Urban Performance and Living Networks

Responsive buildings participate in a new form of architectural performance: they shudder, undulate or blink in response to changing environmental data and audiences. The responsiveness of buildings that deploy sensor-studded envelopes, smart materials, and networked structures creates new terrain for performative architecture. Performance in architecture is a broad application, variably referring to how well a building combats solar heat gain (environmental performance), how customized a component might appear (design performance), and how engaging is its digital affect, such as those outlined in Branko Kolarevic and Ali Malkawi's *Performative Architecture: Beyond Instrumentality* (2005) and in Yasha Grobman and Eran Neuman's *Performalism: Between Form, Function and Performance in Contemporary Architecture* (2011). Architecture's structured engagement with live bodies has been understood in disciplinary terms as program (and codified in bubble, zone, and sequence diagrams). Yet today, performative qualities seem better characterized by relational logics of networks:

Ariane Lourie Harrison
Yale University

> Performance as an entanglement among humans, instruments, algorithms, and machines on the stage, in the laboratories and through the streets of the cities . . . yield(s) new knowing about the world through its sudden presence and equally sudden disappearance.[1]

Actor–network theory and post-human theory describe interaction among diverse (and not necessarily human) actors, and in so doing, help delineate the stakes of today's performative architecture. Linking precedents from the postwar period by Nicolas Schöffer, Cedric Price and E.A.T to recent works by Harrison Atelier and The Living, this essay offers terms and criteria for architecture that performs a networked response to the urban setting. An introductory overview of network theories situates performative architecture at the intersection of several disciplines, while the dialogue between postwar cybernetics and several contemporary works reminds us of the disciplinary persistence of the dream of designing a responsive architecture.

NETWORKS AND PERFORMANCE

The discourses of actor–network theory and post-humanism describe networks less in terms of the *net*—the formal organization of connections—and more in terms of the *work*—the actions linking the actors that form the network. Associated since the 1980s with French sociologists of science Bruno Latour and Michel Callon, among others, including N. Katherine Hayles, John Law and Manuel De Landa, actor–network theory (ANT) extends agency to many actors other than human ones. The ANT network is conceived as a contingent and hybrid amalgamation of actors that may be textual, technological, social, and cultural. Any entity (human, non-human, scientific, architectural) can be conceptualized as both an actor and a network; the networked association defines the actor's intention, agency, and subjectivity. ANT in this way questions the circumscribed attribution of specific capacities to specific things, proposing that such capacities may in fact be distributed widely among networks of human and non-humans. As Latour suggests in *Assembling the Social: An Introduction to Actor–Network Theory* (2005), the relation among actors in a network determines a provisional form, which is nevertheless contained in a larger matrix of relations.[2]

Other bodies of contemporary thought, such as object-oriented ontology, suggest that interaction alone does not fully describe the elements of a network: if objects are actors in a network, they cannot be reduced simply to their effect on other objects and harbor hidden, unique qualities. Object-oriented philosophers such as Graham Harman and Timothy Morton propose a *mesh* of relations, a term that, much like the idea of entanglement, preserves the intimacy between unique objects.[3] Yet in alignment with Latour and Hayles, Harman and Morton describe a flat ontology as a non-hierarchical and contingent network, an emergent organization among diverse actors, of which some if not many are not human.

The discourse of hybrid networks also recalls the *posthuman* continuum between human, nature, and technology. "In the post-human, there are no essential differences or absolute demarcations between bodily existence and computer simulation, cybernetic mechanisms and biological organism, robot teleology and human goals," describes N. Katherine Hayles in her integrative book, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics*.[4] Initially a term used in 1977 by Ihab Hassan in his article "Prometheus as Performer: Toward a Posthuman Culture?" the post-human addressed the effects of incorporating technology into the arts.[5] Hassan allies this shift with the transformation of the humanities under the pressure of technology-driven human sciences. Yet in dismantling humanism's constructs, our self-fashioning capabilities appear in stark relief: "we perform and are performed every moment," Hassan concludes.[6] If this 1977 article represents the first link between the new term post-human and early digital performance, then today's integration of technological networks to shape space is exuberantly intermedial, embracing the interaction of actors, structures and site: "In a posthuman performance paradigm, spectator and performer both relinquish their positionally determinate (dialectical) claims to presence and reconfigure themselves as dynamic, interdependent parts of an emergent system."[7] This performative paradigm adopts

a relational definition of agency, which emerges from the process of constructing associations between humans and nonhumans. Communication between human and non-humans in the absence of language relies on a translation of data. Sensing technologies—motion and chemical sensors, light and color cells—provide an important interface for understanding and visualizing non-human actors in a given site. The following sections offer precedents for designing responsive interfaces in postwar cybernetic experiments, which initially explored sensory structures, and in contemporary practices integrating aspects of these sensing technologies.

