The Question of Thresholds: Immersion, Absorption, and Dissolution in the Environments of Audio-Vision

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Introduction

The space dampens the din of the outside. The gain on our sensory input is reduced a notch until the world outside thins out. We remain in this state for what seems like four or five minutes as clock time takes on less significance. Finally, one of us is led from the waiting space alongside a curved, darkened wall into blackness. The solid floor gives way to a feeling of weightless suspension. The person is seated in a chair, the door closes, and the muffled silence increases in intensity. The space is of indeterminable dimension and volume. As spatial orientation dissolves in the darkness, silence envelops the room. Clicking the teeth or swallowing creates hushed sounds that return immediately back to the listener, with no hope of reverberation. Time stops in this room poised between the noise of the outside and the acoustic blackout within. A sudden flash disrupts the void. The space becomes visible for a fraction of a second, only to recede again. A deep, rumbling tone, devoid of rhythm or tonality, sounds in the far distance. A new sensation of weightlessness sets in, as if one was rising from the floor while still seated. The experience of motion is not an illusion: the chair itself rises up from the darkness, almost as if to enter another room, and mechanically begins to tilt backward. As the person stares upwards, the space feels open and endless. Gradually, the blackness gives way to a dark purple field. Lying down, we stare into infinite space that has neither beginning nor end. The low frequencies sounding in the room below transform into the muted sonance of hissing air, barely perceivable to the ears. The room slowly segues from the colored darkness of twilight to the ambient fog of morning—a swirling on the precipice of disappearance. Blinking our eyes, we see a field that is present one moment and absent the next. The airlike tone fuses with the fog, disrupting frontal vision. Almost minute flickers inhabiting a different color spectrum fire off at the borders of sight as the edges of peripheral vision coax shape, color, form, and substance to blur into indistinguishable phenomena. Vision becomes sound, one dissolving into the other.

The above description depicts an experiment that did not take place. It is rather my imagining of an unrealized proposal by visual artists James Turrell and Robert Irwin for Maurice Tuchman's ambitious Art and Technology Program (Experiments in Art and Technology) at the Los Angeles County Museum of Art in 1968.[1] Both artists initially set out to explore the transformation of consciousness that could occur through the extreme reduction of sensory input in an external environment, yet all of what remains from almost two years of research is a singular report published in mid-1971.[2] In the context of this rather curious and almost forgotten investigation, Turrell and Irwin were interested in enhancing the potential cross talk occurring in the brain when it processes image and sound. In the course of their brief experimentation, however, they opened up new directions whose aesthetic and scientific implications are still relevant to our current sociotechnical and cultural moment.

1 Maurice Tuchman, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971* (Los Angeles County Museum of Art, 1971).

2 See Craig Adcock, *James Turrell: The Art of Light and Space* (Berkeley: University of California Press, 1990), 74–75, for a description of why the project was halted in mid-development during 1969.

The first direction explores the age-old artistic merging of sound and image and this practice's impact on human perception. In what composer and critic Michel Chion calls "synchresis"—the "forging between something one sees and something one hears . . . mental fusion between a sound and a visual when these occur at exactly the same time"—sound and image are joined.[3] As neuroscience is increasingly investigating, this cross-modal integration suggests that overlaps between the different senses at the neural level are more complex than originally thought. Serious research has been focused on such cross- and multi-sensory integration only since the past few decades because, historically, vision and hearing were approached as processed by separate sensory channels and nerve systems. The German physiologist Johannes Peter Müller's long-accepted 1826 doctrine of "specific nerve energies" held that "sensation is not the conveyance to consciousness of a quality or a state of an external object, but rather the conveyance to consciousness of a quality or state of our nerves, brought about by an external cause."[4] According to Müller, sight and hearing differ from one another in that sense organs such as the retina or the hair cells on the cochlear basilar membrane are connected to different nerve centers in the brain which elicit different qualities. In other words, the act of perception is reducible to neural firings in the brain.

Neuroscience, psychology, psychophysics, and philosophy are not the only disciplines to divide up sensory processes. As cultural critic Jonathan Sterne's *The Audible Past: The Cultural Origins of Sound Reproduction* shows, cultural practices driven by scientific models also have reinforced a hierarchy of the senses. Sterne describes a long list of what he calls the "litany" of binary oppositions between vision and audition: hearing is dynamic while seeing is static; vision projects while audition surrounds; the eye can close but the ear remains infernally open to the noise of the world. These attempts at splitting up seeing and hearing carry epistemological weight, as they determine the political ranking of perceptions—that is, what is studied as legitimate objects of knowledge and what is ignored. Why, Sterne asks, was visual representation harnessed to prove the existence of sounding phenomena during the development of the discipline of acoustics? It is famously known, for example, that Ernst Chladni, one of modern acoustics' earliest eighteenth-century pioneers, *visually* justified the phenomenal existence of aural vibrations by creating a representation, a tracing pattern, or so-called Chladni figures generated by the movement of sand across the surface of a quivering brass plate.[5]

As Sterne demonstrates, the transformation of hearing into an object of study through techno-scientific practices and instruments of visual representation is well documented. Conversely, Chion's principle of synchresis suggests that the sensory medium of sound adds something of value that is always lacking in the regime of images. "Sound . . . interprets the meaning of the image and makes us see in the image what we would not otherwise see, or would see differently."[6] This understanding of sound as constructing and altering our perception of image through its complex temporalities has become a common

3 Michel Chion, *Audio-Vision: Sound on Screen*, ed. and trans. Claudia Gorbman (New York: Columbia University Press, 1994), 5.

