The Architectural Continuum

Choropoietic Media and Post-Physical-World Environments

Constantinos Miltiadis

> "Space is, of course, one of those words that frequently elicits modification. The complications perhaps arise more out of the modifications [...] rather than out of any inherent complexity of the notion of space itself. When, for example, we write of "material," "metaphorical," "liminal," "personal," "social," or "psychic" space [...] we thereby indicate a considerable diversity of contexts which so inflect matters as to seem to render the meaning of space itself entirely contingent upon the context." David Harvey, 2004[1]

Introduction

There is something about the notion of space, Harvey writes, that defies any universal definition. But it's not only the very notion of space that is contingent upon its context, he continues; it's also the methodology with which to approach space. The range of approaches to the architectonic rhetoric of the videogame that this volume presents cannot but prove the same claim.

What I want to discuss in this chapter is architectonics—not as phenotypical relationship between videogames and architecture, through stylistic, urban design or visual analyses.

1 | David Harvey, „Space as a Keyword," *Inaugural Marx and Philosophy Conference*, Institute of Education (London: University of London, 2004).

Fig. 78: Entrance to the Rotunda Room, Werner Oechslin Library, Einsiedeln, 2018

Instead, I want to focus on the concept of western design-space, its evolution and tradition, which has been inherited by videogame and architectural design. As such, I want to suggest that through technology, we

can achieve media-specific architectures, which, whether tangible or not, could lead to an expansion of architectural aesthetics.

Space as Embodied Culture

"Ουδείς αγεωμέτρητος εισίτω" read an epigraph on the door of Plato's Academy, according to legend. Often loosely interpreted, a literal translation would be "let no *ungeometered* people enter." For geometry was seen not as mere knowledge, but an embodied modality of being and a form of reasoning. To be *geometered* was to be cultured, cultivated, as geometry was a noble practice. Besides, proportionality—embedded in the Greek *λόγος* and its Latin synonym *ratio*—betrays the mathematics as the root of the western notion of reason.

A few centuries before that, Pythagoras had been studying mathematics as well as music to understand the world, and discover the divine proportions with which God, the Great Geometer, designed it.[2] So deep was this belief that when Hippasus proved that the square root of two is an irrational number—a number that cannot be expressed as a proportion of two others—the other pythagorians murdered him for his hubris, another legend has it.[3]

By the time of Plato, irrational numbers had become accepted. More importantly, geometry had been formalized when Euclid, his contemporary, published one of the most influential books in history in 300 BCE. Euclid's *Elements* provided a set of definitions and postulates, as well as propositions proven by using the standard instruments of unit-less Greek geometry: a straight edge and a compass. To fathom his contribution, we have to consider that *Elements*, through geometry, not only inaugurated Western mathematics but that it also produced for the first time, a rigorous system of axioms and proofs: the first scientific method.[4]

2 | Brian Clegg, *A Brief History of Infinity: The Quest to Think the Unthinkable* (London: Robinson Publishing, 2003).

3 | Michel Serres, "The Origin of Geometry," *Hermes: Literature, Science, Philosophy* (Baltimore: The John Hopkins University Press, 1983), pp. 124-33.

4 | Clegg, 2003.

Fig. 79: God as Architect, the Frontispiece of Bible Moralisee, ca. 1220-1230

In light of this—of the association between geometry with logic and reasoning, and as a space of thought—we can better understand Plato's fixa-

tion with abstract geometry as meditation[5], which manifested both in his philosophy and in the curriculum of the Academy. What is important to consider is that Euclidean geometry, taught today in schools all around the world, is not only a common and shared form of knowledge. Practically a cultural universal, Euclidean space is also a shared instrument of reasoning: one of understanding the visual world[6]—and by the time of René Descartes (1596-1650)—also one of modeling, or transposition of the perceivable to the sensible.