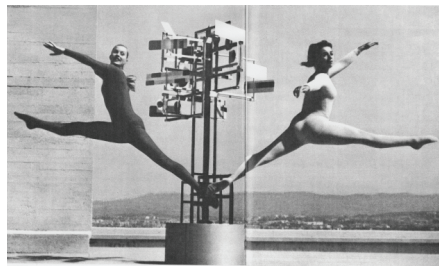

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Figure 1: "CYSP-1 danseuse-etoile est un robot," *Science et Vie* (September 1956).

CYBERNETIC PRECEDENTS

Architecture's potential for networked interactivity took form as the discourse on cybernetics penetrated the spatial imaginaries of postwar architects. Artists and architects, often in collaboration, adapted cybernetics, robotics, and communication theory to justify their attempts to create responsive structures. If, in phenomenological terms, space could be considered an environment that is activated through the perception of its subjects, then technological networks and communication devices could theoretically heighten this effect: these could awaken the body and catalyze new modes of experience and interaction with the built environment. Norbert Wiener, the theorist who first explored the concepts of environmental feedback that led to pioneering cybernetics research, and Claude Shannon, the mathematician and engineer whose research laid the foundations for modern information theory, launched what Hayles describes as a first wave of cybernetic theory flourishing between 1945 and the late 1960s.[8] This initial conceptualization of cybernetics promoted a binary (signal/noise) concept of information that focused primarily on the sender and receiver. Information was considered to be a pattern, immaterial and independent of its carriers and receptors. A second wave of cybernetic theory, launched in the late 1960s by Francisco Varela, Humberto Maturana, and Gregory Bateson, insisted that the material substrate for data was indeed integral to its informational structure. The materiality of the network fostered a more complex informational system, described by theorist Cary Wolfe as *autopoetic* openness to energetic and environmental stimuli and self-reflexive form or closure within this same environment.[9] In exploring the exchange between information, its observers, and its physical infrastructure, second-order cybernetics embraced a number of interdisciplinary collaborations that sought to use technologies in an increasingly interactive manner. From the early cybernetic work of Nicolas Schöffer to the project for Cedric Price's Fun Palace to EAT's Pepsi Pavilion, architects designed new interfaces as a first step toward an architecture capable of performing a response to its users.

The kinetic work of sculptor Nicolas Schöffer rapidly migrated toward to the cybernetic in his work during the 1950s. His fifty-meter high Spatiodynamic Tower (1954) could vibrate, hum and spin in response to its environmental stimuli, but it would soon be surpassed by what Schöffer termed his first "cybernetic sculpture:" the CYSP-1, an eight-foot tall mobile construction with an "electronic brain" developed by Philips engineers.

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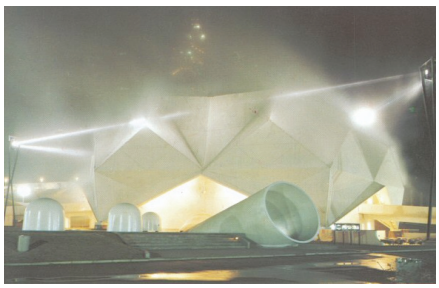

Figure 2: EAT, Pepsi Pavilion, Osaka 1970 © Shunk-Kender, 1970, Daniel Langlois Foundation.

Microphones in CYSP-1's base detected sounds while photoelectric cells sensed color, enabling CYSP-1 to respond to ambient stimuli. For example, the color blue prompted agitated movements from CYSP-1: it rapidly rolled backwards and forwards; it made quick turns; it spun its sixteen polychrome plates. Making its debut as a "robot-dancer," CYSP-1 performed with Maurice Béjart's ballet dancers on the rooftop of Le Corbusier's Cité Radieuse in Marseilles. CYSP-1's "almost organic sensibility,"[10] as noted by an admiring scientific and cultural press, embodied the interactivity on which Schöffer would seek to organize a new body of knowledge: "plastico-sociology," dedicated to developing responsive architectural forms and studying their beneficial effects on humanity.[11] Schöffer projected such constructions at an urban scale in his project for a Spatio-Dynamic City with architect Claude Parent, transforming the city into a totalizing cybernetic system of light, space, and sound.

