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

Nikos A. Salingaros

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NIKOS A. SALINGAROS
Department of Mathematics, The University of Texas at San Antonio, USA
(corresponding author)
salingar@gmail.com

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 visceral connection. The resulting disconnection from the material world will continue to have long-lasting negative consequences for human well-being. Christopher Alexander describes how to revive the visceral connecting process, creating conditions for human-centered design in our times. Biological connectedness arises from an organic projection of the designer's "self" onto the material reality of the object being designed, and to 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 he was developing his theory.

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Introduction

After an uncomfortably long pause, questions of beauty are coming up once again in general discussions.[1] The film *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] The film coincides with renewed interest from architects, designers, and others from many different professional orientations, all converging on a common concern: whatever happened to beauty as an essential factor in healing environments? Why did this feature of human-centered design disappear?[4]

Simplified building shapes, and the 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."[5]

The British Government recently set up the Building Better, Building Beautiful Commission[6] to re-align new building activity towards this goal. Its extensive report links 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."[7] Those goals and that kind of language 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 (notion or quality) of inner feeling, which we connect to unconsciously.[8] This experience cannot exist detached from the human perceptual system, since the effect depends upon sensory connection. Our body responds viscerally to certain signals and informational input coming from our immediate environment. A feeling takes place on both experiential and physical planes, and is the basis of our survival through the three-way set of autonomous responses: fight, flight, or freeze.

At the same time, beauty is deeper than opinion-based aesthetics, and is even independent of humans. This conclusion follows because the configurations that turn out to be "beautiful"—those we respond to viscerally in a positive sense, and unconsciously seek out for comfort and pleasure—were present long before humans evolved. Those examples arise in nature from generative processes related to the organization of matter, and from biological development.[9] All of this occurred before our bodies and sense of aesthetics evolved.

1 Rolf Reber, Norbert Schwarz, and Piotr Winkielman, "Processing Fluency and Aesthetic Pleasure: Is Beauty in the Perceiver's Processing Experience?," *Personality and Social Psychology Review* 8, no. 4 (2004): 364–82, DOI: https://doi.org/10.1207/s15327957pspr0804_3.

2 Donald H. Ruggles, *Beauty, Neuroscience, and Architecture: Timeless Patterns and Their Impact on Our Well-Being* (Murray, KY: Fibonacci LLC, 2017).

3 Mariel Rodriguez-McGill, "Built Beautiful — Trailer," vimeo, 01:57, July 2020, https://neuro-architectology.com/built-beautiful/.

4 Sustasis Collaborative, "Thought Leaders: Christopher Alexander," YouTube video, 4:54, August 8, 2020, https://www.youtube.com/watch?v=o6q1dDAv6zY.

5 Donald Norman, "Then and Now: The Bauhaus and 21st Century Design," *bauhaus now* 1, no. 1 (2018): 18–21, available at https://jnd.org/then_and_now_the_bauhaus_and_21st_century_design/.

6 Sir Roger Scruton et al, *Living with Beauty – Report of the Building Better, Building Beautiful Commission* (London: Gov.UK, 2020), accessed September 30, 2020, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/861832/Living_with_beauty_BBBBC_report.pdf.

7 Ibid., 1.

8 Christopher Alexander, *Nature of Order, Book 1: The Phenomenon of Life* (Berkeley: Center for Environmental Structure, 2002); Christopher Alexander, *Nature of Order, Book 4: The Luminous Ground* (Berkeley: Center for Environmental Structure, 2005).

9 Nikos Salingaros, "Beauty and the Nature of Matter: The Legacy of Christopher Alexander," *Architexturez*, July 22, 2020, https://patterns.architexturez.net/doc/az-cf-198826; Nikos Salingaros, "Beauty and the Nature of Matter: The Legacy of Christopher Alexander," *New English Review*, May 2019, https://www.newenglishreview.org/Nikos_Salingaros/Beauty_and_the_Nature_of_Matter%3A_The_Legacy_of_Christopher_Alexander/.

Although the focus here is on architecture, the discussion might be useful to other design disciplines including industrial and product design as well. Here I will outline Alexander's theory of human-environment connection and its background to enable architects and designers alike 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.[10]

The objective is to set 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 Don Norman's well-known work on emotional design. Biological 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] By establishing a specific mood that focuses on design that adapts to human sensibilities, 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, and degrades our existence when it is absent. Beauty in architecture needs its own model, related to but distinct from biology, physics, systems theory, and so on. To consistently create a tangible feeling of what might be called "visceral beauty" in buildings and cities, we require a pragmatic theory for understanding the world based on observation and repeatability.

Art historians have argued about beauty for centuries, yet discussions in the standard literature lack practical guidelines for today's design professionals. Attention is sidetracked into historical debates, leading away from useful design principles. 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]

Don Norman has said that creating useful products depends upon cognitive design principles, which make it possible to implement human-centered design to design all things: artifacts, buildings, and even cities.[14] Cognitive design — relying upon how our brain engages with form and information — has been successfully applied to product design, but, so far, has not influenced architecture. Contemporary investigations are opening

10 Alexander, *Nature of Order, Book 1*, 313–50; Nikos Salingaros, "Human Physiology and Evidence-Based Design," in *Unified Architectural Theory: Form, Language, Complexity. A Companion to Christopher Alexander's* The Phenomenon of Life: The Nature of Order, Book 1 (Portland, OR: Sustasis Press, 2013), 81–85, also available at https://www.archdaily.com/611788/unified-architectural-theory-chapter-9a/.

11 Pieter M. A. Desmet, Haian Xue, and Steven F. Fokkinga, "The Same Person Is Never the Same: Introducing Mood-Stimulated Thought/Action Tendencies for User-Centered Design," *She Ji: The Journal of Design, Economics, and Innovation* 5, no. 3 (2019): 167–87, DOI: https://doi.org/10.1016/j.sheji.2019.07.001.

12 Donald Norman, *The Design of Everyday Things* (New York: Basic Books, 2013). It is worth noting here that this article will not get into beauty and the fluency of information processing.

13 Sarah Robinson and Juhani Pallasmaa, eds., *Mind in Architecture: Neuroscience, Embodiment, and the Future of Design* (Cambridge, MA: The MIT Press, 2015); Darren Bridger, *Neuro Design* (London: Kogan Page, 2017).

14 Norman, *The Design of Everyday Things*; Juval Portugali, "Information Adaptation as the Link between Cognitive Planning and Professional Planning," in *The Handbook on Planning and Complexity*, ed. Gert de Roo, Claudia Yamu, and Christian Zuidema (Cheltenham: Edward Elgar Publishers, 2020), 203–19.

up new possibilities for human-centered design to use some promising new findings. These include

i eye tracking experiments and eye tracking simulation software reveal what we find unconsciously engaging,[15]

ii geometric rules for visual organization confirm which specific configurations attract our unconscious attention,[16] and

iii biophilia creates an innate attraction to living structure and the geometry of biological forms.[17]

In addition, human-centered design depends upon affordance, context, dimension, ergonomics, interaction, shape, signifiers, usability, and more, which require the designer to be extremely sensitive to a user's physiological and psychological requirements. Cognitive design together with recent scientific discoveries helps a designer 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.[18]

Norman points out that deciding among distinct design choices, especially if they all seem equally sound, is based on emotion.[19] 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 — it may be pulled towards branding (an attractive image) and away from adaptivity (which fits human use and creates a healing environment). Alexander's visceral connecting is emotion-based, but it is effective because it is driven by identifying the "living structure"[20] within the thing being designed. The focus is on a specific group of emotions; otherwise we get lost in our own sentimentality. Adapting to human needs prevents emotional decisions from being influenced by irrelevant factors such as what outside influences persuade us to like, what we have been taught to prefer, and so on.

