and grey concrete cubes decade after decade. Dissociation during combat enables veterans to survive, but permanent trauma has negative consequences for their everyday coping with the world afterwards.⁹² Dissociation applied to architecture produces a public realm of social dissolution. Dissociation and fragmentation in design need not come from aesthetic novelty, but could rather be a direct external expression of internal disconnectedness.^{93,94}

As ethical designers, we should focus on helping all potential users of what we produce to connect to their environment so as to enjoy its healing benefits. Fighting for emotional inclusivity turns the dominant architectural paradigm on its head: we must first reject those industrial-modernist design ideals that sabotage deep feeling and experience, and then try to help every user (including individuals on the autism spectrum and those with PTSD) get the maximum benefit and vitality from a re-structured built environment.^{95,96}

Disconnection leads to the death of art and ornament

Let us define art as the pursuit of beauty leading to a meaningful deep connection (which admittedly is not a universal definition accepted by the profession). This definition respects human physiology and the healing response on the viewer. One key assumption of our culture has highly negative consequences: “art is of no importance to the structure of the universe”.⁹⁷ This notion was universally accepted as axiomatic during the past several decades. Art thus became irrelevant to our existence, transformed to just one more category of consumer goods without deep meaning, tacked onto life’s cheap spectacle.

Ornament suffered the same fate. Yet nature never distinguishes between function and ornament. Ornament that feels natural grows organically out of the form: it is never pre-fabricated, tacked-on decoration, and is always embedded into a larger fractal structure. The arbitrary diktat: “ornament is irrelevant: it is unrelated to function and is even harmful to society” was imposed without any protest in the early 20th century.⁹⁸ This architectural ban on

⁹¹ Bessel van der Kolk, *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma* (New York: Penguin Books, 2015): 17.

⁹² Robyn E. Brickel, “Dissociation: How People Cope with Trauma They Want to Forget”, *Brickel & Associates* (March 6, 2020), accessed July 18, 2020, <https://brickelandassociates.com/dissociation-from-trauma/>

⁹³ Ann Sussman and Katie Chen, “The Mental Disorders that Gave Us Modern Architecture”, *Common Edge* (22 August 2017), accessed June 4, 2020, <https://commonedge.org/the-mental-disorders-that-gave-us-modern-architecture/>

⁹⁴ Ann Sussman, “Walter Gropius, the Horror of War, and How Modern Architecture Mirrors Traumatic Brain Injury”, Chapter in Ann Sussman and Justin Hollander, eds., *Urban Experience and Design: Contemporary Perspectives on Improving the Public Realm* (London and New York: Routledge, 2020), in press.

⁹⁵ Nikos Salingaros, “The Sensory Value of Ornament”, *Communication and Cognition* 36 (2003): 331–351; reprinted as Chapter 4 in *A Theory of Architecture*, 2nd ed. (Portland, Oregon: Sustasis Press, 2014): 84–104.

⁹⁶ Martin Horacek, “Architects as Physicians”, *Inference* 5, Issue 2 (4 May 2020), accessed June 4, 2020, <https://inference-review.com/letter/architects-as-physicians>

⁹⁷ Christopher Alexander, *The Nature of Order; Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004): 19.

⁹⁸ Christopher Alexander, *The Nature of Order; Book 4: The Luminous Ground* (Berkeley, California: Center for

ornament reversed our evolved natural state of interacting with the physical world, disconnecting us. Prohibiting ornament, moreover, is based on an absurd deception and messianic proclamations.^{99,100} An entry point to the world's structural meaning occurs effortlessly through ornament: hence the vehement suppression of ornament in architecture.

We attach most intimately and readily to our environment through the small scale, linking to increasingly larger scales, on up to the largest scale.^{101,102} Yet we experience the whole instantaneously: only later is our attention drawn to its interlocking components and wealth of detail. Among the more interesting developments during the past few decades is understanding the structure of the universe in terms of fractals.^{103,104} Organized complexity combined with fractals generates natural structures that humans unconsciously emulate in traditional architectures.¹⁰⁵ Producing ornament is an attempt to satisfy innate fractal patterns that shaped the evolution of our visual system. The driving force for ornamentation is deep connection.