The Perspective Revolution of the Renaissance

It wasn't until Medieval times that geometry became a standard course in university curricula. Instrumental to the shift from the *Trivium* to the *Quadrivium* model of education was the philosopher Roger Bacon (1220-1292), who in his *Opus Majus* (1267) urged artists to study optics and geometry in order to produce more realistic religious iconography.[7] As Longo writes, it was through perspective that infinity—associated with the divine, and implied in what we now identify as the vanishing point—was first examined.[8] Fourteenth century artists like Giotto di Bondone (ca. 1267-1337) and Ambrogio Lorenzetti (ca. 1290-1348) among the first to attempt a realistic depiction of depth, reserved the use of perspective for annunciation scenes, when God enters the image in the form of an angel.

5 | Morris Kline, *Mathematics in Western Culture* (London: Oxford University Press, 2008), p. 41.

6 | Mark Wagner, *The Geometries of Visual Space* (Mahwah NJ: Routledge, 2006), pp. 12-29.

7 | Margaret Wertheim, "Lost in Space: The Spiritual Crisis of Newtonian Cosmology," *Seeing Further: 350 Years of the Royal Society and Scientific Endeavour* (London: Harper Colllins, 2010), pp. 42-59; Margaret Wertheim, "The Illusionistic Magic of Geometric Figuring," Cabinet Magazine, No. 26 (Summer 2007): 27–31.

8 | Giuseppe Longo, "Mathematical Infinity 'in Prospettiva' and the Spaces of Possibilities," *Visible, a Semiotic Journal* Vol. 9 (2011): pp. 1-10.

By 1425, architect Filippo Brunelleschi (1372-1446) had conducted his famous experiment on perspective.[9] Not far removed from modern day augmented reality, this experiment not only invented linear perspective, but it also demonstrated that mathematical rules can be used to faithfully represent the visual. To disseminate the technology of perspective, Brunelleschi's contemporary, architect and polymath Leon Battista Alberti (1404-1472), published two books on the subject in the subsequent years. The impact of the Renaissance invention of perspective is too extensive to summarize; however, the revolution that it brought about in visual culture had ramifications far beyond the field of architecture.

Fig. 80: Andrea Pozzo, Triumph of St. Ignatius of Loyola, Rome, 1685

Technical and perspective drawing were also adopted by the sciences.[10] Nicolaus Copernicus (1473-1543), Galileo Galilei (1564-1642) and Johannes Kepler (1571-1630), among the first generation to be educated in geometry and drawing, used their knowledge and belief in geometrical reasoning

9 | Samuel Y. Edgerton, "Brunelleschi's Mirror, Alberti's Window, and Galileo's 'Perspective Tube'," *História, Ciências, Saúde-Manguinhos* Vol. 13 (2006): pp. 151-179.

10 | Samuel Edgerton, "The Renaissance Development of the Scientific Illustration," in *Science and the Arts in the Renaissance*, ed. John William Shirley and F. David Hoeniger (Plainsboro NJ: Associated University Presses, 1985), pp. 168-197.

to painfully disprove established truths about the universe.[11] In the arts, by the seventeenth century, *trompe-l'oeil* managed to transcend the status of mere decoration, such that it was impossible to separate them from the—built—architecture they contributed to. More importantly, however, as Paul Feyerabend (1924-1994) states, perspective became the definitive technical knowledge of architecture, and the one which literally elevated the profession from artisanal craft to a technical one.[12] With the maturity of scientific drawing as a medium of communication, knowledge of geometry was enough to reproduce any drawing at any scale—or for that matter, a drawing to a building—rendering the straight edge and the compass inherited from Greek geometry "weapons for mass construction," as Mario Carpo (*1958) writes.[13]

Architecture Across Choropoietic Media

A significant side effect brought about by this newfound ability to codify and instill a visual idea into a design language was the autonomy of drawing. Renaissance architects like Alberti considered drawing the medium of the unadulterated architectural idea, in which the architect-author had total control.[14] To him, the resulting building was a mere copy of the original architecture captured on paper, as Alberti, additionally, urged archi-

11 | More precisely that our solar system is heliocentric (Copernicus); that the moon is not a perfect celestial body (Galileo); and that the movement of celestial objects is not a perfect circle but rather, an ellipse (Kepler). Wertheim 2010; Edgerton 2006.