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.[21] Making the effort to train a new generation of designers in visceral connectedness and human-centered design would parallel equivalent calls for reform in architectural education emerging around the globe.[22] Faculty in architecture schools have stated that they already teach adaptive design, but lack a system for organizing complexity. They only connect to parts, and then usually to the least important parts. There is a powerful urge today to rethink how we shape the artificial environment to improve human health and well-being.

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 seek to link ourselves to a piece of the physical world. Alexander uses philosophical and poetic language to explain this process of discovering the designer's "self" in whatever they are trying to make. He refers to establishing as deep and intuitive a connection to the emergent design and its physical context

15 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, no 2 (2020): 1–19, DOI: https://doi.org/10.3390/urbansci4020026.

16 Nikos Salingaros, "Adaptive Versus Random Complexity," *New Design Ideas* 2, no. 2 (2018): 51–61, available at http://jomardpublishing.com/UploadFiles/Files/journals/NDI/V2N2/SalingarosN.pdf; Nikos Salingaros, "Symmetry Gives Meaning to Architecture," *Symmetry: Culture and Science* 31, no. 3 (2020): 231–60, DOI: https://doi.org/10.26830/symmetry_2020_3_231.

17 Stephen R. Kellert, Judith Heerwagen and Martin Mador, eds., *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life* (New York: John Wiley, 2008); Nikos A. Salingaros, "The Biophilic Healing Index Predicts Effects of the Built Environment on Our Well-being," *JBU–Journal of Biourbanism* 8, no. 1 (2019): 13–36, available at https://journalofbiourbanism.files.wordpress.com/2020/08/jbu_viii_1_2019.pdf.

18 Donald H. Ruggles, "Beauty, Neuroscience and Architecture," in *The Conscious Cities Anthology, 2019*, ed. Itai Palti (London: The Centre for Conscious Design, 2019), online, DOI: https://doi.org/10.33797/CCA19.01.08.

19 Donald Norman, *Emotional Design: Why We Love (Or Hate) Everyday* (New York: Basic Books, 2004), 12.

20 Alexander calls an adaptive, healing environment as being analogous to the structure of living forms.

21 Michael W. Meyer and Donald Norman, "Changing Design Education for the 21st Century," *She Ji: The Journal of Design, Economics, and Innovation* 6, no. 1 (2020): 13–50, DOI: https://doi.org/10.1016/j.sheji.2019.12.002.

22 Nicholas Boys-Smith and Sir Roger Scruton, "Beauty and Sustainability in Architectural Education," *ArchNewsNow*, August 22, 2019, http://www.archnewsnow.com/features/Feature583.htm; Nikos Salingaros et al., "Architecture Programs Need a Change: Put People First — Not Art," *The James G. Martin Center for Academic Renewal* (blog), November 6, 2019, https://www.jamesgmartin.center/2019/11/architecture-programs-need-a-change-put-people-first-not-art/; "Pune Declaration on the State of Architecture in India," *Architexturez* (portal), January 2020, https://patterns.architexturez.net/doc/az-cf-193563.

as possible. Before any design can be conceived as visual form, or even in order 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 he has established some deeply felt connection with the amorphous virtual object. He then uses this felt sense of connection to guide the creative process. This very personal emotional link is essential because it helps designers discern among the overwhelming range of possibilities present at each step of the development cycle.

Lacking such a visceral connection leads the design process astray, however. When designers have no aid to guide them in taking sequential design decisions, they default to a facile, one-step standard — copy from a pre-existing vocabulary of forms. Those ready-made solutions can range from barely adequate to totally inappropriate; they can never truly adapt to the specific requirements of the current problem.[23] But 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 users any closer to connecting emotionally to the finished result.

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 previously discovered solutions.[24] Interacting design patterns distill proven socio-geometric solutions that can be reused with adaptive changes according to the situation at hand. Without some such ordering framework, our emotions can draw us toward impractical excursions that work against functionality.

Alexander essentially proposes that designers establish an intuitive connection with the prospective artifact as a precondition to design. The method is a mental exercise that engages an experience of physical healing. (A positive visceral/emotional connection triggers physiological and psychological reactions that generate a positive feeling, and which — by reducing stress — boosts health over the long term). The emotional link to that sense of healing guides each subsequent step in the design process — the designer uses their feelings, triggered by that viscerally felt sense of connection, to assess each design decision. Feedback should not be forced towards something that the designer wants — the design will develop based on empathy and harmony. This approach helps to keep the designer from making choices that lead away from human-centered design, as it insulates the process from externally imposed fashionable or formalistic influences.

The Personal Connection to Buildings with Life

Buildings that have "life" — a certain character, imbued into the design out of that deep sense of connection — embedded in their geometry are able to trigger a positive visceral connection with users.[25] Even though that connection is shared among people of all backgrounds, each individual experiences a specifically personal connection. Connecting occurs through feeling that is

23 Michael W. Mehaffy and Nikos A. Salingaros, "Computational Irreducibility," in *Design for a Living Planet: Settlement, Science, and the Human Future* (Portland: Sustasis Press, 2015), also available at https://www.metropolismag.com/ideas/frontiers-of-design-science-computational-irreducibility/.

24 Christopher Alexander et al., *A Pattern Language: Towns Buildings Construction* (New York: Oxford University Press, 1977); Michael W. Mehaffy et al., *A New Pattern Language for Growing Regions: Places, Networks, Processes* (Portland: Sustasis Press, 2019).

25 Alexander, *Nature of Order, Book 1*, 469–71; Nikos Salingaros, "Life and Complexity in Architecture from a Thermodynamic Analogy," in *A Theory of Architecture*, 2nd ed. (Portland: Sustasis Press, 2014), 105–28, available at http://blog.p2pfoundation.net/life-and-complexity-in-architecture-from-a-thermodynamic-analogy/2014/06/18.

elicited by the geometry and color of the existing detail or place, sequence of spaces, pattern of light and dark, and so on. Alexander had discovered that every human, regardless of origin or education, has in them the inborn ability and drive 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 visual connection, and neglect for the present moment other sensorial dimensions (proprioception, smell, sound, touch, etcetera) through which we connect to our environment. What do you, the designer, see in your mind's eye (imagining a variety of alternative scenarios) for the proposed design, and seek to present in the physical setting, that can be identified as points to connect with?[26] Component elements are typically a complex combination of color, contrast, curvature, detail, balanced shape, interacting scales, touchable surface, symmetries, and more. Neurologically healthy people (those not suffering from brain or visual pathologies, or mental conditioning) respond individually and positively to each of these factors as part of the evolved connective apparatus that biological organisms possess.

