Architectural studies boasts a wealth of material that examines the role of print, paper and other analog media in forming and transforming architectural practice.\(^1\) While numerous titles on the significance of digital media exist (for example, Beckman, Benedikt, Perry and Hight, Poster, Castronova) that explore their impact on architectural production, no definitive analysis has yet emerged. Indeed, given the rapid pace of change and the development of new digital devices and applications, a definitive work on this topic may never be possible. We offer this chapter as a gathering of resources and a framework within which analyses may proceed. The work done on print media’s effects clearly shows that medial effects go beyond architectural practice into such issues as the spread of architectural ideas, the dissemination of architectural writing, and the formation of an architectural canon of forms, styles, and components (for example, Colomina 1996, Carpo 2001). Even this, however, is not a complete inventory. Media effects can be explored in four distinct but interrelated areas: effects on how buildings are conceptualized, effects on how buildings are constructed, effects on the subjectivities of those who envision buildings, and effects on those presumed to inhabit the structures. Given limitations of space, we will focus our analysis on the last two areas – subjectivities of practitioners and assumptions about what constitutes the human, with glances at environmental, spatial, technological, and cultural forces that most deeply affect the transformations.

First, some ground clearing on our central terms. Virtuality currently has two central clusters of meanings, one deriving from virtual reality technologies (see Hillis...
[1999] for a summary), the other from the influential Deleuzian concept of the virtual as that which is in dynamic tension with the actual (Deleuze, 2005). Both these senses are relevant to our discussion. We begin by offering the hypothesis that all architecture, built or unbuilt, is virtual in the Deleuzian sense. Architecture, we propose, is not building, nor is it some privileged subset of building. Rather, we posit architecture as an emergent property of a range of media, buildings among them. It is that which makes building meaningful to an on-going tradition. Not building itself, but, as the dictionary tells us, a particular “art,” “science,” or “manner” of building; as Reyner Banham put it, “what distinguishes architecture is not what is done … but how it is done” (Banham, 1996).

Further, we posit that architecture is a function of embodied discourse, that is, discourse instantiated in speech or, more typically, written or graphical documents. “Document,” as the term is used in textual studies, is distinct from “text” or “work” because it implies the existence of a physical (or digital) object.

Just as all buildings hold within them the potential of becoming architecture, so the documents that precede, surround, and follow buildings are constitutive players in imagining, planning, and implementing architectural practices and thus also participate in creating architecture. Embodied buildings and embodied documents are physical objects witnessing to architectural acts, but architecture can never be reduced to these objects. Rather, architecture partakes fundamentally of the virtual in the Deleuzian sense, a nimbus of potentialities in dynamic interaction with the actuality of buildings and documents. Both the virtuality of architecture and the physicality of documents and buildings are real, but whereas documents and buildings are location-specific, comprising myriad individual instances, architecture is malleable, dispersed, always in flux. As a
totality, architecture is ineffable, for as soon as it is written or built, it moves from the virtual to the actual. The collective labor of the discipline acts as midwife to architecture, moving from the raw materials of architectural actual media (whether buildings, construction documents, or philosophical writings) and guiding the emergence of architecture’s virtuality into the actuality of things we can read, touch, and traverse.

An important implication that follows from this view is the impact of media on architecture. Like love, the term “media” evokes universal recognition, yet there is a surprising lack of consensual definitions. For a field such as Communication Studies, media mean communication technologies such as television, radio, and the Internet; for Marshall McLuhan, media were famously configured as “extensions of man,” a definition that cast telegraphy into the same bin as roads. For our purposes, we regard media as materio-semiotic systems that enact the circulation of signs. A neologism coined by Donna Haraway (among others), “materio-semiotic” connotes objects that partake both of signifying practices and physical instantiation. An earthy example is provided by the rural Midwest landscape one of us (NKH) knew as a child, a time when indoor plumbing was ubiquitous but not quite universal. In that landscape, one occasionally encountered outdoor privies, and not infrequently, visits to them revealed, in the form of a Sears catalogue, the spirit of thriftiness that indelibly marked those who lived through the Great Depression. A materio-semiotic object, the catalogue served a dual purpose: as one lingered while waiting for certain biological processes to occur, it provided casual reading material; later, its material properties (the tearability of the relatively cheap paper, etc.) came to the foreground.
Media, as material systems conveying signs, have two principal strategies at their disposal: circulating signs through people, and circulating people through signs. Typically documents are identified with the first strategy and buildings with the second. Library books circulate among people, for example, while Gothic cathedrals functioned as sign systems through which people circulated as they performed liturgical rituals. The history of books and buildings shows many other possible combinations of strategies. Medieval codices were often chained to podiums, so that it was the people who moved while the books were stationary. Conversely, as Robert Venturi has taught us (Venturi, Brown, and Izenour, 1977), buildings may be designed to be seen from moving cars, so from a relativistic perspective that takes the viewer’s position as constant, the buildings circulate while the person remains sitting in her seat.

Considering both documents and buildings as media—that is, as materio-semantic systems—has multiple advantages. Defamiliarizing the usual categories that parse buildings as durable architectural entities and documents as ephemera, the medial perspective articulated above encourages interpretations that link semiotic functions to material actualities, so that buildings and books are neither reduced only to discursive entities nor to material objects. Another advantage inheres in the new configurations that emerge when the usual dichotomy between built and paper architecture is broken down and replaced by more flexible and dynamic interactions between virtuality and actuality. As media change – for example, from print-based documents to digital files – the dynamic between architecture’s virtuality and the medium’s actuality changes accordingly, often with dramatic effects. Virtual architecture, those unbuilt or unbuildable digital constructions of the contemporary generation, becomes not a pseudo-
architecture suffering from a lack of physicality but rather an essential architecture unencumbered by physicality. Virtual architecture does not operate outside the pale of the discipline in a lesser realm of the unbuilt (the design equivalent of the undead), as many detractors have insisted. Rather architecture, by virtue of its dynamic interaction with actual media, infuses the physicality of the written and the built with the infinite potential of the virtual. Inhering at the very heart of the discipline, architecture’s ineffability, unspeakable as such, is the reservoir that renews the discipline and makes innovation possible.