12 | Paul Feyerabend, "Brunelleschi and the Invention of Perspective," in *Conquest of Abundance: A Tale of Abstraction Versus the Richness of Being*, ed. Bert Terpstra (Chicago: University of Chicago Press, 1999), pp. 89-128.

13 | Mario Carpo, "Building with Geometry, Drawing with Numbers," in *When is the Digital in Architecture?* ed. Andrew Goodhouse (Montréal: Sternberg Press, 2017), pp. 33-44.

14 | Mario Carpo, "The Art of Drawing," *Architectural Design* Vol. 83, No. 5 (September 1, 2013) https://onlinelibrary.wiley.com/doi/abs/10.1002/ad.1646 (accessed June 28, 2019), pp. 128-33.

tects to leave the construction of their designs to somebody else.[15] Perhaps Étienne-Louis Boullée (1728-1799) put it best in the introduction of *Architecture, Essay on Art*:

> What is architecture? Shall I join Vitruvius in defining it as the art of building? Indeed, no, for there is a flagrant error in this definition. Vitruvius mistakes the effect for the cause. In order to execute, it is first necessary to conceive. Our earliest ancestors built their huts only when they had a picture of them in their minds. It is this product of the mind, this process of creation that constitutes architecture and which can only consequently be defined as the art of designing and brining to perfection any building whatsoever. Thus the art of construction is merely an auxiliary art, which in our opinion, could appropriately be called the scientific side of architecture. Art in the true sense of the word, and science, these we believe have their place in architecture.[16]

Although material architecture would prevail as authorship, drawing, too, lived to occasionally be credited as a medium of architecture. Beyond buildings and plans, modern history books came to include architectures never intended to escape their medium of drawing. Besides Boullée and Giovanni Battista Piranesi (1720-1778) who are often acknowledged for their drawn architecture; Archigram, Archizoom, Lebbeus Woods (1940-2012), Zaha Hadid (1950-2016), and Bernard Tschumi (1944) are a few more recent Western examples.

With drawing as an established and valid medium of architecture, besides the one of building, we can consider architecture in other non-representational spatial substrates, or *choropoietic media*. According their own modalities of design-space, such media also allow for different aesthetic qualities by evoking different architectonics. In an analysis of the different readings and functions of space in Daniel Libeskind's (*1946) early drawing work, Robin Evans (1944-1993) showed that even drawing is not a unified medium.[17] On the contrary, for Evans "architecture without build-

15 | Mario Carpo, *The Alphabet and the Algorithm* (Cambridge MA: MIT Press, 2011), pp. 21-23.

16 | Etienne Louis Boullée, Architecture, *Essay on Art*, ed. Helen Rosenau, trans. Sheila de Vallée (London: Academy Editions, 1976), p. 82.

17 | Robin Evans, "In Front of Lines that Leave Nothing Behind. Chamber Works," *AA Files*, No. 6 (1984), pp. 89-96.

ing" is incorruptible, a potent rather than a latent, and a restoration of architectural practice beyond antiquated conceptions of space. Considering evocations of architecture across different and potential *choropoietic* media would not only liberate architecture from its grounded traditions, but also posit a new path forward. As Hans Hollein (1934-2014) wrote in his 1968 manifesto "Alles ist Architektur": "[a] true architecture of our time, then, is emerging, and is both redefining itself as a medium and expanding its field".[18] Unbounded by thinking in terms of building and "freed from the technological limitations of the past," Hollein's transdisciplinary architecture focused on both spatial and psychological qualities, for its redefinition and advancement. With *choropoietic* media as the different architectural substrates that can evoke their own, media-specific aesthetic qualities, we can consider architecture as a continuum—moreover, an expanding one, populated by the spectra of experience that different modalities of architecture can elicit.

The 20th Century's Trompe-l'oeil

New technologies will continue to fuel the fantasy of synthetic realism. As André Bazin (1918-1958) writes, the "myth of total cinema," marking the birth of the film medium, was nothing less than that of total realism.[19] Morton Heilig's (1926-1997) *Sensorama*—a later example published in 1958 that featured colored widescreen stereoscopic video, stereo audio, "aromas," wind, and vibrations—was admittedly a vision of a unification of the arts, a technological *Gesamtkunstwerk*. Ivan Sutherland (*1938), who would go on to invent the first head-mounted display, in 1968[20], wrote:

18 | Liane Lefaivre, "Everything is Architecture. Multiple Hans Hollein and the Art of Crossing Over," *Harvard Design Magazine*, No. 18 (2013): pp. 1-5.