Visceral connection to the world is a primary, unconscious mechanism that animals use to inhabit and negotiate their environments. Connectedness is imperative for life because mammals feel safe through attachment. A large body of experimental evidence reveals the geometrical factors responsible for this connection.[27] It seems that specific types of symmetry upon the vertical axis play a deciding role.[28] Those symmetries are found in traditional human artifacts, constructions, and ornamentation prior to artistically "designed" buildings and objects starting from the 1920s. Further specialization occurs within the particular symmetry of animal faces, which evolution has fixed into animal and human perceptive systems.[29] We connect strongly to face-like structures, because our brains have specific face-recognition cells.[30] Such symmetries drive our attention.

Why do we link ourselves to pieces of the physical world? Alexander believes that this visceral connection lies in the nature of matter, and is not merely an invention of the human mind. As I will explain 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—by creating artifacts such as construction details, ornaments, or tools, even complete structures and places—is a physical process, and not a neurological one.

Beyond Biophilia: The Existence of the "I"

Alexander reintroduces an ancient concept to describe something for which we have no adequate vocabulary.[31] Visual details, pieces of matter, places, and portions of nature possess a discernible quality that we can connect to on a deeply personal level. This quality is termed the "I" of whatever we connect to, even though the object may be inanimate.[32] Once one has gotten

26 Alexander, *Nature of Order, Book 4*, 50.
27 Alexander Coburn et al., "Psychological Responses to Natural Patterns in Architecture," *Journal of Environmental Psychology* 62 (April 2019): 133–45, DOI: https://doi.org/10.1016/j.jenvp.2019.02.007; 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): 15164–69, DOI: https://doi.org/10.1073%2Fpnas.192579399.
28 Salingaros, "Symmetry Gives Meaning to Architecture"; Christopher W. Tyler et al., "Predominantly Extra-Retinotopic Cortical Response to Pattern Symmetry," *Neuroimage* 15, no. 24 (2005): 306–14, DOI: https://doi.org/10.1016/j.neuroimage.2004.09.018.
29 Le Chang and D. Y. Tsao, "The Code for Facial Identity in the Primate Brain," *Cell* 169, no. 6 (2017): 1013–28, DOI: https://doi.org/10.1016/j.cell.2017.05.011.
30 Ruggles, *Beauty, Neuroscience, and Architecture*, 77–87; Ann Sussman and Justin B. Hollander, *Cognitive Architecture: Designing for How We Respond to the Built Environment* (New York: Routledge, 2015), 56–106.
31 Alexander, *Nature of Order, Book 4*, 58, 69.
32 Ibid., 49–72.

over the initial strangeness of this concept, it is easy to see how a connection to an artifact might be akin to one happening between two living beings.

The "I" is not the self of the designer, but resides instead in the object to which the designer connects. Whether this term is the best one to use or not, Alexander's idea endows an object with imagined living presence 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 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 the desire for glory and power. That self-centered motivation, which predominates in today's buildings, can never lead to human-centered design.

Alexander's approach to the connection between designer and the world therefore requires careful clarification, otherwise the purported "human-centered design" can easily be misinterpreted as "self-centered" or "ego-centered" design. Visceral connection works with empathy, whereas the design profession today, especially among the highest profile architectural and urban projects, is totally ego-driven. That approach allows an architect's purely personal/subjective experience — dictated, moreover, by abstract cult images — to shape the public sphere.

Visceral 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 organic geometry of nature.[33] People connect with other organisms instinctively, and this exposure proves to be physically healing.[34] When applying biophilic design principles to 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 approach fails to connect to the deeper structure.

Alexander anticipated biophilic design as *The Nature of Order* was being written in the early 1980s. He goes much further than biophilia in trying to reach the spiritual sense of connectivity as envisaged by preindustrial peoples.[35] 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 such objects or living forms 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. Bin Jiang has approached this phenomenon from a scientific perspective, which hopefully signals the beginning of a research effort.[36]

This discussion now enters into the deeply mystical aspect of religions, something that makes designers — and most people in general, these days — uncomfortable because they don't know how to handle it within the current technological worldview. Today, talking about such visceral 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.

33 Edward O. Wilson, *Biophilia* (Cambridge, MA: Harvard University Press, 1984); Stephen R. Kellert, *Nature by Design: The Practice of Biophilic Design* (New Haven: Yale University Press, 2018).

34 Kellert et al., eds., *Biophilic Design*; Salingaros, "The Biophilic Healing Index."

35 Alexander, *Nature of Order, Book 4*, 58, 69.

36 Bin Jiang, "Living Structure Down to Earth and Up to Heaven: Christopher Alexander," *Urban Science* 3, no. 3 (2019): 1–20, DOI: https://doi.org/10.3390/urbansci3030096.

While it is true that sections of society worldwide have maintained a more sensitive and spiritual basis for understanding the world, dominant culture was swept up by the machine paradigm. Mechanization took over, especially after the early 20th Century, and those crude forms of thinking are still with us today, albeit disguised by a vastly developed technology. But all the present techno-glitter is not giving us a more human environment, while it has led to a catastrophic loss of connection to our inner self and to the universe.[37]

The Mirror-of-the-Self Test

In *The Nature of Order*, Alexander offers an interesting tool that helps us choose between two similar objects or settings by using visceral connectedness. Alexander asks which of two objects provides a better picture of one's "self."[38] 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. Remarkably, those who apply this test make fairly uniform choices.[39]

Which one of the pair is a more faithful representation of your "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 we aspire to. Visceral 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, one's healthy self is hard-wired to seek connectedness with another being, thus validating the personal connective approach for judging design and form.

By forcing ourselves to evaluate the geometry of an object intuitively on a visceral level, 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"?

Richard Gabriel and Jenny Quillen (both of whom worked with Alexander) discuss the Mirror-of-the-Self test in detail.[40] 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 people invariably pick the more valuable carpet as measured by age, scarcity, and antique value according to professional authorities.[41] When everyday utilitarian objects are compared pairwise, people usually select the more human-centered design that better fits our biology.

37 Alan Lightman, "The Virus Is a Reminder of Something Lost Long Ago," *The Atlantic*, April 1, 2020, https://www.theatlantic.com/ideas/archive/2020/04/coronavirus-is-changing-habits-of-mind/609181/.

38 Alexander, *Nature of Order, Book 1*, 313–50; Salingaros, "Human Physiology."

39 Alexander, *Nature of Order, Book 1*, 313–50.

40 Richard P. Gabriel and Jenny Quillien, "A Search for Beauty/A Struggle with Complexity: Christopher Alexander," *Urban Science* 3, no. 2 (2019): 1–32, DOI: https://doi.org/10.3390/urbansci3020064.