Typefaces and the grotesque

The “grotesque” in architecture and art is a long tradition where something is willfully distorted so as to provoke a response, most often drawing forth a negative emotion. Even though we occasionally find ourselves in frightening situations, there is never any grotesque design in nature, because form has a physical basis or has evolved to accommodate living processes. The grotesque is a human invention since it triggers purely human associations. It produces monsters, reactions of fear, horror, and pain in works that are not “pretty” but intentionally provocative.

This concept has been especially implemented in religious art to communicate the frightening raw power of Gods or dangerous spirits. It also occupies the central purpose of a cathartic experience, where disturbing images or descriptions of events are meant to teach a positive and redemptive lesson to followers: for example, the passion plays describe the tormenting and execution of Christ to reinforce the moral value of Christianity. Demons are depicted forcefully in African, American, and Asian art to make humans beware of demonic forces in the world, etc. All of the world's mythologies contain descriptions of terrible and horrifying acts.

Environmental Structure, 2004): 19.

⁹⁹ Nikos Salingaros, “The Sensory Value of Ornament”, *Communication and Cognition* 36 (2003): 331–351; reprinted as Chapter 4 in *A Theory of Architecture*, 2nd ed. (Portland, Oregon: Sustasis Press, 2014).

¹⁰⁰ Michael W. Mehaffy and Nikos A. Salingaros, *Design for a Living Planet* (Portland, Oregon: Sustasis Press 2015): Chapter 3 “How Modernism Got Square”, published online by *Metropolis* (19 April 2013), accessed June 4, 2020, <https://www.metropolismag.com/architecture/toward-resilient-architectures-3-how-modernism-got-square/>

¹⁰¹ Terry M. Mikiten, Nikos Salingaros and Hing-Sing Yu, “Pavements as embodiments of meaning for a fractal mind”, *Nexus Network Journal* 2 (2000): 63–74. Reprinted as Chapter 7 of: *A Theory of Architecture*, 2nd ed. (Portland, Oregon: Sustasis Press, 2014): 144-158, accessed June 4, 2020, <https://link.springer.com/content/pdf/10.1007/s00004-999-0009-5.pdf>

¹⁰² Yannick Joye, “Fractal architecture could be good for you”, *Nexus Network Journal* 9, no. 2 (2007): 311-320, accessed June 4, 2020, <https://link.springer.com/content/pdf/10.1007/s00004-007-0045-y.pdf>

¹⁰³ Richard P. Taylor, “Reduction of physiological stress using fractal art and architecture”, *Leonardo* 39, no. 3 (2006): 245–251, accessed June 4, 2020, <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.741.8120&rep=rep1&type=pdf>

¹⁰⁴ Nikos Salingaros, “Fractal Art and Architecture Reduce Physiological Stress”, *JBU – Journal of Biourbanism* 2, no. 2 (2012): 11-28. Reprinted as Chapter 26 of *Unified Architectural Theory* (Portland, Oregon: Sustasis Press, 2013): 170-190, accessed June 4, 2020, https://journalofbiourbanism.files.wordpress.com/2013/09/jbu-ii-2012-2_nikos-a-salingaros.pdf

¹⁰⁵ Alexandros A. Lavdas and Uta Schirpke, “Aesthetic preference is related to organized complexity”, *Plos ONE* 15, no. 6: article e0235257 (June 26, 2020), accessed June 26, 2020, <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0235257>

The idea of the grotesque was adopted wholeheartedly in the early 20th century, but totally detached from any cathartic, moral, or religious purpose. It was employed by design revolutionaries purely for shock value so as to present design novelty. As Paul Virilio describes, dominant culture embraced the grotesque in art.¹⁰⁶ Heretofore, designers had instinctively avoided making users of their products feel uncomfortable, but this inhibition switched with the trauma of World War I to become a driving force for designing the everyday environment. Humane systems of production were pushed to local or marginal niches.