19 | André Bazin, "The Myth of Total Cinema," *What is Cinema* No. 1 (1967): pp. 17-22.

20 | Ivan E. Sutherland, "A Head-Mounted Three Dimensional Display," *Proceeding of the December 9-11, 1968, Fall Joint Computer Conference*, Part I (ACM, 1968), pp. 757-64.

> The ultimate display would, of course, be a room within which the computer can control the existence of matter. [...] With appropriate programming such a display could literally be the Wonderland into which Alice walked.[21]

Interestingly, Sutherland was also the inventor of *Sketch Pad*, the predecessor to modern CAD software, which begs the question as to whether experiencing digital space is the natural consequence of being able to draw digital geometry.[22]

By the mid 1980s, Jaron Lanier (*1960), who had previously been a game designer for *Atari*, created the first modern VR implementation, coining the term "virtual reality".[23] His vision for VR was not that of a consumer medium. On the contrary, he envisioned VR as an expressive design platform for "post-symbolic communication" between its users.[24] Architects were among the first to experiment with such technologies. Early pioneers such as Markos Novak[25], Daniela Bertol[26], Peter Anders[27], Monika Fleischmann and Wolfgang Strauss[28] and the lab of Gerhard

21 | Ivan E. Sutherland, "The Ultimate Display," *Proceedings of the IFIP Congress* (New York 1965), pp. 506-8.

22 | Ivan E. Sutherland, "Sketch Pad a Man-Machine Graphical Communication System," *Proceedings of the SHARE Design Automation Workshop* (ACM, 1964), pp. 6.329-46.

23 | The first recorded occurrence of the term "virtual reality" is in Artaud's essay "The Alchemical Theater." Antonin Artaud, *The Theater and Its Double*, trans. Mary C. Richard (New York: Grove Press, 1994), p. 49.

24 | Kevin Kelly, "Virtual Reality: An Interview with Jaron Lanier," *Whole Earth Review* No. 64 (Fall 1989), pp. 108-119

25 | Marcos Novak, "Liquid Architectures in Cyberspace," in *Cyberspace: First Steps*, ed. Michael Benedikt (Cambridge MA: MIT Press, 1992), pp. 225-54.

26 | Daniela Bertol, *Designing Digital Space: An Architect's Guide to Virtual Reality* (New York: Wiley, 1996).

27 | Peter Anders, Envisioning Cyberspace: Designing 3D Electronic Spaces (New York: McGraw-Hill Professional, 1998).

28 | Monika Fleischmann and Wolfgang Strauss, "The House of Illusion: Extending the Boundaries of Space," *AVOCAAD First International Conference Proceedings*, ed. K. Nys et al. (Brussels: Hogeschool vor Wetenschap en Kunst, 1997); Monika Fleischmann and Wolfgang Strauss, "Implosions of Numbers—Performative Mixed Reality," in *Disappearing Architecture: From Real to Virtual to*

Schmitt,[29] produced a significant amount of work exploring VR as an architectural medium.

By the 1990s, VR had become a buzzword, such that Simon Penny (*1955) declared it "the completion of the enlightenment project".[30] However, along with the aforementioned efforts, VR was abandoned for a few more decades, due to the untimeliness of technology.

Contemporary Technology and Tradition

Contemporary VR might have originated in gaming, but it has had applications in fields ranging from media art to experimental psychology. Architecture, too, was early to adopt this technology. Primarily, it has been used as a medium for visualization, simulation and design evaluation. Though subject to a historical bond with materiality and physical reality, architecture still appears reluctant to embrace VR as an architectural medium. Nevertheless, designating VR as a—new—tool to simulate architecture referencing the physical world has prevented architecture from recognizing or examining the degree of "architecturality" that media-specific VR environments can elicit.