41 Alexander, *Nature of Order, Book 1*, 323–24.

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 visceral connection, which can then be used to guide 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

An online Mirror-of-the-Self survey (Figure 1) presented two wooden carvings of the same size (approximately 13 cm square). The results were comparable. Out of 50 responses, 56% favored the one on the left, whereas 44% chose the one on the right. This 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 connecting biologically. Performing this test sharpens an individual's sensitivity to environmental structure that possesses organized complexity.

An interesting analysis in the following section shows that the preattentive visual response during the first 3–5 seconds (before conscious vision begins) is reinforced after spending 6–151 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 was revealed.

Figure 1
Two wooden carvings were compared using the Mirror-of-the-Self test. Left: 18th Century Portugal; right: 20th Century India.

Eye Tracking Studies and Simulation Software

Decades after Alexander wrote about the importance of the visceral connection mechanism, scientific results are validating his insights. More than half the information coming into the brain is visual, so 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.[42] This cognitive process occurs without conscious control, and is independent of training in architecture, art, or design. After the initial unconscious fixations, we can override where we focus only by forcing our attention onto visual regions that were at first avoided. For example, we consciously employ our visual/cognitive apparatus to locate a building entrance that is hidden by the design, an action that stresses our body. Or we need to extract visual information from a building façade to orient ourselves despite it provoking an avoidant reaction. In architecture, we are given no choice, since the architect has imposed his/her design and we have to use it as best as we can. But this action could have negative consequences, because it may generate a fight or flight reaction, which induces distress in our body.[43] One dramatic example is monotonous repetition on the large scale—either horizontal or vertical—which induces headaches.[44]

Although eye tracking does not answer all the questions about visceral connection, it identifies the crucial primary step in that process. Something must first attract our unconscious attention before we can connect to it deeply. Triggers associated with visual attraction are hard-wired to detect potential for danger, food, or reproduction. If, on the other hand, the object or scene is disengaging for whatever reason— if we do not fix our eyes on it immediately—then it lies outside any possibility of visceral 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 schools, which is incapable of predicting how humans will react to forms and surfaces.[45] A very simple test—pre-attentive eye fixation—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 connection. Future research efforts should concentrate on engaging designs and not waste time with situations that are disengaging to begin with.

Going back to the two wooden carvings shown in Figure 1, an eye tracking product by 3M called Visual Attention Software (VAS) was used to compare them.[46] The results are displayed in Figures 2 and 3. We see that

42 Salingaros and Sussman, "Biometric Pilot-Studies Reveal."

43 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 (2019): 564–71, DOI: https://doi.org/10.1016/j.foar.2019.07.004; Ruggles, *Beauty, Neuroscience, and Architecture*, 101.

44 Arnold J. Wilkins, "A Physiological Basis for Visual Discomfort: Application in Lighting Design," *Lighting Research & Technology* 48, no. 1 (2016): 44–54, DOI: https://doi.org/10.1177%2F1477153515612526; Arnold J. Wilkins, "Looking at Buildings Can Actually Give People Headaches, Here's Why," *CNN.com*, July 6, 2018, https://www.cnn.com/style/article/why-looking-at-buildings-can-give-people-headaches/index.html.

45 Nikos Salingaros, "Architectural Theory," in *Unified Architectural Theory: Form, Language, Complexity. A Companion to Christopher Alexander's* The Phenomenon of Life: The Nature of Order, Book 1 (Portland: Sustasis Press, 2013), 26–33, also available at https://www.archdaily.com/433898/unified-architectural-theory-chapter-2a.

46 "Visual Attention Software," Commercial Solutions, 3M, accessed September 30, 2020, https://www.3m.com/3M/en_US/visual-attention-software-us/.

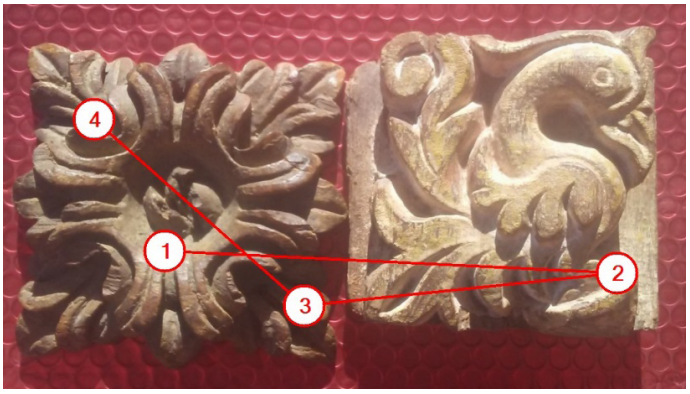

Figure 2
A VAS eye tracking simulation determines the four most likely pre-attentive fixation spots for our eyes. This scanning sequence estimates where our gaze first lands—without conscious awareness—and how it successively jumps to take in the rest of the image. Result from VAS software by Ann Sussman specially for the present article. Image licensed under CC BY by Ann Sussman, 2020.

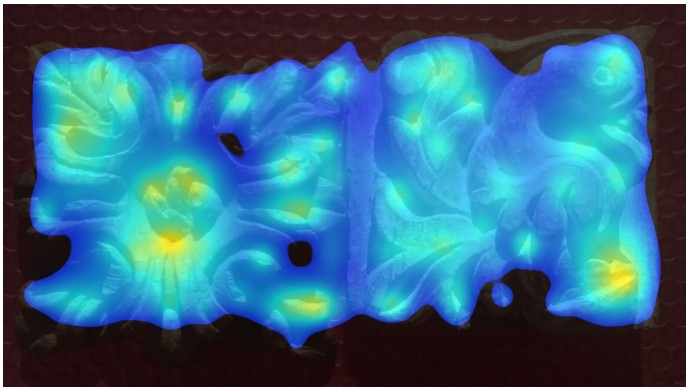

Figure 3
Heatmap showing the likely distribution of visual attention during pre-attentive gazing, that is, during the first 3–5 seconds. The yellow spots indicate those regions most likely to attract our eye's attention. Result from VAS software by Ann Sussman specially for the present article. Image licensed under CC BY by Ann Sussman, 2020.

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.

The eye tracking experiment estimates unconscious visual fixation during the first 3–5 seconds of the gaze. Both carvings are equally noticed to begin with. Contrast the brief time in pre-attentive viewing (3–5 seconds) with the Mirror-of-the-Self test carried out in the preceding section, where viewers needed 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: respondents in the online survey 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.

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). If we count the yellow regions of more intense interest, there is a slight preference for the panel on the left, consistent with the documented viewers' preferences in the survey.

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 affordances, 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 our actions and we have to force ourselves to accomplish even the most basic everyday functions under stressful conditions.

The active connecting method introduced above as a deliberate design tool underlies the passive mechanism by which we unconsciously experience our immediate environment. Biological connection therefore extends to encompass all aspects of human life. Our surroundings determine whether we sense if we belong in—feel connected to—a particular setting, and are thus able to carry on life's functions without distress.[47] One of those functions could be something 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."[48] Neuroscience and environmental psychology provide cumulative evidence of how the immediate environment influences our state of health and mind. The connection process responsible for these effects starts with a basic need for the physical presence of graspable handles for our attention—objects of prehension—or merely their suggestion, in our close surroundings.[49] Connection extends to include the list of attractive biophilic criteria that help us feel empathy unconsciously.[50] Finally, eye tracking experiments and simulations reveal where our visual attention is drawn, versus what portions of our environment are disengaging.[51] Together, these factors catalyze life's activities, or if absent, inhibit them.