VIRTUALITY AND MEDIUM SPECIFICITY
One cannot develop a critical theory of new media if one begins from the assumption that they are somehow immaterial (Poster, 2006, 56).

The rise of the virtual, stimulating a renewed consideration of material specificity, has catalyzed new interpretations of materiality. Matthew Kirschenbaum (2005, 2008), for example, has distinguished between forensic and formal materiality. Materiality, referring to the artifactual nature of an object, should not be confused with physicality. As we have argued elsewhere (Hayles, 2005), an object has a potentially infinite array of physical attributes. One could, for example, refer to the chemical composition of ink when discussing print technology, and beyond that to the molecular components, their energy states, etc. Physicality alone, then, is insufficient to specify an object. Rather, certain physical attributes are typically of interest in a given circumstance—say, the colors associated with the chemicals in ink. Materiality expresses this conjunction of attention and attributes, focus and physicality. Attention shifts, focus changes, and
materiality transforms. Always embedded in an overt or implied context, materiality, far from being given by an object’s physicality, is an emergent event.

Kirschenbaum’s formulation of formal and forensic materiality builds on this idea and carries it further by distinguishing between the material substrate of computer technologies (forensic materiality) and the formal sign systems that constitute computer codes (formal materiality). Reconfiguring the usual dichotomy of hardware and software by incorporating their material properties into the definitions, Kirschenbaum draws attention to issues of scale and contingency. Just as any artifact can be parsed in an infinite number of ways, so any two apparently identical artifacts can be seen to differ if the scale of observation is small enough. Two boards, for example, may be judged the same size, but drop to a smaller scale—millimeters rather than inches, nanometers rather than millimeters—and differences previously undetectable become observable. Kirschenbaum illustrates the point by taking a CD-ROM to a nanotechnology laboratory, where a scanning tunneling microscope reveals very slight irregularities in the bit patterns. Although we are accustomed to say that information is infinitely and exactly reproducible, this is true only within given tolerances. Along with a context of attention, materiality implicitly references a context of measurement from which observations are generated. Consequently, materiality has borderlands in which it can be transformed, either by a shift of attention or a shift of scale. Like the coastline of Britain in Benoit Mandelbrot’s well-known example (1983), materiality cannot be specified in advance and without reference to context, for social, cultural, and psychological aspects interact with technical specifications.
Complementing and complicating this idea of forensic materiality is formal materiality, which in Kirschenbaum’s formulation consists of the processes or behaviors in which a computational object engages. Just as one bit is not identical to another bit when the scale of observation is small enough, so the codes that the computer executes may have idiosyncrasies that testify to their origin’s historical circumstances, as Kirschenbaum (2008) demonstrates by finding the kernel of an older computer game embedded within the code of a newer one. As with forensic materiality, formal materiality has social, cultural, and psychological dimensions as well as technical ones. Thus both formal and forensic materialities are inherently emergent; in Bruno Latour’s terms (2007), they are nature/culture hybrids. As emergent entities, they are path-dependent; they have histories, and these histories mark their materiality in ways that break open simple categories such as one and zero bits or executable and not executable code. The material entities become individuals capable of revealing their stories when interrogated with the proper (i.e., forensic) techniques.

What changes when we move from hardware and software to formal and forensic materiality? From the outset the emergent nature of forensic and formal materiality makes clear that multiple recursive feedback loops cycle between physicality and sociality, media as technical objects and social processes. Adrian Mackenzie (2006) has convincingly argued that software construction is an intensely social process. The framework sketched above broadens this insight to include the technical functioning, social practices and media representations of architectural work. Researchers may understandably choose to focus on a particular aspect of a multiple recursive cycle (as for example Friedrich Kittler does in his emphasis on hardware in such essays as “There is
No Software” [1997a] and “Protected Mode” [1997b]), but in our view it is a mistake to fetishesize any one component as if it alone could explain the dynamics of a complex system. As Donald M. Lowe shows (1995), social, economic, and technological factors work together to form “the body” in late-capitalist USA. Take, as another example, our claim above that attention is a co-specifying factor in the emergent dynamics shaping which aspects of physicality become materiality. This might seem to privilege attention as the determining component. Attention itself, however, has historical and culturally specific dimensions that spring from the effects of media and other technologies, as numerous studies have shown. Jonathan Crary’s Suspensions of Perception (2001) traces the emergence of attention as a medical and industrial concern and explores the complex dynamic between its creation and dissolution; Wolfgang Schivelbush’s The Railway Journey (1986) demonstrates the effects of rail travel on modes of attention in the late nineteenth and early twentieth century; and Steven Johnson (2006) and we (Hayles, 2007) have argued for the effects on attention of contemporary media. To engage a richer sense of the complex dynamics that co-determine media specificity, interactions throughout the system should be understood as entwined with and mutually affecting one another.

Media specificity has been a minority interest in the humanities for most of the twentieth century, with the long dominance of print inducing a kind of somnolence in this regard. (An important exception is textual studies, which has typically engaged with what Jerome McGann [2001] has called “bibliographic codes,” that is, the material aspects of texts). All this changed, however, with the rapid development of networked and programmable media in the later twentieth century. Signs of crisis are now everywhere
apparent as the humanities struggle to come to terms with the importance of media specificity in composition, publishing, credentialing, and a host of other areas. Architecture has been significantly in advance of other areas of the human sciences in investigating interactions between architecture and the objects, subjects, contexts and media that conspire to produce it. A convenient example can be found in Robin Evans’s widely read 1986 essay, “Translations from Drawing to Building” (1986).

Evans’s text relates a simple tale: the constructed dome of the Royal Chapel at Anet (1547-52) by Philibert de l’Orme does not match the drawing of it inscribed in the pavement below nor does their relationship match de l’Orme’s description of it in his *Premier tome de l’architecture* (1567). For Evans, these differences do not signal a deficiency in the work, a failure on the part of the architect to translate precisely an architectural concept from one medium to another; rather, the case reveals the differences between the various media (drawings, books, and buildings) that were deployed to produce the architecture in question, as well as the way in which those differences condition and inflect it.