Few works integrated cybernetics, information theory and performance as famously as the unrealized project for the Fun Palace (1961–1964) by architect Cedric Price with his interdisciplinary team including theater director Joan Littlewood, and cybernetician Gordon Pask. Envisioning an improvisational and participatory scaffold for activity, the Fun Palace promised constant adjustment to its users' desires. Roving gantry cranes would assemble and dismantle each of the building's elements in response to these changing programs. Flexible in siting, program, and form, the Fun Palace manifested a performative logic, which, when allied with Littlewood's experimental theater practice, sought to encourage new social configurations. Price argued that architecture needed to become more adaptive as well, hence his interest in collaborating with Pask, who launched a Committee for Fun Palace Cybernetics Theater. Pask integrated informational networks into a project that Price had envisioned initially in terms of mechanical mobility. The Cybernetic Theater would pool from many disciplines to create a uniquely interactive theater, capable of absorbing ''feedback'' from its audience: theater seats, among several elements of the Fun Palace's program spaces so equipped, would relay audience feedback to a computer, then to actors on stage, who would adapt their performance accordingly. Lobsinger describes this interweave of avant-garde theatre, early cybernetics and *anti-building* (Price's term): "in the act of performing the machine, the visuality and spatiality of architecture would be annulled for the ephemerality of pure, unrepeatable communication."[12] Price's conception of anti-building envisions architecture diffused into the social realm: its manifestations are event based rather than formal; and its actors, brought together through the act of observing themselves within feedback systems such as the Cybernetic Theater, would organize as a collective.

This cybernetic vision for architecture reached broad audiences during Montreal's Expo '67, which promoted "the plastic and technological mutation of the urban setting," and Osaka's Expo '70, which realized a futuristic landscape of robot-buildings.[13] Actualizing what Pask and Price had only planned, the Czech Pavilion at Expo '67 housed a functioning cybernetic theater for Radúz Cincera's pioneering interactive film *Kinoautomat*; red

and green buttons on each of the theater seats allowed the audience to govern the trajectory of the film at several decision points.

An interactive program had also been planned by the collective Experiments in Art and Technology (E.A.T.) for the Pepsi Pavilion of Expo '70. Architect John Pearce, along with more than fifty engineers and scientists, transformed the preexisting geodesic dome into a hive of interactive technologies. Fujiko Nakaya's water vapor device gave the pavilion a shifting diaphanous form; the pavilion entry buzzed with the movements of Robert Breer's sonorous "Floats." Inside the pavilion, a ninety-foot spherical mirror magnified the effects of laser light and sound displays. The interior program, ultimately deemed too expensive by Pepsi, would have allowed viewers to "shap[e] their own reality from the materials, processes, and structures set in motion by its creators": the totality producing what E.A.T. would exuberantly describe as a "living" responsive environment.[14] This pavilion, among many of the others lodged within Kenzo Tange's massive space frame, materialized the prior decade's vision of an interactive relationship between building, media, and audience. These interactive Expo pavilions, along with Price's vision offer valuable precedents for today's responsive architecture.

URBAN PERFORMANCES

The use of sensing technologies in design to address larger and more diverse urban audiences raises a number of questions: what is to be sensed? What is to be communicated? And what role do digital and analogue systems play to establish responsive architectures? The works by Harrison Atelier (HAt) and The Living, among a number of emerging practices outside of the scope of this essay, offer a spectrum of performative approaches to design.