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. Factors that prevent interaction define anti-affordances—both physiological and psychological—perceived unconsciously.[52] Geoffrey Miller points out that we perceive the world not as objects, but as opportunities for action.[53] Those affordances in the environment play a determining role in human life, yet are not perceived directly.

Unnatural physical details and spaces can make us feel less "alive"—although the effect may be subtle and only accumulate long term. Anti-affordances require an evolutionary time scale—multiple human generations—to become adaptations.[54] 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

47 Christopher Alexander, "Our Belonging to the World," in *The Nature of Order, Book 3: A Vision of a Living World* (Berkeley: Center for Environmental Structure, 2005), 41–66.

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

49 Nikos Salingaros, "Why We Need to 'Grasp' Our Surroundings: Object Affordance and Prehension in Architecture," *Journal of Architecture and Urbanism* 41, no. 3 (2017): 163–69, DOI: https://doi.org/10.3846/20297955.2017.1376003.

50 Nikos Salingaros, *Biophilia and Healing Environments* (Amherst: Levellers Press, 2015), also available at https://www.terrapinbrightgreen.com/wp-content/uploads/2015/10/Biophilia-Healing-Environments-Salingaros-p.pdf; Salingaros, "The Biophilic Healing Index."

51 Sussman and Hollander, *Cognitive Architecture*; Salingaros and Sussman, "Biometric Pilot-Studies Reveal."

52 Norman, *The Design of Everyday Things*, 11.

53 Geoffrey Miller, "Reconciling Evolutionary Psychology and Ecological Psychology: How to Perceive Fitness Affordances," *Acta Psychologica Sinica* 39, no. 3 (2007): 546–55, available at http://journal.psych.ac.cn/acps/EN/Y2007/V39/I03/546.

54 Ibid.

accepting minimalist architecture confines much of the world's population within an inadequate experiential state.[55]

Fighting a Culture of Disconnection

In the remainder of this article, I try 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*, Alexander and his coauthors expose the fierce opposition they encountered while building a campus in Tokyo, Japan.[56] That story served 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 the polemic that follows.

Detailed, erudite, and thoughtful studies of design philosophy try to be inclusive, bringing Bauhaus Modernism together with complexity theory and pragmatic product design.[57] I find little value in such attempts, despite their upright professional intentions, because they mix opposites in a way that confuses the practical designer. According to my own research, Alexander's work links to and is supported by complexity theory, whereas modernist ideology undoes all of it.[58] Quoting from the Bauhaus Masters and their uncritical supporters legitimizes their abstract, disconnected approach to design while it subverts all other efforts.[59]

Human-centered design at its best achieves a profound connectedness—through visceral beauty—between the physical surroundings and one's self, which exists in an interior realm. A person who seeks this state of unity has to first learn and then practice linking the outer world emotionally to one's inner world. To help the reader's understanding, Alexander describes situations and settings where he feels most connected.[60] Many of us can identify with the truth of those examples, having experienced visceral connection with animals, buildings, dance, human artifacts, music, people, ornamental details, spaces, complex but highly ordered information, and so on.

For someone conditioned by dominant culture, however, Alexander's examples may seem romantic or even fantastic. It is unfortunately very difficult to teach something like this effect using verbal or visual descriptions: the only way to do it successfully is through a powerful visceral experience. And there exists an institutionalized obstacle to achieving such an emotional union. Connectedness is hampered by external ideas that architects, experts, and society impose on our natural instincts, leading to disconnection. An abstract simulation of reality as the mandatory ritual of modernity has replaced direct physical experience in architecture.[61]

Eye tracking experiments reveal that it is nearly impossible to connect in a visceral manner to the color, details, geometry, and surfaces of a building created using a modernist or contemporary high style.[62] Many human artifacts and utensils give the impression of detaching us from the material world.[63] They may satisfy a primary affordance (their specific, intended use) but present several more secondary anti-affordances that make the product awkward to use. A sensitive individual has to go to a lot of trouble

55 Alexander, "Our Belonging to the World."
56 Christopher Alexander, Hans J. Neis and Maggie M. Alexander, *The Battle for the Life and Beauty of the Earth: A Struggle between Two World-Systems* (New York: Oxford University Press, 2012).
57 Richard Buchanan, "Thinking about Design: An Historical Perspective," in *Handbook of the Philosophy of Science, Volume 9: Philosophy of Technology and Engineering Sciences*, ed. Anthonie Meijers (Amsterdam: Elsevier, 2009), 409–53.
58 Nikos Salingaros and Kenneth Masden, "Architecture in the Making: Intelligence-Based Design," in *In Pursuit of a Living Architecture: Continuing Christopher Alexander's Quest for a Humane and Sustainable Building Culture*, ed. Kyriakos Pontikis and Yodan Rofè (Champaign: Common Ground Publishing, 2016), 30–49, also available at https://patterns.architexturez.net/doc/az-cf-193128.
59 Meyer and Norman, "Changing Design Education," 13–50.
60 Alexander, *Nature of Order, Book 4*, 74–110.
61 James Stevens Curl, *Making Dystopia: The Strange Rise and Survival of Architectural Barbarism* (Oxford: Oxford University Press, 2018), 361–64.
62 Sussman and Hollander, *Cognitive Architecture*; Ann Sussman and Janice M. Ward, "Game-Changing Eye Tracking Studies Reveal How We Actually See Architecture," *Common Edge*, November 27, 2017, https://commonedge.org/game-changing-eye tracking-studies-reveal-how-we-actually-see-architecture/; Salingaros and Sussman, "Biometric Pilot-Studies Reveal."
63 Nikos Salingaros, "From Industrial to Artisan: Modernism's Sleight-of-Hand," *ArchDaily*, July 17, 2013, https://www.archdaily.com/402877/from-industrial-to-artisan-modernism-s-sleight-of-hand.

to find everyday objects and environments that are not crude, ill-fitting, or jarring—not from their designer's carelessness, but because of style.[64]

Most people may not realize how dominant culture condemns objects, places, and structures we relate to deeply as morally forbidden, old fashioned kitsch, and even as dangerous for economic progress.[65] Why? Apologists of modernism offer the excuse that intense emotional nourishment coming from things is somehow unmodern, and discourage people from connecting viscerally to the manufactured world.[66] A form of psychological conditioning as part of design practice makes us feel self-conscious about experiencing the joy of a relationship to visceral beauty that is artificially created .[67]

Yet we hardly question the sensory isolation that has replaced traditional human-centered design everywhere.[68] Potent economic and societal forces promote a modern unemotional existence based on abstractions.[69] Schools resort to obsolete ideology from the 1920s to justify this polarization between our sensory system and the built environment.[70] Architectural education compartmentalizes the action of visceral connection in our minds, permitting us to connect emotionally to another human being or pet animal, perhaps, but not allowing the same for an artifact, a building, or a piece of ornament. Many people are stuck inside this isolating cognitive box.