De l’Orme’s work hinges on a consonance between the two-dimensional, three-dimensional, and textual instantiations of a complex geometrical pattern, a consonance that Evans’s analysis demonstrates to be incorrect geometrically. The work may look like a virtuoso feat of projective geometry (and in fact it is), but this feat was not executed as advertised. Constructing an alibi for de l’Orme, Evans surmises that the architect fudged the floor paving, cropping the aesthetically inferior portions at the projection’s edges and scaling up the entire pattern to produce an effect that more closely resembled that of the dome above. De l’Orme’s adjustments can be seen as an extension of the ancient Greek
practices of visual correction (entasis, the modulation of column spacing, etc.), which likewise torqued, stretched, and adjusted elements to produce a more convincing appearance of their being parallel, perpendicular, evenly spaced, or plumb. Evans demonstrates that de l’Orme’s corrective adjustments extend into the *Premier tome* as well, which similarly values the effect of rigorous method over its actual application. We might append de l’Orme’s triumphant finish, “…forming by this means compartments that are plumb and perpendicular above the plan of the said chapel,” with ‘but this didn’t look quite right, so we cropped off the outer, ugly bits and made the whole thing bigger.’ The addition, while ruining the text’s rhetorical effect, would nevertheless have the salutary effect, important for our argument, of revealing the transformational effects of translating between and among media.

In each mediated instantiation of the chapel – the constructed dome, the patterned floor, du Cerceau’s engraved drawings, de l’Orme’s printed text, Evans’s diagrams and photographs – the architectural effect of dizzying geometrical precision was crafted and modulated according to the specific media through which that effect was produced. In the end, we understand that these effects at Anet issue not from a single source but rather from the dynamic interaction of the building’s materiality with its myriad mediated representations, as well as with the architect(s) that produces it and the perceiving subjects that engage it. Like writing, each of the media involved made possible and also precluded specific inflections of the thoughts they embody. In many cases, media deployed by architects give rise to ideas that are thinkable only through those media; recall, for instance of Peter Eisenman’s cunning redrawing of Le Corbusier’s Maison Domino. Originally published by the French architect as a two-point perspective, the
image was re-drawn by Eisenman as a series of axonometric diagrams (Eisenman, 2004). This translation of an iconic drawing from one style of projection to another opened the simple form to a host of new interpretations.

Another avenue along which this line of thinking might develop is architectural photography. Migrating built form to the printed page through the lens of the camera, with its cultural affiliations with truthful representation, made possible modes of architectural thinking unavailable to drawing or writing. Truth travels in step with fiction, producing productive slippages between assumed facts and media representations. As pointed out by Beatriz Colomina, photography and its attendant body of techniques can manipulate reality as much as reflect it. “Rather than represent reality, it produces a new reality” (Colomina, 1996, 80). Colomina goes on to demonstrate in her interpretation of Le Corbusier’s serial redrawing of postcards that these new realities signify not as a function of single images but rather through their accumulation and relation to other media: “a photograph does not have specific meaning in itself but rather in its relationship to other photographs, the caption, the writing, and the layout of the page” (Colomina, 1996, 93-100).

As photography is multiplied in film and made infinitely malleable with digital technologies, these potential “new realities” are likewise multiplied, and with them their available interactions with other media and their potential to produce new forms of architectural thinking. Let us return for a moment to Eisenman’s representations of the Maison Domino (Eisenman, 2004; Figures 1 and 2). Here, Eisenman uses an abstract drawing technique to produce a series of spare interpretations of Corbusier’s already stripped-down original. Taken together, Eisenman’s drawings produce an effect of
teleological development, an implied history of a primitive form’s articulation over time. This effect is particularly effective rendered as an axonometric, which imposes a three-dimensional framework revealing spatial relations while retaining dimensional congruence. The argument instantiated in Corbusier’s more realistic perspective would occlude much of the essential information. Over a series of projects through the 1970s and into the present, Eisenman developed this technique further in analyses of the work of Guiseppe Terragni as well as in his own work, producing a series of projects that adopted a narrative syntax to produce the effect of the serial elaboration of primitive forms over time (Eisenman, 1999 and 2003). With the advent of 3D computer modeling and animation software in the 1990s, such serial elaborations were possible not only in far greater degrees of complexity but also with much higher frame refresh rates. From Le Corbusier’s single iconic image to Eisenman’s step-by-step transformations to Greg Lynn’s fluid animations, we see the persistent development through various media of architecture as a specific narrative discourse, the articulation of which is only possible through the specific media that produce it. Coupling these digital animations with soundtracks, live actors, and cinematic techniques, firms operating outside the discipline of architecture such as Imaginary Forces push this discourse still further in their development of architectural pre-visualizations and what has been called “experience design” (see Krakowsky, 2007). The perceivable effects of this discourse do not inhere solely within the objects produced, regardless of whether those objects take the form of buildings, drawings, computer animations, or texts. Rather, these effects obtain from the dynamic interactions that arise in the virtual space between the various media that embody them and the perceiving subjects that engage them.
NEW MEDIA AS ARCHITECTURE

Over the past twenty years, digital technologies have perpetrated a fundamental transformation not only of architectural working methods, but also of the kind of work architects produce and the manner in which that work is interpreted and discussed. Shifts in attention from form to surface, from objects to atmosphere, from meaning to mood, and from critical to post-critical (or projective) practice have been advanced by critics and historians from all camps as symptoms of a more general move away from a discursive paradigm centered upon stable objects and legible meaning to one concerned primarily with fluid environments, ephemeral effects, and ambiguous moods. While others, such as Robert Venturi, have attempted to situate new technologies within old regimes of signification and iconography, we eschew his tendency to cast architecture and media as opposing forces. While architecture might emerge from the interaction of iconography and electronics with generic buildings in the work of Venturi and others, in our view, more interesting work is being done by firms committed not to a conceptual separation of digital media and built form but rather to their seamless integration.