Largely ignored by the field of architecture, videogames—facilitated by the popularization of personal computers and the advancement of computer graphics—have been doing so for decades. Since they first appeared, videogames have been recognized as a new form of literacy,[31] while game

Quantum, ed. Georg Flachbart and Peter Weibel (Basel: Birkhäuser Architecture, 2005), pp. 119-31.

29 | Gerhard Schmitt, Florian Wenz, David Kurmann and Eric van der Mark, "Toward Virtual Reality in Architecture: Concepts and Scenarios form the Architectural Space Laboratory," *Presence: Teleoper, Virtual Environ*, Vol. 4, No. 3 (January 1995): pp. 267-85; Gerard Schmitt, *Information Architecture: Basics of CAAD and its Future* (Basel: Birkhäuser, 1999).

30 | Simon Penny, "Virtual Reality as the Completion of the Enlightenment Project," in *Culture on the Brink: Ideologies of Technology*, eds. Gretchen Bender and Timothy Druckrey, Discussions in Contemporary Culture 9 (Seattle: BayPress 1994), pp. 231-48.

31 | Eric Zimmermann, "Gaming Literacy: Game Design as a Model for Literacy in the Twenty-First Century," *The Video Game Theory Reader 2*, ed. Bernard Perron and Mark J. P. Wolf (New York: Routledge, 2008), pp. 253-71.

studies, the academic field devoted to research of their phenomena, has noted the medium's preoccupation with space as instrumental to their form. Espen Aarseth (*1965) noted that "games celebrate their spatial representation as their central motif and raison d'être",[32] while Jenkins—comparing architecture and game design, citing both as preoccupied with design over a spatial substrate—suggested game design as "narrative architecture".[33] More recently, Stephan Günzel (*1971) proclaimed the "spatial turn" as a paradigm shift in computer game studies, reflecting both their design and practice.[34]

Euclid's Fifth Postulate Against the Shape of Space

While the importance and utility of Euclidian geometry is established and taken for granted in most fields of its application, it has troubled mathematicians since its early beginnings. In particular Euclid's 5th postulate—the infamous "parallel postulate," the last remaining proposition to prove the consistency of this ancient mathematical system—remained unsolved until it was deemed unsolvable in the early nineteenth century. Mathematician János Bolyai (1802-1860) and Nikolai Lobachevsky (1792-1856), independently inventing hyperbolic space, showed instead that conditions of parallelism are constitutive to space, or different forms of it.[35] In parallel, Friedrich Gauss (1777-1855), concerned with similar investigations, de-

32 | Espen J. Aarseth, "Allegories of Space. The Question of Spatiality in Computer Games," in *Cybertext Yearbook 2000*, eds. Raine Koskimaa and Markku Eskelinen (Jyväskylä 2001), pp. 44-47.

33 | Henry Jenkins, "Game Design as Narrative Architecture," *Computer* Vol. 44 (2004): p. 53.

34 | Stephan Günzel, "The Spatial Turn in Computer Game Studies," in *Exploring the Edges of Gaming*, Vienna Games Conference 2008-9 (Vienna: Braumüller, 20190), pp. 147-56.

35 | Mich Wycoff, "Margaret Wertheim: Complexity, Evolution and Hyperbolic Space," *Evolution: Education and Outreach* Vol. 1m No. 4 (2008): pp. 531-35; Bertrand Russell, An Essay in the Foundations of Geometry (CreateSpace Independent Publishing Platform, 2018), pp. 7-15.

vised a means of studying two-dimensional surfaces intrinsically, instead of embedding them in a three-dimensional Cartesian box, published as *Theorema Egregium* in 1828. Continuing his work, Gauss's student Bernhard Riemann (1826-1866) proposed a new generative geometry that could produce smooth and metric manifolds in his habitation, entitled *On the hypotheses which lie at the bases of geometry*[36], which essentially formalized non-Euclidean geometry.