It helps to leave aside global consumerist culture and pay attention to life occurring at its edges. Where people have to rely on their own resources, they create comfortable things for themselves. Institutionalized power may suppress the innate human habit of connecting, yet many people around the world produce objects and environments that make their lives more pleasant. Opposing top-down economic and political pressures, local groups apply more humane systems of construction and production. It is here, in informal settlements or away from the hegemony of the design establishment, that we find visceral connecting to be practiced continuously.

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.[71] 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.[72]

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.[73] Le Corbusier's documented response to visual complexity is totally 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," he said at one point, "gives the same play as would the smooth

64 Norman, *The Design of Everyday Things*, 132–42.

65 Sir Roger Scruton, "A Point of View: The Strangely Enduring Power of Kitsch," *BBC News: Magazine*, December 12, 2014, https://www.bbc.com/news/magazine-30439633.

66 Brianna Rennix and Nathan J. Robinson, "Why You Hate Contemporary Architecture," *Current Affairs*, October 31, 2017, https://www.currentaffairs.org/2017/10/why-you-hate-contemporary-architecture.

67 Jenefer Robinson, "On Being Moved by Architecture," *The Journal of Aesthetics and Art Criticism* 70, no. 4 (2012): 337–53, DOI: https://doi.org/10.1111/j.1540-6245.2012.01526.x.

68 Michael W. Mehaffy and Nikos Salingaros, "Geometrical Fundamentalism," in *A Theory of Architecture*, 2nd ed., ed. Nikos Salingaros (Portland: Sustasis Press, 2014), 172–94.

69 Curl, *Making Dystopia*, 361–64.

70 Steven Bingler and Martin C. Pedersen, "How to Rebuild Architecture," *The New York Times*, December 15, 2014, https://www.nytimes.com/2014/12/16/opinion/how-to-rebuild-architecture.html

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

72 James Stevens Curl, "Building Bad," *Inference: International Review of Science* 5, no. 1 (2019): online, https://inference-review.com/letter/building-bad; James Stevens Curl, "Modernist Ideology Contributed To Unhealthy Architecture," *The American Conservative*, May 8, 2020, https://www.theamericanconservative.com/urbs/modernist-ideology-spawned-dangerous-and-unhealthy-architecture/.

73 Ann Sussman and Katie Chen, "The Mental Disorders that Gave Us Modern Architecture," *Common Edge*, August 22, 2017, https://commonedge.org/the-mental-disorders-that-gave-us-modern-architecture/; Ann Sussman, "Walter Gropius, the Horror of War, and How Modern Architecture Mirrors Traumatic Brain Injury," in *Urban Experience and Design: Contemporary Perspectives on Improving the Public Realm*, ed. Ann Sussman and Justin B. Hollander (London and New York: Routledge, 2020), 214–20.

side of a room."[74] While Le Corbusier is known to have been blind in one eye, and 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 which led to his losing sight in one eye), and visual agnosia.[75] Modernist design pioneers introduced and ceaselessly promoted their vision of a grey, lifeless, depressing world.[76] Why impose sensory deprivation on all neurotypical people? It's no different from the white torture techniques inflicted on political prisoners.[77] And how did this informationally-restrictive design style become modernity's founding myth? Reality is strongly influenced by internal conditions we may not realize we carry.

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. Nevertheless, 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.[78] 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. Especially after World War II, architectural culture chose disengaging over empathetic, engaging, and soothing environments, instead favoring ill-fitting and sometimes inhuman spaces, such as oppressively low ceilings.[79] This precocity in applied carelessness towards humanity raises the possibility of biological or neurological deficits among those individuals who decided the future shape of the built environment.

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

> "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."[80]

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. It's the death of creativity! Dissociation during combat enables veterans to survive, but permanent trauma has negative consequences for their everyday coping with the world afterwards.[81] 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.[82] Since such anti-affordances cannot be consciously

74 Le Corbusier, *The City of Tomorrow and Its Planning* (New York: Dover, 1987), 69; Nikos A. Salingaros, "Architecture, Patterns, and Mathematics," *Nexus Network Journal* 1, no. 1–2 (1999): 75–86, DOI: https://doi.org/10.1007/s00004-998-0006-0; Nikos Salingaros, "Architecture, Patterns, and Mathematics," in *A Theory of Architecture*, 2nd ed. (Portland: Sustasis Press, 2014), 129–43, available at https://link.springer.com/content/pdf/10.1007/s00004-998-0006-0.pdf.

75 Nikos Salingaros, "The Sensory Value of Ornament," *Communication and Cognition* 36, no. 3-4 (2003): 331–51, https://psycnet.apa.org/record/2004-16748-009; Nikos Salingaros, "The Sensory Value of Ornament," in *A Theory of Architecture*, 2nd ed., ed. Nikos Salingaros (Portland: Sustasis Press, 2014), 84–104.

76 Ingrid Fetell, "Unhappy Hipsters: Does Modern Architecture Make Us Gloomy?," *Psychology Today*, February 6, 2010, https://www.psychologytoday.com/us/blog/design-and-the-mind/201002/unhappy-hipsters-does-modern-architecture-make-us-gloomy.

77 Jodi Smith, "White Torture Is a Sensory Deprivation Method That Erases All Sense of Reality," *Ranker*, September 3, 2019, https://www.ranker.com/list/extreme-white-torture-facts/jodi-smith.

78 Sussman and Chen, "Mental Disorders," online; Sussman, "Walter Gropius."

79 Nikos Salingaros, "Why Do Some People Choose Oppressive Environments?," *Metropolis*, December 15, 2015, https://www.metropolismag.com/uncategorized/why-do-some-people-choose-oppressive-environments/.

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

81 Robyn E. Brickel, "Dissociation: How People Cope with Trauma They Want to Forget," Brickel & Associates, LLC, March 6, 2020, https://brickelandassociates.com/dissociation-from-trauma/.

82 Sussman and Chen, "Mental Disorders," online; Sussman, "Walter Gropius."

perceived, one century's exposure is too brief for natural selection to evolve an aversion to them.

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) derive the maximum benefit and vitality from a re-structured built environment.[83]

Disconnection Leads to the Death of Art and Ornament

Let us define art as the pursuit of beauty leading to a meaningful visceral connection (which admittedly is not a universal definition accepted by the profession). This definition respects human physiology and the healing response from the viewer. One key assumption of our culture, that "art is of no importance to the structure of the universe," has highly negative consequences.[84] This notion has been universally accepted as axiomatic during the past several decades. Art has thus become irrelevant to our existence, transformed into just another 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 form: it is never pre-fabricated, tacked-on decoration, and is always embedded into a larger fractal structure. The arbitrary diktat that "ornament is irrelevant: it is unrelated to function and is even harmful to society" was imposed, without protest, in the early 20th century.[85] This architectural ban on 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.[86] 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.[87] 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.[88] Organized complexity combined with fractals generates natural structures that humans unconsciously emulate in traditional architectures.[89] Producing ornament is an attempt to satisfy innate fractal patterns that have shaped the evolution of our visual system. The driving force for ornamentation is visceral 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

83 Salingaros, "The Sensory Value of Ornament"; Martin Horáček, "Architects as Physicians," *Inference: International Review of Science* 5, no. 2 (2020): online, available at https://inference-review.com/letter/architects-as-physicians.