The New York office of Diller, Scofidio and Renfro has long been at the forefront of integrating technology and virtuality in architecture as well as in extending architectural practice into neighboring disciplines such as gallery art, theater, and film. The firm’s precocious facility with virtual effects as well as the trademark elements of their work may be attributed to their long history of collaboration with the theater and stage production. In contrast to the earnest monumentality of architectural form, the theater deals unapologetically in artifice, regularly deploying actual construction and
virtual projection to construct its illusions. DS+R operates in a similar fashion, and recurrent elements in their projects recall standard theatrical elements and tropes. Their famous mechanical apparatuses, for example, evoke the ad-hoc mechanical tackle of the theater fly-space. Their aggressive use of architectural drawing conventions (plan and section projections, linear perspective, etc.) to manipulate spatial perception corresponds to the intermingling of architectural technique and theatrical illusion described in early treatises ranging from Vitruvius to Alberti and illustrated in Mannerist examples such as Palladio’s Teatro Olimpico in Vicenza or Scamozzi’s Teatro di Sabionetta. In theater as in the work of DS+R, mechanical and projective devices, from illusionistically painted sets to the split and distorted perspectival recessions of the *scena per angolo* to Diller and Scofidio’s early deployment of angled mirrors, come together to produce a range of virtual effects that confound the distinctions between the actual and the virtual and in recent works have become the primary locus of their architectural experimentation.

This tendency is apparent in such hallmark projects as their production design for “The Rotary Notary and His Hot Plate” of 1987 (Figure 3). Drawing inspiration from Marcel Duchamp, Diller and Scofidio devised an apparatus composed of an opaque screen that divided the stage parallel to the proscenium and a mirror fixed at 45 degrees that revealed a plan view of the concealed space to the audience. Viewed head-on (and in the most commonly published photographs), the apparatus effectively flattens into a single plane akin to an elevation drawing, reproducing the gendered separation of bride’s and bachelor’s domains of Duchamp’s “Grande Verre” while producing a multiplication of the performance space that unleashes a panoply of illusory potential. Moving into the concealed area of the stage displaces the actor’s bodies into the virtual space of the mirror
apparatus where they are rendered weightless, fragmented, and dismembered. Diller and Scofidio honed their techniques and expanded their repertoire to include video projections in a series of theatrical productions through the 1990s,\textsuperscript{11} as well as in installations such as Para-Site at the Museum of Modern Art in New York (1989), Loophole at the Second Artillery Armory of Chicago (1992), and in projects such as the Slow House on Long Island (unfinished, 1992) and the Brasserie at the Seagram Building in New York (2000). In each case, carefully positioned cameras and video monitors displaying both real-time and time-delayed imagery produced on-site as well as remotely, displace and multiply architectural spaces, producing jarring spatial and temporal juxtapositions heightened by their architectural constructions but impossible to achieve through strictly mechanical means. Too, the firm devised complex presentations of each work, from armatures that blurred distinctions between drawings, models, and the structures designed to support them in earlier works to clever combinations of analog and digital representational techniques in later presentations. The firm’s work developed in scope and ambition through the 1990s and into this century alongside rapid advances in digital technologies, and the office remains at the forefront of experimentation with them that re-imagines the affective potential of architectural projects as well as the technical scope of architectural practice.

Perhaps the firm’s most ambitious attempt at integrating digital technologies and physical construction is their Blur Building at Yverdon-les-Bains, Switzerland (2002, Figure 4). To construct an artificial cloud on the grounds of Swiss Expo ‘02, the firm employed digital technologies in concert with analog techniques through all stages of conceptualization, design, construction, and operation. Their use of these techniques,
from the fusions of analog and digital drawing methods in presentation materials to the integration of computer controlled weather sensors to modulate the complex fog generation system on the project, is well known and widely published. The project’s dissemination in other media, from extensive publication in the popular and scholarly press to the use of its imagery in contemporary products ranging from telephone cards to chocolate bars, has also been noted (see Diller and Scofidio, 2002). For the present discussion, the project’s unrealized digital components, which aim to eradicate the boundary between virtual and actual spatial environments, are most pertinent.

In the indeterminate space of the Blur Building, familiar architectural depth cues were to be all but erased by the mist. To compensate for diminished visual stimuli, alternative modes of spatial orientation were to have been made available through digitally controlled sound and light effects. As the Blur Building developed, the firm and its many collaborators experimented with a number of integrated media components, from scrolling LED text displays to automated ‘braincoats’ to interactive online controls, most of which were eliminated due to budget constraints from the final built work. We have noted previously the unfortunate lacunae their absence left in the experience of the built work (Gannon, 2002), but, as has been noted by Mark B. N. Hansen, “in addition to being a temporary built project in the world, the Blur Building exists as a work of embodied conceptual art preserved in the archive of traces that document its making and that include – as a central core of its drama – the media components” (Hansen 2006b, 280). While these unrealized media components did not inflect the constructed spectacle at Yverdon-les-Bains, they are essential to an understanding of the full architectural
significance of the Blur Building and point to the burgeoning potential of architecture
born out of the interpenetration of new and old media.

Offering much needed protection from the cool mist of the pavilion, Diller and
Scofidio’s digitally enhanced braincoats open up new avenues of social interaction and
spatial organization. (Figure 5) Upon arriving at the pavilion, visitors were to complete a
simple questionnaire meant to divine specific personality traits, the answers to which
were then uploaded to a central database and to the individual’s braincoat. Sensors and
transmitters embedded in the coats would communicate with each other as visitors moved
through the space, causing visual, aural, and mechanical transformations to the coat based
on proximity to other coats and the programmed information they carried. As a visitor
wandering in the mist approached another visitor who had given similar answers to the
questionnaire, the system would signal a potential affinity by shifting the color intensity
of each coat toward green and increasing the frequency of audio pulses emitted by the
coat. Contrasting answers would elicit an antipathetic response signaled by a red hue, and
exact matches would trigger a vibrating sensation in the coat, “mimicking the tingle of
excitement that comes with physical attraction” (Diller and Scofidio, 2002, 217).