Figure 4. Serif font on the left embodying complexity towards design adaptation versus “grotesque” sans-serif font on the right. The overly simplified sans-serif typeface is neither as attractive nor as legible as the serif typeface. Copyright © 2006 Nikos Salingaros.

For example, grotesque typefaces in typography took over after World War I and have become the standard choice today in architectural culture (Figure 4).^{107,108} The first such character was “Berthold Akzidenz Grotesk”, a sans-serif font that evolved into the commonly-used Helvetica typeface. Its inventors knew very well that it looked strange — “grotesque” — because of its stroke having uniform width and intentional lack of serifs on the characters.^{109,110} In keeping with the makeover of architecture and art towards minimalism and the avoidance of ornament, sans-serif fonts replaced serif fonts almost everywhere in common use for architectural texts.

Using 3M’s VAS eye-tracking simulation software gives us an indication of what happens when the eye confronts serif versus sans-serif fonts. In Figures 5 and 6, the two versions of the character “a” shown in Figure 4 were tracked. The serif font shows far more visual interest. Note how the eye is first attracted to the left-hand-side, and only after two fixations does it move to the right-hand-side.

¹⁰⁶ Paul Virilio, *Art and Fear* (London, UK: Continuum Press, 2006).

¹⁰⁷ Eduardo Souza, “10 Fonts For Architects”, *ArchDaily* (16 October 2017), accessed July 16, 2020, <https://www.archdaily.com/881233/10-fonts-for-architects>

¹⁰⁸ Architectural Fonts, *Archisoup* (2020), accessed July 16, 2020, <https://www.archisoup.com/architectural-fonts>

¹⁰⁹ Nikos Salingaros, “The Sensory Value of Ornament”, *Communication and Cognition* 36 (2003): 331–351; reprinted as Chapter 4 in *A Theory of Architecture*, 2nd ed. (Portland, Oregon: Sustasis Press, 2014): 84–104.

¹¹⁰ David Brussat, “Google belly flops logo test”, *Architecture Here and There* (5 September 5, 2015), accessed June 6, 2020, <https://architecturehereandthere.com/2015/09/05/google-logo-design-typeface/>

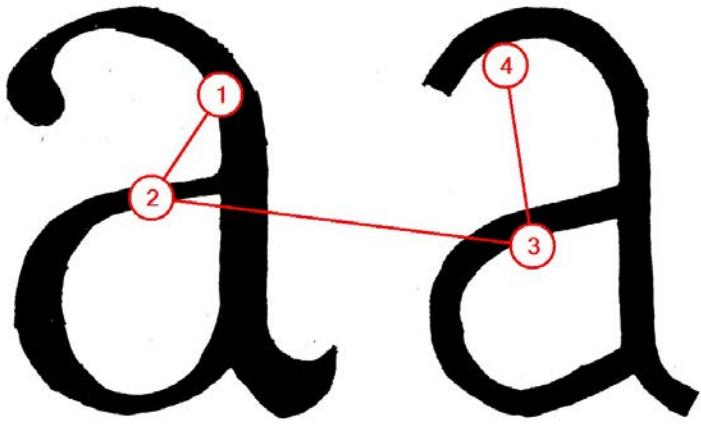


Figure 5. 3M's VAS eye-tracking simulation software applied to compare a serif “a” to a sans-serif “a”. The first visual fixations are on the serif font on the left. Analysis carried out by Ann Sussman, and reproduced here with permission.