84 Alexander, *Nature of Order, Book 4*, 19.

85 Ibid., 19.

86 Salingaros, "The Sensory Value of Ornament"; Michael W. Mehaffy and Nikos A. Salingaros, "How Modernism Got Square," in *Design for a Living Planet* (Portland: Sustasis Press, 2015), also available at https://www.metropolismag.com/architecture/toward-resilient-architectures-3-how-modernism-got-square/.

87 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, DOI: https://doi.org/10.1007/s00004-999-0009-5; Terry M. Mikiten, Nikos A. Salingaros, and Hing-Sing Yu, "Pavements as Embodiments of Meaning for a Fractal Mind," in *A Theory of Architecture*, 2nd ed., ed. Nikos Salingaros (Portland: Sustasis Press, 2014), 144–58, available at https://link.springer.com/content/pdf/10.1007/s00004-999-0009-5.pdf; Yannick Joye, "Fractal Architecture Could Be Good for You," *Nexus Network Journal* 9, no. 2 (2007): 311–20, DOI: https://doi.org/10.1007/s00004-007-0045-y.

88 Richard P. Taylor, "Reduction of Physiological Stress Using Fractal Art and Architecture," *Leonardo* 39, no. 3 (2006): 245–51, DOI: https://doi.org/10.1162/leon.2006.39.3.245; Nikos A. Salingaros, "Fractal Art and Architecture Reduce Physiological Stress," *JBU — Journal of Biourbanism* 2, no. 2 (2012): 11–28, available at https://journalofbiourbanism.files.wordpress.com/2013/09/jbu-ii-2012-2_nikos-a-salingaros.pdf; Nikos Salingaros, "Fractal Art and Architecture Reduce Physiological Stress," in *Unified Architectural Theory: Form, Language, Complexity. A Companion to Christopher Alexander's* The Phenomenon of Life: The Nature of Order, Book 1 (Portland: Sustasis Press, 2013), 170–90.

89 Alexandros A. Lavdas and Uta Schirpke, "Aesthetic Preference is Related to Organized Complexity," *Plos ONE* 15, no. 6 (2020): e0235257 (online), DOI: https://doi.org/10.1371/journal.pone.0235257.

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 gives power to catharsis in human tragedy when 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 wary of demonic forces in the world. All of the world's mythologies contain descriptions of terrible and horrifying acts.

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.[90] Up until then, designers had instinctively avoided making users of their products feel uncomfortable, but this inhibition lapsed after the trauma of World War I. Provocation became instead a driving force for designing the everyday environment. Humane systems of production were pushed to local or marginal niches.

For example, grotesque typefaces in typography took over after World War I, and have become the standard today in architectural culture (see Figure 4).[91] The first such set of characters 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 its stroke had uniform width and an intentional lack of serifs on the characters.[92] 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.

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

91 Eduardo Souza, "10 Fonts for Architects," trans. Guilherme Carvalho, *ArchDaily*, October 16, 2017, https://www.archdaily.com/881233/10-fonts-for-architects; "Architectural Fonts," *Archisoup* (platform), accessed October 1, 2020, https://www.archisoup.com/architectural-fonts.

92 Salingaros, "The Sensory Value of Ornament"; David Brussat, "Google Belly Flops Logo Test," *Architecture Here and There*, September 5, 2015, https://architecturehereandthere.com/2015/09/05/google-logo-design-typeface/.

Figure 4
Serif font on the left embodying complexity towards design adaptation versus the 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.

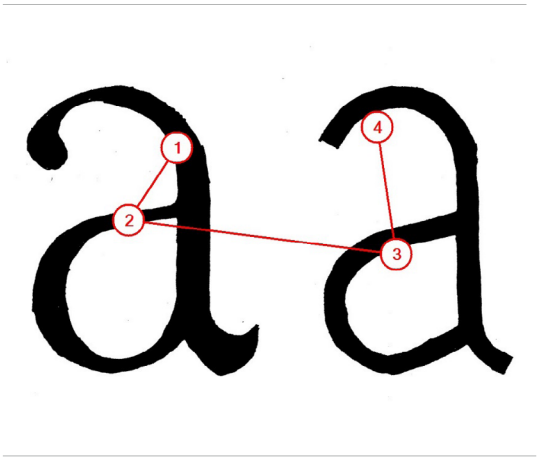

Figure 5
3M's VAS eye tracking simulation software applied to compare a serif "a" to a sans-serif "a." The first visual fixations are on the serif font on the left. Result from VAS software by Ann Sussman specially for the present article. Image licensed under CC BY by Ann Sussman, 2020.

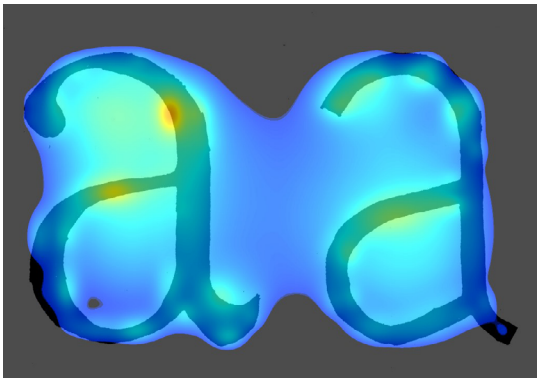

Figure 6
A heatmap comparing pre-attentive visual interest of a serif "a" compared to a sans-serif "a." The yellow-orange spots indicate increased attention, clearly favoring the serif font on the left. Result from VAS software by Ann Sussman specially for the present article. Image licensed under CC BY by Ann Sussman, 2020.

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.

The original sans-serif fonts ought to always be associated with two notorious signs written in capital letters: ARBEIT MACHT FREI over the entrance gate of Auschwitz; and JEDEM DAS SEINE on the metal door to Buchenwald. Most people, especially the younger generations, are unaware of the unsavory industrial background to that psychological and visual change in how text looks. The parallel is that brutal industrialization removed the biological design qualities of fonts (for no reason other than to look crudely mechanical), just as it removed human qualities from individuals in pursuing utopian—usually totalitarian—ideals.

Contrary to what one reads about "the evolution of fonts from old-fashioned typefaces to easy-to-read contemporary ones," the data belie those claims. It appears once again that the myth of modernity has overridden reality. Comparing the ease of reading printed text in serif versus sans-serif fonts reveals a clear advantage in comprehension for the serif font.[93] Text on a computer screen, however, obeys different parameters depending upon the font size and display resolution.[94]

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.[95] How did it happen? When studying a phenomenon analytically, it must be isolated from all the other phenomena acting in a physical situation simultaneously. Careful, artificial isolation — whether in an experimental setup or when 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. 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 is there any place for emotions, let alone an emotional connection to the world. Life has turned into an accidental phenomenon occurring in a clockwork mechanical universe, which therefore holds no meaning. Our internal universe of emotions and feelings becomes an imagined neurological construct, pure and simple, without physical importance.[96] Design in the 20th century embraced this nihilistic philosophy, which we now have the challenge of rejecting.