The results of this new spatial experiment remain unknown. Like minded visitors
might have attracted one another, causing a segregation of inhabitants based on
personality that would have resulted in uniform clusters of glowing green coats and rapid
aural pulses. Alternatively, visitors might have been turned off by their supposed
matches, causing those with similar profiles to repel one another. This might have led to
an ironic arrangement of mismatched personalities seeking the comfort of strangers in the
closest proximity to one another. More likely, of course, would have been an oscillating
swarm of rising and falling pulse tones and a full spectrum of glowing coats as individual visitors pursued individual agendas and entered and exited the system at varying rates – a field of peripatetic denizens blushing, beeping, and vibrating their way through an otherworldly milieu.

In another aborted embellishment, the pavilion was to be equipped with PTZ cameras capable of being controlled by virtual visitors experiencing the space through the internet. While these visitors would not have been able directly to enjoy the full range of physical sensations and alternative social opportunities offered by the braincoats, they would have been afforded a remote view of the spectacle as well as an opportunity to affect the content of the LED displays (and perhaps, by extension, the behavior of the visitors at Yverdon) through interaction with web-based interfaces. As such, the Blur Building would have inhabited the virtual space of the Internet as it simultaneously occupied the physical space over Lake Neuchâtel, with its virtual and actual visitors likewise occupying multiple positions in the manifold virtual instantiations of the space projected around the globe by the Internet.

While budgetary constraints precluded the inclusion of these elements in Yverdon, other projects demonstrate the potential of active digital media on architectural design. Linking integrated sensors to computer-controlled lighting elements, Toyo Ito’s 1986 Tower of Winds in Yokohama transformed contextual data into “environmental music” expressed in constantly changing light patterns. Greg Lynn’s Embryological House project (2000) invites clients to participate in the design process through an interactive website. More recently, the D-Tower by Lars Spuybroek and artist Q.S. Serafin combines physical construction with web-based components to produce a hybrid,
interactive work that colorfully maps the collective emotional state of a small Dutch town.\textsuperscript{14} Younger practices such as Höweler+Yoon, servo, Xeferotarch and others routinely combine digital technologies with physical construction to produce architectural works impossible to consider in a strictly analog terms. Far exceeding Venturi’s call for a generic architecture adorned with electronic signage, these works (in all their varied instantiations) guide the emergence of an aggressively intermediated architecture that choreographs a complex, integrated ensemble of physical construction, virtual simulation, and pervasive interaction of human subjects and intelligent machines.

VIRTUALITY AND NOTIONS OF HUMAN SUBJECTIVITY

I am teaching a design studio at UCLA. A student has been working on a 3D model of a building and is walking me through the latest changes. It is an early summer afternoon in Southern California and the studios, designed with analog drafting in mind, are bathed in natural light. The sun’s glare makes it difficult for me to see the image on the screen, so I ask the student to turn it toward me so that I might get a better view. A second later, without lifting a hand, she asked, “Is that better?” Flummoxed, I reply, “You didn’t move anything.” Her right wrist flicks the mouse almost imperceptibly, and the 3D image on the screen rotates about its vertical axis. “How about now?” I reach forward and turn the monitor myself.

Two generations peer at the screen, the older seeing the screen in space, the younger the screen as space. Such anecdotes pepper the literature surrounding the advent of digital technologies in design studios through the 1990s to the present. As more robust platforms and projects such as Second Life come online, these occurrences have become
increasingly commonplace. While virtual spaces in built work are only beginning to alter the architectural environment, the virtual spaces in which work is produced have been fully assimilated into workplace practices and, increasingly, into leisure time as well. These professional and leisure practices have had dramatic effects not only on architects but also on artists, writers, and cultural critics. In the cultural imaginary, the virtual in architecture, in vibrant conversation with the actual media of networked and programmable machines, leaps ahead of present construction to envision a built world in which simulated overlays merge seamlessly with actual buildings to create mixed reality environments inhabited by augmented humans.

Such a world is given pride of place in Vernon Vinge’s speculative fiction *Rainbows End*, where it is imagined so vividly and pervasively that it almost qualifies as the novel’s protagonist. In Vinge’s near-future world, buildings are quite plain and even ugly, for they are not designed to be seen in themselves but rather to function as underpinnings onto which virtual overlays are projected. They are in this sense malleable, mutating as the projections change; Juan, a student at Fairmont High School, notices that the “buildings were mostly three stories today. Their gray walls were like playing cards stacked in a rickety array” (50). There would indeed be little sense in creating elaborate exteriors when what the eye perceives comes not from the building but the computer. Programmable gear provides the projections, texturing, and detailing that transform surfaces into whatever the user has fashioned in his or her wearable. Visions are shared either through VR projections or directly as digital files. Users thus become instant collaborators with architects, creating custom visual effects that advertise their virtuosity in manipulating digital information.
The cumulative effects on human culture and subjectivity are profound. The novel’s putative protagonist, Robert Gu, is an older man who had been a world-class poet before he descended into the deep twilight of Alzheimer’s. Rescued from darkness by medical advances, he re-awakens to a contemporary world in which most people around him are living in a mixed reality that he can enter only through arduous re-education. The plot foregrounds how class has been reconfigured; the emphasis is no longer on the have-haves and have-nots but on the digitally facile and digitally obtuse. Just as in former times one was required performatively to display a certain class, gender, and race to have access to a gentleman’s club, so now the elite are defined by their skills in manipulating the wearables that create the environments to which other people respond.

The ornate surfaces created by VR projections cover over architectural infrastructures permeated by computational devices. In contrast to their unremarkable exteriors, buildings have remarkable functionalities that, invisible to casual inspection, bestow smart capabilities that make them something like intelligent entities in their own right. “Cryptic machines are everywhere nowadays,” Gu thinks. “They lurked in walls, nestled in trees, even littered the lawns. They worked silently, almost invisibly, twenty-four hours a day. He began to wonder where it all ended” (75). Such is the retrofitted Geisel Library at the University of California at San Diego campus, whose infrastructure includes stabilizers enabling the building to absorb earthquake tremors by counter-movements that ensure continuing stability. A climax arrives when the digital stabilizers are hijacked by a mysterious hacker (who may be, the narrative hints, an emergent virtual entity produced spontaneously by the network’s complexity). In answer to a challenge from a rival faction, the hacker literally makes the building walk by converting the
stabilizers’ counter-measures into coherent directionality. The scene underscores the complexity of agency when it is distributed among embodied individuals, non-human agents, and actual buildings and media.