One way for architects to address time-based media and urban audiences is to collaborate with other disciplines to design actual performances. HAt's recent performances *Anchises* (2010) and *Pharmacophore* (2011) offer different applications for sensing technology. For *Anchises*, a dance-design collaboration with the choreographer Jonah Bokaer, we sought to explore the aging body not as a monolithic concept but as a contingent mixture of genetic, economic, social and technological factors: a "space of controversy," to borrow Latour's description of an ecology.[15] Visualizing the controversy was the aim of the work, which adopted a counter-factual approach to the ancient story by asking: *Could Aeneas have sustained the ideal of filial piety had he been responsible for caring for his aging father Anchises?* A starting point in our research involved learning the movements of the aging body in dance, given that older dancers are infrequently represented: rich repertoires other than stereotyped shuffling emerged from our residency at Bournemouth University's motion capture lab. We recorded retired dancers, creating a digital catalogue of movement that informed the choreography and the set—a soft network of foam blocks and vinyl tubing. Motion capture grounded a repertoire of gesture while the performance itself played out encounters between foam and aging bodies.

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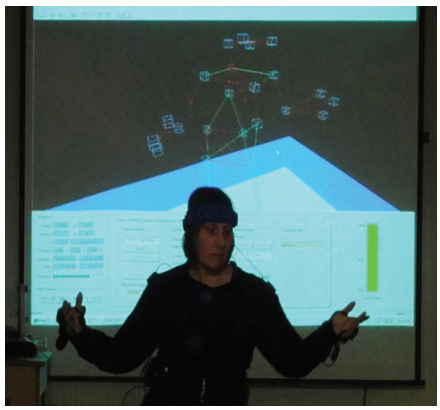

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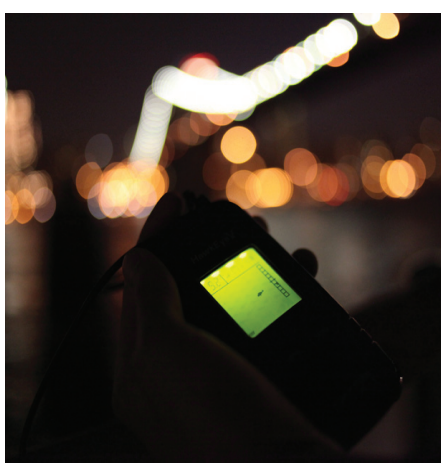

Figure 3: Movement research at the Motion capture lab, Bournemouth University, 2010 © HAt.

Figure 4: Pharmacophore, New York, 2011 © HAt.

Figure 5: Amphibious Architecture, SMS interface © The Living.

For a recent installation, *Pharmacophore: Architectural Placebo*, at the Storefront for Art and Architecture in New York, HAt designed a pharmaceutical-cultural landscape: a network of polyurethane inflatables lodged within a glazed and steel seating structure recalling both pharmaceutical company facade and medical waiting room.[16] The audience sat within this framework, opposed to the back-lit glass and resting against the inflatables. The work juxtaposed narratives about feedback and drug therapy with the unpredictable effects—noise, lights, and informal audiences—of the busy downtown site.

The types of responsive networks that we sought to introduce here engaged both the physical and visual capacities of the audience: the inflatables, in addition to cushioning the audience also transmitted the shifts and movements of his or her neighbors. The "feedback" from the inflatable network was one of alternating pressure, yielding unruly gestures as the inflatable "arms" popped up or in some cases serving as a proxy for an absent human embrace. In manipulating the physical architecture of Storefront's iconic façade designed by Steven Holl and Vito Acconci, we sought to open the "stage" to the varied inputs of the street. The audience for the piece, seated within the installation, became actors in the set as performers opened the gallery to the street; in parallel, streetside spectators found themselves encountering performers on the sidewalk as the interior and exterior space blurred during the performance. "The performance took advantage of the hinged space moving in several directions and the dancers played the space, integrating the fields of dance, art, and architecture. Even the audience was part of the conceptual aspect of the project, not only those looking in from the street but also the audience; we were carved into the place and that made it memorable,"[17] commented Holl. The sense of urban collectivity also drew on the local relations staged by the physical network of the set.

In the work of The Living, sensor-enhanced structures extend a technological network of care across the urban environment, as two works, Amphibious Architecture with Nathalie Jeremijenko, and the Living Light pavilion in Seoul, demonstrate. Developed for the Architectural League's 2009 exhibition, "Toward the Sentient City," the installation Amphibious Architecture introduced floating networks of chemical and motion sensors into New York's East River. Mark Shepard, in his curatorial statement for the exhibition suggests that ubiquitous computing, dataclouds and mobile personal technologies enable an unprecedented communication with and about the urban environment. In this installation, submerged sensors monitored aquatic conditions, relaying information in real-time to colored LED lights that changed color to indicate differing chemical levels in the water as well as the presence of fish. An SMS interface encouraged its public to "text-message the fish,"[18] a step toward "establishing a two-way interface between environments of land and water."[19]

While such communication was entirely mediated and produced by the designers, the idea of SMSing fish is a performative act that challenges architecture's anthropocentrism. The "datacloud" that hovered over the

water shared environmental data as a feedback system encouraging its public to respond to multiple actors in urban waters.