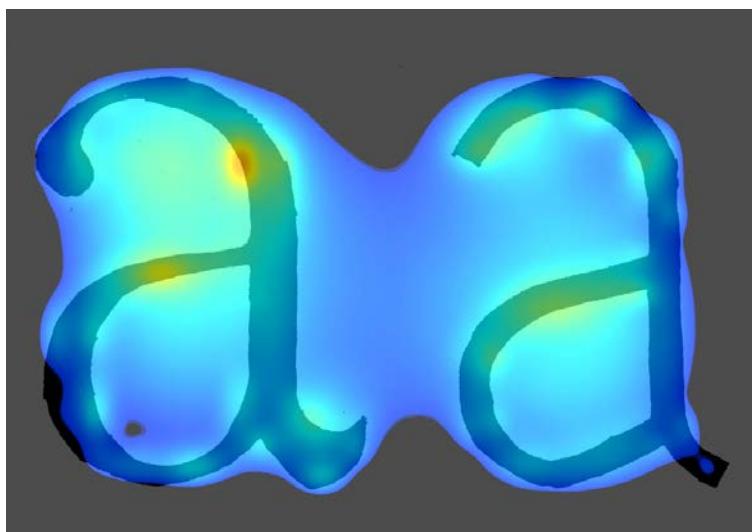


Figure 6. Heatmap compares pre-attentive visual interest of a serif “a” compared to a sans-serif “a”. The yellow-orange spots indicate increased attention, clearly favoring the serif font on the left. Analysis carried out by Ann Sussman using 3M's VAS eye-tracking simulation software, and reproduced here with permission.

The original sans-serif fonts will always be associated with two notorious signs written in capital letters: (i) ARBEIT MACHT FREI over the entrance gate of Auschwitz; and (ii) JEDEM DAS SEINE on the metal door to Buchenwald. Most people are unaware of the unsavory industrial background for this psychological and visual change in texts. Comparing the ease of reading printed text in serif versus sans-serif fonts reveals a clear advantage in comprehension for the serif font.¹¹¹ Text on a computer screen, however, obeys different parameters depending upon the font size and display resolution.¹¹²

¹¹¹ John Wood, “The Best Fonts to Use in Print, Online, and Email”, *American Writers & Artists Institute* (October 2011), accessed July 16, 2020, <https://www.awai.com/2011/10/the-best-fonts-to-use-in-print-online-and-email/>

¹¹² Aries Arditi and Jianna Cho, “Serifs and font legibility”, *Vision Research* 45, no. 23 (November 2005): 2926–2933,

Abusing the scientific method to promote an agenda

Alexander describes in detail how genuine science inadvertently helped to detach humanity from the world of emotions.^{113,114} This happened for the following reason. In studying a phenomenon analytically, it is essential to isolate it from all the other phenomena acting in a physical situation simultaneously. Careful and artificial isolation, whether in an experimental setup or in developing a theoretical model, pays off. Scientific progress, especially in the 19th century, is founded on this method. Detachment from the complexity of natural situations is necessary in order to study and analyze a single factor without forgetting the whole, yet this method is abused as an excuse for detachment in general.

The rigorous methods of scientific analysis from the 19th century and before established a worldview wherein matter is inert, neutral. There is no value that humans can recognize in the sense of a physical object being “better” or “worse”; nor any place for emotions, let alone an emotional connection to the world. Life turned into an accidental phenomenon occurring in a clockwork mechanical universe, and therefore possessing no meaning. Our internal universe of emotions and feelings becomes purely and simply an imagined neurological construct without physical importance.¹¹⁵ Design in the 20th century embraced this nihilistic philosophy, which we are now challenged to undo.

What follows is my opinion, which draws on personal experience in the world of architecture. Pundits offer totally confused statements about what is “good” design, abusing their considerable position of authority to confuse everyone else.^{116,117} Certain people pursue the goal of isolating themselves from the healing function of living structure in supporting a minimalist design aesthetic. But then, they misapply science to justify this, claiming that a disconnecting worldview is necessary because it is supposedly “scientific”. Nothing could be further from the truth. Those persons come from architecture and the arts, and are not scientists. They misinterpret science and scientific thinking to promote their own peculiar aesthetic agenda.

A morally ambiguous role for scientists

Alexander concludes that architecture became trivial following the deliberate split between function and the beauty of shape and form.¹¹⁸ Building absurd and ridiculous forms for shock value is irrelevant to humanity.^{119,120} Architecture after the 1920s pursued the

accessed July 16, 2020, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4612630/>

¹¹³ Christopher Alexander, *The Nature of Order, Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004).

¹¹⁴ Nikos Salingaros, “Beauty and the Nature of Matter: The Legacy of Christopher Alexander”, *New English Review* (1 May 2019), accessed June 4, 2020, <https://www.newenglishreview.org/custpage.cfm?frm=189673>

¹¹⁵ Christopher Alexander, *The Nature of Order, Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004): 19.