The novel dramatizes effects documented in a host of non-fictional studies, including rapid technological change and the concomitant obsolescence (Sterling, 2005; Harvey, 1992); global microsociality emerging from a combination of instantaneous transnational communication and the exigencies of local times and places (Knorr-Cetina and Bruegger, 2002); crowd sourcing (Howe, 2006), here envisioned as “affliances,” short-term contracts establishing relationships between citizens and corporations for temporary cooperation on a project; government power at once centralized and exercised through distributed networks (Galloway and Thacker, 2007); and conspiracies that thrive on asymmetric warfare (Der Derian, 2001). Subjectivity is not about interiority expressed through verbal constructions (metaphorized in the poet protagonist, who finds he has lost his gift to make words sing) but about manipulating information so that it forms a pervasive real-time interface with everyday life. Human intelligence has been so thoroughly integrated with intelligence augmentation technologies that “media,” properly conceived, are no longer external affordances but integrated systems rippling across multiple artifactual and biological interfaces (Thacker, 2004).

This near-future scenario lies on a trajectory that stretches back at least as far as the early years of the twentieth century. Writing on the influence of media, particularly film and photography, on Le Corbusier’s architecture, Beatriz Colomina notes that “to inhabit” means “to inhabit the camera. But the camera is not a traditional place, it is a system of classification, a kind of filing cabinet. ‘To inhabit’ means to employ that
system” (Colomina, 1996, 323). Similarly, “to inhabit” the structures in *Rainbows End* means to occupy the systems of classification and protocols that enable information to flow smoothly along the networks. Working from the extensive materials in Le Corbusier’s archives, Colomina shows that “the traditional humanist figure, the inhabitant of the house, is made incidental to the camera eye; it comes and goes, it is merely a visitor” (329). Architectural elements, particularly windows, are consistently superimposed with contemporary media: “Telephone, cable, radios . . . machines for abolishing time and space. Control is now in these media” (332). Colomina argues that “the window in the age of mass communication provides us with one more flat image. The window is a screen” (334). Further along the trajectory, the screen in *Rainbows End* leaps out of the frame and projects directly onto ambient surfaces, dynamically engaging with and indeed co-creating environments. The novel performs a world consonant with Anthony Vidler’s observation that “contemporary subject identity, if it is optical at all, finds its subject in screens, in clouded surfaces, in the indeterminacy of non-perspectival structure” (2006, 135).

What, then, of contemporary subjectivity? Writing about the earlier twentieth century, Colomina concludes that “a dematerialization” follows from “the emerging media. The organizing geometry of architecture skips from the perspectival cone of vision, from the humanist eye, to the camera angle. It is precisely in this slippage that modern architecture becomes modern by engaging with the media” (334). Architecture in the present and near future, however, does more than displace the “traditional humanist figure.” Rather, it incorporates the individual (or as Deleuze says, the ‘dividual’) as a node in a global network of interconnectivity that promiscuously mingles human with
non-human agency, local embodiments with global communication flows, virtual overlays with actual buildings and media.

**HOW TO FASHION A PRO-HUMAN POSTHUMANISM**

*If there is to be a new urbanism it will not be based on the twin fantasies of order and omnipotence, it will be the staging of uncertainty, it will no longer be concerned with the arrangement of more or less permanent objects but with the irrigation of territories with potential; it will no longer aim for stable configurations but for the creation of enabling fields that accommodate processes that refuse to be crystallized into definitive form . . . it will no longer be obsessed with the city but with the manipulation of infrastructure for endless intensifications and diversifications, shortcuts and redistributions—the reinvention of psychological space (Koolhaas, 1995, 969).*

As we confront the issue of contemporary subjectivity, it is worth remembering that humans have been co-evolving with technology almost from the beginning of the species. This complex co-evolutionary spiral has aptly been called technogenesis (Hansen, 2006a; Stiegler, 1998), producing and produced by the complex feedback loops whereby the production of new tools creates new visions of human being, which leads to new environments, which puts selective pressure on some features and enhances others, which leads to different practices and related ontogenic changes, which in turn stimulates the creation of yet more tools. As Deleuze has remarked (1995, 178) the pertinent question ought not to be whether the present era is better or worse than what came before (a question impossible to answer comprehensively). Rather, we might better ask what opportunities for constructive interventions are presented to us by our information-intensive environments. One way into the question is to take seriously objections raised to our posthuman condition and consider carefully how undesirable effects can be mitigated and salutary effects enhanced.
The traditional humanist subject was seen as having a body, but (at least in the philosophical tradition) that body was reductively viewed as a support system for the all-important rational mind, as has been shown, among others, by Elizabeth Grosz in *Volatile Bodies* (1994) and George Lakoff and Mark Johnson in *Philosophy in the Flesh* (1999). With the advent of cyberspace, enthusiasts made extravagant claims for leaving the body behind, and transhumanists such as Ray Kurzweil (2006) confidently looked forward to the near future when the body could either be extensively re-engineered for radical life extension or, in Hans Moravec’s visions (1990; 2000), dispensed with altogether by uploading consciousness into a computer. In light of such fantasies, we can sympathize with Francis Fukuyama’s warning (2006) that there is a human nature and we mess with it at our peril, or Arie Graafland’s important comment that we have “finally lost all ground” (2006, 156). “What gets lost here,” Graafland continues, “is corporeality in a threefold way: three bodies are lost at the same time, the territorial body of the planet and ecology, and social body or socius, and our human body” (156). Graafland is correct but only in theory—that is, in reference to theories that erase the enduring biological inheritance we call the body and all the richly sedimented behaviors, inclinations, and proclivities it encodes, chief among them the desire to socialize with other humans, the origin of socius.