This information might seem redundant until we recognize that Albert Einstein's (1879-1955) theory of *Special Relativity* in 1905, which collapsed space and time into space-time, did so by implementing a four-dimensional Minkowskian manifold.[37] In other words, besides cancelling the autonomy of space as a unique entity, the current and corroborated scientific theory of space answers to a completely different geometry than the one described by Euclid. It is crucial to mention that, unlike Cartesian space, such geometries do not afford or privilege an origin point—as a reference of absolute difference. Instead, manifolds only allow for subjective difference, or—as described in philosophy—pure difference.[38] As is also manifested in the paradigm shift of relativity physics, reality, in the form of space-time, is not external. Rather, it is intrinsic to the observer and their frame of reference.

Western culture's insistence on visual interpretations of space is not a new phenomenon.[39] However, it's not only our culture and design thinking that are rooted in Euclidean space, but also our design tools. It wouldn't be an exaggeration to say that contemporary spatial design software packages, both in architecture and in game design are flat-earth-

36 | Bernard Riemann, *On the Hypotheses Which Lie at the Bases of Geometry* (University of Göttingen, 1854).

37 | Linda Dalrymple Henderson, "Einstein and 20th-Century Art: A Romance of Many Dimensions," in *Einstein for the 21st Century: His Legacy in Science, Art and Modern Culture*, eds. Peter Galison, Gerarld Holton and Silvan Schweber (Princeton University Press, 2018), pp. 101-29.

38 | See Gilles Deleuze, *Difference and Repetition* (Bloomsbury Academic, 2014), pp. 28-69.

39 | Martin Jay, "Scopic Regimes of Modernity," in *Vision and Visuality*, ed. Hal Foster (Seattle: The New Press, 1999), pp. 3-28; Erik Davis, "Acoustic Cyberspace," *Xchange On-Air Session* (November 11, 1997), https://techgnosis.com/acoustic-cyberspace/ (accessed June 27, 2019).

Fig. 81: Patterson Hume and Donald Ivey, Frames of Reference, Directed by Richard Leacock. Physical Science Study Committee, University of Toronto, Canada, 1960, Film Still

simulators: they rely on obsolete spatial concepts, disregarding the actual science of what they are supposed to model. The problem with enforced Euclidean design-space is not that design software ignores phenomena as fundamental as earth's curvature. It's that they make it almost impossible to take them into consideration, or to employ them creatively. And while such phenomena might be negligible, or even irrelevant to building, are they irrelevant to design and architecture? Few are the analyses of the lack of spatial sophistication in videogames,[40] as well as the ones that speculate on the extended spatial constitutions that the digital medium can afford design.[41] Margaret Wertheim (*1958) blames a deeper existential cause for this dissonance:

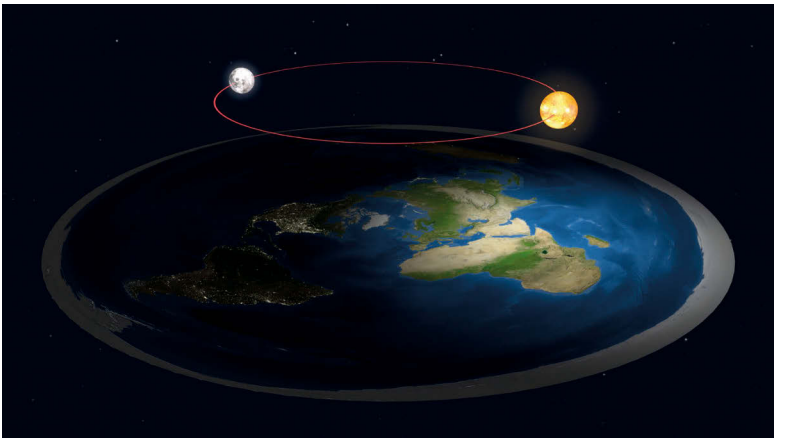
40 | Benjamin Fraser," Why the Spatial Epistemology of the Video Game Matters: Metis, Video Game Space and Interdisciplinary Theory," *Journal of Gaming & Virtual Worlds* Vol 3, No. 2 (2001): pp. 93.-106; Natalija Majsova, "Outer Space and Cyberspace: An Outline of Where and How to Think of Outer Space in Video Games," *Teorija in Praksa* Vol 51, No 1 (2014): p. 106.