¹¹⁶ Nikos Salingaros, “Twentieth-Century Architecture as a Cult”, *New English Review* (1 March 2019), accessed July 16, 2020, <https://www.newenglishreview.org/custpage.cfm?frm=189607>

¹¹⁷ Nikos Salingaros, “The Rise of the Architectural Cult”, *Inference: International Review of Science* 5, Issue 1 (13 December 2019), accessed June 4, 2020, <https://inference-review.com/article/the-rise-of-the-architectural-cult>

¹¹⁸ Christopher Alexander, *The Nature of Order, Book 4: The Luminous Ground* (Berkeley, California: Center for Environmental Structure, 2004): 27.

¹¹⁹ John Silber, *Architecture of the Absurd* (New York, New York: Quantuck Lane Press, 2007).

¹²⁰ Peter Buchanan, “Empty gestures: Starchitecture’s swan song”, *Architectural Review* (27 February 2015), accessed June 4, 2020, <https://www.architectural-review.com/architects/empty-gestures-starchitectures-swan-song/8679010.article>

strategic political goal of undoing traditional society. The revolution aimed to detach human beings from their culture, inherited values, religion, tradition, the extended family, etc. that anchored them to a reassuring world. The Bauhaus and the Italian and Russian Futurists openly admitted this massive experiment in social engineering as their objective.^{121,122} In the process of severing traditional ties through abstractions, architecture severs people from their own humanity.

If, as Alexander maintains, there was a catastrophic reversal in how persons in advanced technological societies connected to physical reality, then we have to ask why that took place. Scientists would consequently be in part complicit in this action, or at the very least, not-so-innocent bystanders.^{123,124,125} There are two possible motives to blame them directly:

(i) Scientists ignore whenever others misuse science to coerce people to cut their links to the living world. Scientists did not notice what has been happening over decades, or else consider it outside their topic of interest. Or, perhaps, they are too meek to criticize popular culture and economic power groups, and therefore quietly accept pseudoscientific nonsense invading architecture and the arts.¹²⁶ A hands-off attitude justifies non-intervention in other professional disciplines. Scientists have remained mute and uninterested, refusing to exert their authority as society's watchdogs against charlatanism and manipulation.

(ii) Scientists have gone off on very isolated and narrow pursuits. Their sharp focus is of course standard procedure among scientific investigators, yet it is also highly reductionistic.¹²⁷ Our world's most intelligent researchers thus ignore disturbing and damaging actions towards nature and society. Trying to create universal schemes of understanding the universe, including theories of "everything", they left out perhaps the most important phenomenon: how humans connect to the physical world. The questions that Alexander tackles escape most scientists entirely, as they falsely believe them to lie outside science. They don't.

Our worldview must change to permit us to seek a deep connection to meaningful structure required to maintain the living world. Starting in the 20th century, science began to develop into more connected directions, investigating inter-relationships and large-scale order. This happens, for example, in biology, complexity theory, ecology, emergent systems, networks, quantum entanglement, etc. Scientific disciplines originally limited to narrow segments branched out. Yet these developments have not nearly gone far enough. We still

¹²¹ James Stevens Curl, *Making Dystopia: The strange rise and survival of architectural barbarism* (Oxford: Oxford University Press, 2018).

¹²² Malcolm Millais, *Exploding the Myths of Modern Architecture*, 2nd Edition (Portland, Oregon: Sustasis Press, 2019), <https://www.boekenbestellen.nl/boek/exploding-the-myths-of-modern-architecture/9789463868112>

¹²³ Miguel Córdova-Ramírez, "A False Promise of Progress", *Inference* 5, Issue 2 (4 May 2020), accessed June 4, 2020, <https://inference-review.com/letter/a-false-promise-of-progress>

¹²⁴ Michael Mehaffy, "An Obsolete Ideology", *Inference* 5, Issue 2 (4 May 2020), accessed June 4, 2020, <https://inference-review.com/letter/an-obsolete-ideology>