Graafland and others who want to resist contemporary erasures of the body may ironically participate in the very movements they would contest, for they accept as given problematic claims from which they extrapolate a dire state of affairs. For example, in arriving at the above conclusion, Graafland cites Chirstine Boyer to the effect that “in the Cartesian world of computers there is no longer any reference to the body” (Boyer, 1996,
This statement is both true and false—true if one focuses only on logic gates, idealized bit patterns, and so forth, but false if one considers the full range of affordances in networked and programmable machines, which include multiple body interfaces from the GUI to the mouse and extensive software packages designed specifically with human perceptual systems in mind, for example PET scans and functional magnetic resonance images. Moreover, computers themselves have bodies in the sense of being instantiated entities. As we saw earlier with forensic materiality, these bodies bear the marks of specific histories that place them within social, economic, and political contestations. As Kirschenbaum remarks, “[computers] are material machines dedicated to propagating a behavioral illusion, or call it a working model, of immateriality” (2005, 5) We should not, however, be seduced into taking this illusion for reality. Materiality introduces difference, and difference opens the way for the contingent, the unexpected, the aleatory.

This is the crucial missing point in Boyer’s later argument in “The Body in the City: A Discourse on Cyberscience” (2006), which gives a solid account of first and second order cybernetics but in its conclusion accepts ideal abstractions as reality. Discussing artificial life and emergence, she argues that “this model ushers in by the back door via its bio-social episteme a totalizing desire for omnipotence as a post-humanist fabricator of artificial life or generic cites. Followed to the extreme, signs in this second cybernetics engender the capacity of complex systems to alter, modify, and develop their own programs controlling life and death decisions. This is what ‘second-order’ emergence is all about” (Boyer, 2006, 47). Such a conclusion erases an important aspect of emergence: once evolutionary processes are given a chance to work, they may well produce something no one expected, including those who engineered the evolutionary
programs. As materio-semiotic actors, artificial life programs can and do exploit small differences in materialities to enact path-dependent trajectories entirely different from those their creators imagined.

What one makes of these unexpected events is an open-ended question that cannot be answered by referring solely to the technology; the emergent result is radically under-determined with respect to the technology and therefore susceptible to a wide range of interpretations and interventions. John Cage, for example, sought in “chance operations” (his version of emergence) a release from the limits of the ego and an opening out of human consciousness to the inconceivable diversity that lies all around us, if only we have the mindsets and orientations to perceive it. Gregory Bateson (whom Boyer does not mention) saw in second order cybernetics possibilities for new alignments between human consciousness and the recursive processes that connect us with our environment (Bateson, 1980). Our point is not that claims by second-order cyberneticians or researchers in artificial life should be taken at face value, or that we should credit the much more problematic fantasies of the transhumanists. Rather, we want to underscore the importance of interventions that emphasize the positive ways in which current technological trends can open opportunities for progressive actions and empowering practices.

Although limitations of space prevent us from discussing such opportunities in detail, we will point to four areas that seem to us especially promising. The first group is characterized by *theoretical emphases on embodiment and its potentialities*. Richly diverse, these approaches seek to use our present lack of ground as an opportunity to re-envision the relationship between embodied perception, digital media, and artistic and
architectural practices. If the body is one important component of our ground, as Graafland argues, perhaps “losing our ground” is not such a bad thing if it means sluffing off outmoded conceptions of the body that are the residue from a liberal tradition saturated with universalist assumptions about the superiority of the white race, the male gender, and the rational mind. Once we have moved on from this ground, new conceptions of embodiment can coalesce around a number of important sites. Research in brain functioning and imaging technologies, for example, is interpreted in light of art traditions in Barbara Stafford’s *Echo Objects* (2007). Gerald Edelman’s work (1989), which draws in part on imaging technologies, has stimulated a number of responses from the humanities and arts communities, including those by Joseph Tabbi’s *Cognitive Fictions* (2002) and Warren Neidich’s “Resistance is Futile: The Neurobiopolitics of Consciousness.” (2006). Mark B. N. Hansen in *New Philosophy for New Media* (2006) sees in the lack of ground instantiated in digital media positive opportunities for digital artists to foreground embodied responses as the stabilizing component necessary to make sense of artistic digital productions. Bernadette Wegenstein in *Getting Under the Skin* (2006) goes further by conceptualizing the body itself as a form of media, a move also made by Eugene Thacker in *Biomedia* (2004). After recapitulating much of the recent research on the body, Wegenstein remarks, “We still do not know what the body really is” (2006, 16). Working from a similar idea of enlightened ignorance, Arakawa and Madeleine Gins (1979, 2002) treat it as an empowering premise, for it enables them to start with the primacy of embodiment (not from the body, which is always already a social, cultural, and technological construction) and devise architectural structures
designed to short-circuit customary perceptions and open onto new sensory experiences and embodied orientations.

A second kind of positive intervention takes the form of recognizing the irreducible social and cultural complexities of contexts in which perceptions of embodiment (and the body) are embedded. The celebratory rhetoric surrounding the advent of cyberspace and globalization is contextualized by David Harvey’s *A Brief History of Neoliberalism* (2007) as part of a transnational movement by the upper classes to recuperate the economic ground lost in the inflationary periods of the 1970’s. Harvey convincingly shows that neoliberalism, although taking different forms in the United States, Chile, England and China, nevertheless represents class warfare by other means. His richly textured analyses provide salutary examples of how underlying patterns can be discerned without treating reductively the social and cultural complexities in which they are embedded. On the negative side, we might think of transhumanist rhetoric as it appears in such prominent spokespeople for the movement as Max Moore. Focused on the transcendent possibilities for individuals, transhumanist rhetoric almost entirely ignores the complex issues that would arise from even modest life extension, including generational conflict, scarcity of resources, and the just allocation of resources when the world population explodes uncontrollably.