Designed by The Living for Seoul's Peace Park in 2009, the Living Light pavilion engages both the global reach of wireless communication and specific urbanity of Seoul, South Korea, from an environmental perspective. While the canopied structure communicates real-time information about Seoul's air quality, the installation also establishes a wireless dialogue with the city's residents. "People text message the building and it will text them back," explain The Living of their vision for integrating an SMS interface within the surfaces of the Living Light pavilion.[20] The Living's implementation of sensors to create a "responsive architecture" poses a broader question about the role of environmental politics in shaping contemporary urbanity. Living Light's canopy takes the form of an abstracted map of Seoul divided into the twenty-seven zones, or *gu*, in which the Korean Ministry of Environment operates air monitoring stations in the city. The transparent acrylic panels are etched with the city streets of their respective zones and bounded by fiber optics that blink and brighten in response to fluctuating data. Urbanity is literally inscribed in the panel surface. In terms of the physical encounter with Living Light, the pavilion's acrylic panels blink and flicker, giving fifteen-minute air quality updates from each of the twenty-seven municipal environmental stations. Improvements in air quality cause zones to light up, offering a panel-by-panel real-time visualization of the city's "best-" to "worst-performing" urban zones in terms of air quality.

To achieve city-wide "responsiveness" requires that data be communicated visually and relatively simply to as broad an audience as possible: the panel does not register gradations, rather it registers whether Seoul's air quality is above or below a given threshold. This binary display is what The Living describes as "low resolution" information. Low-resolution information may be comprehended at a glance—a light is on or off. The panels also illuminate in response to text-messaged requests for information on specific urban areas, blinking in response to text messages and lighting the zone in question. Yet the light coursing through the panels reflects the lively pulse of an information exchange between the building and the public. The integration of an architectural facade system with wireless communication networks further reflects the "new systems" of The Living layer into architecture's simultaneous modes of address.

Living Light's curved canopy serves as shelter, meeting point, and informational network. Living Light is a physical encounter with the responsive surfaces of the pavilion; it is a dialogue with the building through a cellphone interface; and it is a remote repository of environmental information. According to The Living:

> Performance in terms of metals and material limits quickly overlapped with performance in terms of atmospheric effect, civic engagement, and communication through architectural envelopes.[21]

This is not to suggest that the interface of hand-held devices should be considered a "public" interface, nor that the Living Light pavilion presumes

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Figure 6: Living Light, Seoul, Korea
© The Living.

ENDNOTES

1. Chris Salter, *Entangled: Technology and the Transformation of Performance* (Cambridge, MA: The MIT Press, 2010), 352.
2. Bruno Latour, *Assembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005), 116.
3. Timothy Morton, *The Ecological Thought* (Cambridge, MA: Harvard University Press, 2010).
4. N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics* (Chicago: University of Chicago Press, 1999), 3.
5. Ihab Hassan, "Prometheus as Performer: Toward a Posthumanist Culture? A University Masque in Five Scenes," *The Georgia Review* 31 (1977): 830-850. His characterizes the term as follows: "We need first to understand that the human form—including human desire and all its external representations—may be changing radically, and thus must be re-visioned. We need to understand that five hundred years of humanism may be coming to an end, as humanism transforms itself into something that we must helplessly call post-humanism," 843.
6. Ibid., 850.
7. Ralf Remshardt, "Posthumanism," *Mapping Intermediality in Performance*, Eds. Sarah Bay-Cheng, Chiel Kattenbelt, Andy Lavender, and Robin Nelson, (Amsterdam: Amsterdam University Press, 2010), 135.
8. Hayles' *How We Became Posthuman* describes differing cybernetic models in the postwar period.
9. Cary Wolfe, *What is Posthumanism?* (Minneapolis: University of Minnesota Press, 2010), 112.
10. Gerard Cottin, "CYSP-1 danseuse-etoile est un robot," *Science et Vie* (September 1956): 65. See www.cyberneticszoo.com for articles on CYSP-1.
11. Ibid.
12. Mary Lou Lobsinger, "An Architecture of the Performance," *Daidalos* 74 (2000): 24.