41 | Edvin Babic, "On the Liberation of Space in Computer Games," *Eludamos, Journal for Computer Game Culture* Vol. 1, No. 1 (2007).

In essence, concepts of space and concepts of self are inextricably entwined so that when a culture adopts a new conception of space, as Western culture did in the seventeenth century, it impacts our sense of not merely where we are but of what we are.[42]

However, the few examples from the tradition of videogames, such as *Portal* (2007) or *Antichamber* (2013), are promising for their investigations of experience in spatial constitutions of post-physical-world environments.

Fig. 82: Digital Design Software for both Architecture and Videogames simulate a Flat-Earth Space



42 | Wertheim 2010, pp. 61-2.

Towards Virtual Architectures

This chapter attempted to demonstrate that space and design-space are not neutral entities. Examining and embracing new notions of space through digital media can provide new grounds for architectural experimentation and contribute new spectra of its experience. Videogames, as theoretically suggested[43] and experimentally proven, engage with and improve actual, concrete skills.[44] Additionally, not unlike flight simulators for pilots, the practice of videogames can cultivate and further develop spatial-cognitive capacities,[45] while VR is already serving as an ideal framework for testing extended notions of spatial presence and experience.[46]

To borrow form another discipline, in 1979, Rosalind Krauss (*1941) identified the fact that contemporary sculpture could no longer be described by historicizing narratives, which normalize the new by making the category of sculpture "almost infinitely malleable".[47] Less permissive

43 | Espen J. Aarseth, "Virtual Worlds, Real Knowledge: towards a Hermeneutics of Virtuality," *European Review* Vol. 9, No. 2 (2001): pp. 227-232.

44 | Isabela Granic, Adam Lobek and Rutger C. M. E. Engels, "The Benefits of Playing Video Games," *American Psychologist* Vol. 69, No. 1(January 2014), https://psycnet.apa.org/record/2013-42122-001?doi=1 (accessed June 28, 2019), pp. 66-78.

45 | Kaveri Subrahmanyam and Patricia M. Greenfield, "Effect of Video Game Practice on Spatial Skills in Girls and Boys," *Journal of Applied Developmental Psychology* Vol. 15, No. 1 (1994): pp. 13-32; Diana Gagnon, "Videogames and Spatial Skills: an Explanatory Study," *Educational Communication and Technology* Vol 33, No. 4 (1985): pp. 263-75.

46 | Khrystyna Vasylevska, Jana Podkosova and Hannes Kaufmannm, "Walking in Virtual Reality: Flexible Spaces and Other Techniques," in *The Visual Language of Technique* (London: Springer, 2015), pp. 81-97; William H. Warren et al., "Wormholes in Virtual Space: From Cognitive maps to Cognitive Graphs," *Cognition* 166 (September 1, 2017): pp. 152-63 https://doi.org/10.1016/j.cognition.2017.05.020 (accessed June 27, 2019); William H. Warren, Daniel B. Rothmann, Benjamin H. Schnapp and Jonathan D. Ericson, "Non-Euclidean Navigation," *Journal of Experimental Biology* Vol. 222 (2019), https://jeb.biologists.org/content/222/Suppl_1/jeb187971 (accessed June 27, 2019).

47 | Rosalind Krauss, "Sculpture in the Expanded Field," *October* 8 (1979): pp. 31-44.

than Hollein, Krauss's "expanded field" argues for an art form that is negatively defined by what it is not rather than by what it is. Similarly, utilizing this articulation for architecture would generate a more generous and plural field for itself and its aesthetics, rather than of a singular point.

In other words, can we consider a continuum of architecture in the model of the continuum of real numbers? Could we envision imaginary architectures—not imaginary as fictional, but rather as the imaginary in complex numbers? What could $\sqrt{(-1)}$ architectures be, that are to concrete architectures as paramount and tangible as imaginary numbers are to the real number set? Embracing transdisciplinary articulations—and given their knowledge and available tools—today's architects can play a decisive role in exploring the future of architecture across *choropoietic media*, uncovering the latent aesthetic domain of it's "expanded field."