A third kind of positive intervention comes in recognizing new modes of organization that digital media require and developing theoretical approaches that take their specificities into account. In *Protocol*, Galloway (2005) makes an important contribution in developing what he calls a protocological approach, focusing on the regimens that allow information to flow through the networks or, conversely, that prevent
the release of high-value informational assets to unauthorized users. In *The Exploit*, Galloway and co-author Thacker (2007) work from the theoretical models of Delueze and the sweeping historical panorama of Hardt and Negri’s *Empire* to theorize the network as a ground for political action, showing for example that the networks can be integrated into centralized bureaucracy as well as into asymmetric warfare. Other important contributions have been made by Friedrich A. Kittler. Wittily observing that “the entertainment industry is, in any conceivable sense of the word, an abuse of army equipment” (1999, 96-97), Kittler traces the technological lineages that resulted in the contemporary configuration of the military-industrial-entertainment complex. Although his methodology is anti-humanistic, in that it refuses the primacy of the human as an adequate explanation for technological development, his approach nevertheless recognizes the importance of social and cultural presuppositions as they are entwined with technological issues of data storage, transmission, and manipulation.

Last but hardly least are theoretical approaches, artistic creations, and architectural practices that *emphasize the importance of recursive feedback loops between embodied practices, social constructions, and the specificities of digital media*. The videographer Paul Ryan, for example, has focused on the tendency of complex systems, particularly turbulent flow, to produce chaotic patterns that endure over time without ever repeating themselves exactly (Ryan, 2006). Collaborating with Ryan, Stephanie Strickland and Cynthia Lawson Jaramillo created *slippingglimpse*, a digital art work of considerable beauty and theoretical sophistication (Strickland, Jaramillo and Ryan, 2007). Our own contribution in this area develops the concept of intermediation as a framework
within which digital literature, art, and architecture may be understood (Hayles, 2005; 2008 and Gannon and Hayles, 2007).

Returning again to Graafland’s comment on the loss of ground, we note that complex systems in general lack a ground in the sense that they defy formalization through explicit equations, precisely because every factor interacts with, influences, and is influenced by every other factor. Complex systems do not, however, lack order; rather they instantiate a particularly complex kind of order capable of demonstrating emergent properties. Seeking a ground has historically been represented through such monumental enterprises as the Russell and Whitehead’s *Principia Mathematica*, which sought to axiomatize mathematics (Russell and Whitehead, 1911). This grand enterprise was driven by the hope that mathematics could be made logically consistent and formally complete; it would then, so the reasoning went, provide a solid ground upon which all the other sciences (and perhaps the social sciences and even the arts) would build. When the enterprise was proven impossible by Gõdel’s Theorem and related developments such as the Church-Turing proof, the lack of ground became the catalyst for important artistic explorations typified by M. C. Escher and, later in the twentieth century, the reading and writing protocols associated with deconstruction.

The lack of ground need not mean the end of agency, the loss of order, or the utter transformation of the human into some post-biological version that would be more machine than biological entity. Rather, viewed as an opportunity for constructive interventions, the recognition that complex systems are how the natural world mostly operates opens onto a number of important realizations: that agency is always distributed; that cognition is a much broader function than consciousness and includes many
embodied capacities outside the central nervous systems; that action always takes place within embedded and recursive systems that can unpredictably amplify the consequences of our actions; and that ethical considerations should therefore always be a component of our considerations. Architecture, deeply entwined with digital media and necessarily attentive to social and cultural constructions, constitutes an ideal site from which to explore and intervene in the recursive feedback loops co-constitutive of materiality, contemporary subjectivity, and digital media.
IMAGES

Figure 1:
Figure 2 (sections a, b, c, and d):
Figure 3:
Diller and Scofidio, *The Rotary Notary and His Hot Plate (Delay in Glass)*. Production design. Courtesy of Diller Scofidio and Renfro.
Figure 4:
Figure 5: Diller and Scofidio, *Braincoat*, 2000. Rendering. Courtesy of Diller Scofidio and Renfro.
Endnotes


2 As Evans’ text is discussed at length elsewhere in this volume, we will limit our discussion to a few salient points. For a fuller treatment, see Christopher Hight, “Manners of Working: Architectural Tactics of Subterfuge and Evasion in Digital Based Design.”

3 For a discussion of visual correction in ancient Greek architecture, see Coulton, (1977).

4 De l’Orme (1567, 112), quoted by Evans (1986, 191).

5 It is interesting to note that Evans produced his analysis of the Royal Chapel without having visited the building, and relied only on mediated representations to develop his argument. Further, his subsequent visit to the chapel compelled him to add a postscript in which he slightly altered his findings, based as much on his visit as on additional photographs he took while there. See Evans, (1986, 188).

6 This observation was often pointed out in graduate seminars led by Robert Somol at both Ohio State and UCLA, but we know of no published essay in which these thoughts are recorded.

7 The literature on this pervasive phenomenon is vast. For a sampling of the more influential works on the subject, see Riley (1995), Kipnis (2002), Somol and Whiting (2002), Speaks (2002), Lavin (2004), and Baird (2004). Our own contribution focuses on the role digital design technologies play in these shifts in focus (Gannon and Hayles, 2007). Elsewhere in this volume, Stefan Al and Shiloh Krupar outline what they see as a
shift from object to atmosphere in the development of corporate “brandscapes.” See their “Notes on the Society of the Spectacle.

8 Venturi’s position regarding the role of symbolic form was famously advanced in Learning from Las Vegas (Venturi, Scott Brown, and Izenour, 1977) and has been developed to incorporate electronic display technologies in Venturi (1996).

9 For a discussion of the importation of these illusionistic techniques into historical architecture, see Oechslin, (1984). We are indebted to Sylvia Lavin for fruitful discussions on the theater, architecture, and Diller and Scofidio as well as for directing our attention to Oechslin’s essay.

10 The project, and Liz Diller’s 1987 discussion of it at the Architectural Association in London, is reproduced in Diller and Scofidio (1994, 103-134).

11 For a documentation of these projects and an illuminating essay, see Goldberg (2003).


13 The project was exhibited at the 7th Venice Biennale of Architecture in 2000 and can be accessed at www.embryologicalhouse.com.

14 See www.d-toren.nl.

15 In many ways, Vinge’s fiction follows Venturi’s lead toward generic buildings adorned with electronic iconography. But as we will see below, his projection of Venturi’s ideas into a dystopian near future gives rise to consequences well beyond the intentions of Venturi’s graphic urbanism.