13. Georges Patrix, "The Triumph of Prospective Architecture in Montreal," cited in Larry Busbea, *Topologies: The Urban Utopia in France 1960-1970* (Cambridge, MA: MIT Press, 2007), 151.

14. Randall Packer, "The Pepsi Pavilion: Laboratory for Social Experimentation," in *Future Cinema: The Cinematic Imaginary after Film*, ed. Jeffrey Shaw and Peter Weibel (Cambridge, MA: The MIT Press, 2003), 145.

15. Bruno Latour, *The Politics of Nature* (Cambridge, MA: Harvard University Press, 2004); Bruno Latour, 'The Space of Controversies: An Interview with Bruno Latour,' *New Geographies* 0 (2008), 122-136.

16. Pharmacophore: Architectural Placebo was the third installment in Harrison Atelier's Pharmacophore series, conceived, designed by Seth and Ariane Harrison, choreographed by Silas Riener and performed by Merce Cunningham Dance Company members Rashaun Mitchell, Silas Riener, Jamie Scott and Melissa Toogood. The production featured lighting design by Aaron Copp and Nick Houfek, and an original score by Loren Dempster. Pharmacophores are the common features shared by the set of chemical structures that interact predictably with classes of biological targets. Yet, the desired cause and effect relationship is often perturbed by physiological and psychic forces, among the most common is the placebo effect: a beneficial change in a biochemical state, albeit temporary and unreliable, produced in anticipation of therapy.

17. Steven Holl, quoted by Nina Rappaport, "Pharmacophore at Storefront," *Constructs* (Spring 2012): 25.

18. The network contained a grid of twenty-five tubular components with a submerged "sensory" assemblage (sonar for presence of fish; chemical sensors for dissolved oxygen, nitrates, and pH; accelerometer for hydrodynamic forces) and a buoyant signaling device (photovoltaic/battery pack; stack of lighting disks) to convert sensory data into information (lighting pattern on the buoys; text messages). See Nathalie Jeremijenko and David Benjamin and Soo-in Yang, "Case Study: Amphibious Architecture," *The Sentient City* (Cambridge, MA: MIT Press, 2010) and Jordan Gieger, "The Living: surface tensions," *AD Territory* (2010): 60-65.

19. www.thelivingnewyork.com/amphibiousarchitecture and www.amphibiousarchitecture.net (Accessed 3/1/2012).

20. David Benjamin and Soo-in Yang, "Living Architecture Lab," Graduate School of Architecture, Planning and Preservation, Columbia University, www.arch.columbia.edu/labs/living-architecture-lab (accessed 3/7/2012).

21. David Benjamin, "Testing Material Limits, Testing Material Territories," in *Post-Ductility: Metals in Architecture and Engineering*, ed. Michael Bell and Craig Buckley (New York: Princeton Architectural Press, Forthcoming), page 4 of 7, manuscript courtesy of David Benjamin.

22. Karen Barad, "Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter," *Signs*, vol. 28, no. 3 (2003): 801-831, 826.

a democratic reach based on consumer devices; the pavilion instead overlaps physical and virtual means of communication to create a structure that responds to rhythms of the city.

INTRA-ACTIVE NETWORKS

> A posthumanist formulation of performativity makes evident the importance of taking account of "human," "nonhuman," and "cyborgian" forms of agency (indeed all such material-discursive forms). This is ... necessary because agency is a matter of changes in the apparatuses of bodily production, and such changes take place through various intra-actions, some of which remake the boundaries that delineate the differential constitution of the "human."[22]

Karan Barad's emphasis on the materiality of performance and the translation of this idea into an expanded sense of agency helps define the aspirations for responsive architecture. Her term, "intra-action" describes the relational quality that many architectural practices seek to set into play as media-rich architectural environments for the living city. Works such as those by The Living engage performance in various urban contexts and provoke a spectrum of responses, while assembling hybrid collectives as evidence of architecture's intimate entanglement within living networks. ◆