¹²⁵ Malcolm Millais, "The Origins of Architectural Barbarism", *Inference* 5, Issue 2 (4 May 2020), accessed June 4, 2020, <https://inference-review.com/letter/the-origins-of-architectural-barbarism>

¹²⁶ Nikos Salingaros, "The Rise of the Architectural Cult", *Inference: International Review of Science* 5, Issue 1 (13 December 2019), accessed June 4, 2020, <https://inference-review.com/article/the-rise-of-the-architectural-cult>

¹²⁷ Ramray Bhat and Nikos Salingaros, "Reductionism Undermines Both Science and Culture", *New English Review* (1 March 2013), accessed June 4, 2020, https://www.newenglishreview.org/custpage.cfm/frm/134366/sec_id/134366

lack a physical basis for Alexander's connecting method. And the world of architecture and art continues in almost complete isolation from experienced phenomena.

On the positive side, the recent explanation of deeply-moving connective experience coming from neuroscience is very helpful, but even that does not suffice. It limits itself to explaining deep connection as a cognitive neurological resonance inside the brain of an individual. And nothing more. This neurological connective state appears irrelevant to physics, hence irrelevant to the structure of the universe. How do we then explain "beauty" in the configurations of matter? Present-day science is not prepared to consider deep connectivity as a physical phenomenon, and to investigate the possible mechanisms that may be responsible for it.

Conclusion

Christopher Alexander puts forward a theory of how we connect to the world, in large part visually, although our other senses are also involved. He maintains that deep connection is necessary to help designers create objects, buildings, and places adapted to human use. This paper described how to implement this process of deep connection, helping readers navigate the relevant parts of Alexander's four-volume book *The Nature of Order*. Otherwise there is a real danger of coming up with sterile, dead objects to which we cannot connect. This is indeed the case with much of the built environment following World War II that was created according to formalism and ideology.

The following observations summarize some problems we face today:

1. Science does not yet cooperate in trying to understand an empirically perceived deep connective process;
2. we lack a proper vocabulary even to describe this connective effect;
3. dominant architectural culture imposes its own stylistic agenda of disconnection.

Significant progress has been made in dealing with the phenomenon of deep connection. In particular, eye-tracking and software that simulates eye-tracking help dramatically, as they establish which visuals we might connect to while eliminating those that are disengaging (i.e. regions that fail to attract our attention, or repel it). One should then concentrate on the "engaging" cases to determine how deeply we connect to them. We can create a framework that privileges human-centered design through a connection established between designer and object. A novel set of tools is ready to be implemented in the near future to generate a wonderful new adaptive architecture.

The advertising world respects a basic rule: "What is not communicated does not exist". Ever since educated people ceased to apply and even think about deep connection, the concept itself has all but disappeared from human consciousness. It lives on only at the margins of society and in more traditional cultures, outside consumerist-technocratic society controlled by mass media. Our educational system ignores and omits to teach deep connection to young people. Much of today's population is incapable of getting emotional nourishment from beauty in the environment. Beauty is no longer created since no one — except young children — feels a visceral need for it.

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Declaration of Interests

There are no conflicts of interest involved in this article.

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¹²⁸ Nikos Salingaros, “Christopher Alexander’s beginning chapters of The Nature of Order Book 4”, video lecture given to the Building Beauty Master’s Program (21 May 2020), accessed June 4, 2020, <https://drive.google.com/drive/folders/1aMK8vpMvS75OHykA1IKsQjOaiiRy7Ltm>

¹²⁹ Nikos Salingaros, “Beauty and the Nature of Matter: The Legacy of Christopher Alexander”, video lecture given to the Building Beauty Master’s Program, Sorrento, Italy (28 March 2019), accessed June 4, 2020, <https://vimeo.com/328174786>

¹³⁰ Nikos Salingaros, “Beauty and the Nature of Matter: The Legacy of Christopher Alexander”, *New English Review* (1 May 2019), accessed June 4, 2020, <https://www.newenglishreview.org/custpage.cfm?frm=189673>

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