What follows from here on in is my opinion, informed by my 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.[97] Certain people pursue the goal of isolating themselves from the healing function of living structure by supporting a minimalist design aesthetic. But they misapply science to justify it, claiming that a disconnecting worldview is supposedly scientific. Nothing could be further from the truth. Persons promoting this idea of isolation come from architecture and the arts, and are not scientists. They misinterpret 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.[98] Building absurd and ridiculous forms for shock value is irrelevant to humanity.[99] Architecture after the 1920s pursued the strategic political goal of undoing

93 John Wood, "The Best Fonts to Use in Print, Online, and Email," *American Writers & Artists Institute*, October 2011, https://www.awai.com/2011/10/the-best-fonts-to-use-in-print-online-and-email/.

94 Aries Arditi and Jianna Cho, "Serifs and Font Legibility," *Vision Research* 45, no. 23 (2005): 2926–33, DOI: https://doi.org/10.1016/j.visres.2005.06.013.

95 Alexander, *Nature of Order, Book 4*, 11–28; Salingaros, "Beauty and the Nature of Matter," online.

96 Alexander, *Nature of Order, Book 4*, 19.

97 Nikos Salingaros, "Twentieth-Century Architecture as a Cult," *New English Review*, March 2019, https://www.newenglishreview.org/custpage.cfm?frm=189607; Nikos Salingaros, "Book Review, *Making Dystopia: The Strange Rise and Survival of Architectural Barbarism*: The Rise of the Architectural Cult," *Inference: International Review of Science* 5, no. 1 (2019): online, https://inference-review.com/article/the-rise-of-the-architectural-cult.

98 Alexander, *Nature of Order, Book 4*, 27.

99 John Silber, *Architecture of the Absurd: How "genius" Disfigured a Practical Art* (New York: Quantuck Lane Press, 2007); Peter Buchanan, "Empty Gestures: Starchitecture's Swan Song," *Architectural Review*, February 27, 2015, https://www.architectural-review.com/architects/empty-gestures-starchitectures-swan-song/8679010.article.

traditional society. The revolution aimed to detach human beings from their culture, inherited values, religion, tradition, the extended family, and so on that anchored them to a reassuring world. The Bauhaus and both Italian and Russian Futurists openly admitted this massive experiment in social engineering as their objective.[100] 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 switch took place. Scientists would consequently be partially complicit in this—or, at the very least, not-so-innocent bystanders.[101] There are two plausible motives that implicate them directly.

i Scientists ignore whenever others misuse science to coerce people to cut their links to the living world. Scientists either have not noticed what has been happening over decades, or they consider it outside their areas of interest. Or, they are too meek to criticize popular culture and economic power groups, and therefore quietly accept pseudoscientific nonsense invading architecture and the arts.[102] 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.[103] 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. Most scientists falsely believe that the questions Alexander tackles lie outside science. The point being made in this article, however, is that the locus of these questions is *not the mind*.

Our worldview must change. We must be able to seek a visceral connection to meaningful structures required to maintain the living world. Starting in the 20th century, science began to explore the foundations of connection, investigating inter-relationships and large-scale order. This happens, for example, in biology, complexity theory, ecology, emergent systems, networks, quantum entanglement, and more. Scientific disciplines originally limited to narrow segments have branched out. Yet these developments have not gone nearly far enough. We still lack the physical mechanism for understanding 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. Those results explain visceral connection as a limited cognitive neurological resonance inside the brain of an individual. It is also known in cognitive neuroscience that psychotropic drugs can induce feelings of connectedness and self-awareness.[104] While interesting, this neurological

100 Curl, *Making Dystopia*.

101 Miguel Córdova-Ramírez, "A False Promise of Progress," *Inference: International Review of Science* 5, no. 2 (2020): online, available at https://inference-review.com/letter/a-false-promise-of-progress; Michael Mehaffy, "An Obsolete Ideology," *Inference: International Review of Science* 5, no. 2 (2020): online, available at https://inference-review.com/letter/an-obsolete-ideology; Malcolm Millais, "The Origins of Architectural Barbarism," *Inference: International Review of Science* 5, no. 2 (2020): online, available at https://inference-review.com/letter/the-origins-of-architectural-barbarism.

102 Nikos Salingaros, "Rise of the Architectural Cult," online.

103 Ramray Bhat and Nikos Salingaros, "Reductionism Undermines both Science and Culture," *New English Review*, March 2013, https://www.newenglishreview.org/custpage.cfm/frm/134366/sec_id/134366.

104 Matthias Forstmann, Daniel A. Yudkin, Annayah Prosser, S. Megan Heller, and Molly J. Crockett, "Transformative Experience and Social Connectedness Mediate the Mood-Enhancing Effects of Psychedelic Use in Naturalistic Settings," *Proceedings of the National Academy of Sciences* 117, no. 5 (2020): 2338–46, DOI: https://doi.org/10.1073/pnas.1918477117.

connective state appears irrelevant to physics, hence irrelevant to the structure of the universe. How do we then explain visceral beauty in the configurations of matter? Present-day science is not prepared to consider visceral connectivity as a physical phenomenon, let alone 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 obviously involved. He maintains that a visceral connection is necessary to help designers create objects, buildings, and places adapted to human use. In this article, I have described how to implement this connective process, and sought to help readers navigate the relevant parts of Alexander's four-volume book *The Nature of Order.* If designers and architects do not learn this process, there is a real danger of coming up with sterile, dead artifacts that the world can no longer afford. This was indeed the case with much of the built environment following World War II that was created according to formalism and ideology.

For those of us who perceive architecture and design as producing poorly-adapted results, the following observations summarize some problems we face today. This is an invitation for future research, and as the impetus for present research to be recalibrated towards achieving the goal of human-centered design.

- Dominant architectural culture imposes its own stylistic agenda of disconnection.
- Science does not yet fully cooperate with the notion that a visceral connective process is perceived empirically.
- We lack a proper vocabulary even to describe this visceral connective effect.

Significant progress has been made in dealing scientifically with the phenomenon of visceral connection. Eye tracking experiments and software that simulates eye tracking establish which visuals we might connect to, while eliminating those that are disengaging (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 or even think about visceral 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 instruction in visceral 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.

105 Nikos Salingaros, "Christopher Alexander's Beginning Chapters of *The Nature of Order, Book 4*," Youtube video, 1:40:57, May 21, 2020, https://www.youtube.com/watch?v=CCDRs-BFDLk.

106 Nikos Salingaros, "Beauty and the Nature of Matter: The Legacy of Christopher Alexander," video, 1:30:43, March 28, 2019, https://vimeo.com/328174786.

107 Salingaros, "Beauty and the Nature of Matter," online.

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