4 Johannes Müller, cited in Andrei Gorea, "Thoughts on the Specific Nerve Energy," in *Representations of Vision: Trends and Tacit Assumptions in Vision Research*, ed. Andrei Gorea (Cambridge, UK: Cambridge University Press, 1991), 219–229, here 219, (see also http://andrei.gorea.free.fr/PUBLICATIONS/Gorea_Thoughts%20on%20SNE_91.pdf for the full text); quotation translated by Bela Julesz; originally published in German in Johannes Müller, *Handbuch der Physiologie des Menschen*, 4th ed., 2 vols. (Koblenz: J. Hölscher, 1844).

5 Jonathan Sterne, *The Audible Past: The Cultural Origins of Sound Reproduction* (Durham: Duke University Press, 2003), 43–44.

6 Chion, *Audio-Vision*, 34.

motif in the quest to write the artistic histories of audio-vision. From the shattering moments when sound met image in motion pictures at the end of the nineteenth century and the sensory hallucinations of 1960s light shows and visual music to our current fusion of audio and image inscribed in the command line, many detailed accounts of audiovisual interaction have concentrated on media conditions, spatial architectures, software representations, and mechanisms of composition, sequencing, and synthesis, as well as their technosocial effects. Due to the very possibility of synthesizing sight and sound through code, one might thus be led to believe that the final domain for audiovisual perception lies outside the bodily subject and within the machine—a transformation of *its* perception through new forms of sensory integration produced by a pervasive binary technicity.[7] After all, as Friedrich Kittler gleefully informs us, all sensations are equal for the machine, rendered into numbers with the separation between sense medias eradicated at the level of bits.

Clearly, the cross-modal stimulation and sensory blending that neuroscience now evidences as actual cortical phenomena have previously manifested themselves in the construction of experiences using image and sound across artistic practices. Indeed, much of the early twentieth-century work of composers involving the coloration of sound and the spheres, such as Alexander Scriabin's *Le Poème de l'extase* (Poem of Ecstasy, 1905–1908) and the unrealized seven-day *Mysterium*, Wassily Kandinsky's *Der Gelbe Klang* (The Yellow Sound, 1912), and Olivier Messiaen's color-music-space fusions in *Quatuor pour la fin du temps* (Quartet for the End of Time, 1941) or his later, mammoth *Saint François d'Assise* (1983), to name only a few examples, were partly inspired by exotic longings for indigenous cultures who did not make separations between the senses. Together with more technologically advanced cinematic paeans to audiovisuality such as Stanley Kubrick's hallucinatory trip beyond the infinite in the Star Gate sequence of *2001: A Space Odyssey* (1968), Chris Marker's estranged, electronically generated Tokyo of fleeting icons and sonic ciphers in *Sans Soleil* (1983), and Andrei Tarkovsky's spectral sounds and desolate landscapes of absence in *Stalker* (1979) and *The Sacrifice* (1986), these proto-synesthetic artworks call up both transcendent and immanent planes of aesthetic experience: impressions and apperceptions that invoke the intensity of the present moment combined with the ineffable.

Yet, if Turrell and Irwin's experiment sought a sensory feedback between environment and perceiver, then we can locate a second, more profound implication evoked by this suspended attempt. Unlike the common stereotype which holds that the collaboration between image and sound leads to a saturation, an overwhelming of the senses, Turrell and Irwin's *Gedankenexperiment* takes the approach of a sheer denudation; an acute reduction of the sensory context that seeks to bring about a new perception enabled from a featureless field. In setting up a physical environment with extremely low intensity levels of sound and light in which spectators were required to "pay attention to the images and sounds of their own perception," Turrell and Irwin immediately call into question the locus and action of experience itself—where, when, and how it takes place. Perception has to create its own conditions for experience to happen. "The experiencing act itself . . . is the 'thing' or 'object.'"[8] In other words, the aesthetic event is not an object or space. Turrell and Irwin's proposed combination of an anechoic chamber, a room that absorbs all reflection such that no sound ever bounces away from its point of origin, with the powerful effect of a visual

7 I use the word technicity in the sense that the French philosopher of technology Gilbert Simondon uses it to describe a "mode of technical being." See Gilbert Simondon, *Du Mode d'existence des objets techniques* (Paris: Aubier, 1958).

8 Tuchman, *Report on the Art and Technology Program*, 132.

ganzfeld, a horizon without depth or size, only constructs the material conditions for experience. It is, however, the *performance*, the *act* of perception grappling with the process of seeing and hearing in a space on the verge of slipping away that constitutes the work.

The rupture of consciousness in the artists' chamber of audiovisual edges goes much further, however, than the self-reflective performance of *seeing oneself see*. Similar to Turrell's later, purely visual light works which involve what Georges Didi-Huberman calls "submitting the disquieted vision to a field of perception void of objects and planes," the position of the visitor's own self in such environments is also questioned.[9] As Didi-Huberman so eloquently articulates it: "How could I observe myself losing the sense of spatial limits?"[10] In effect, Turrell and Irwin appear to be seeking some kind of dissolution where there is no turning back to comfortable ground.

There is something dynamic and transformative underlying the desire to generate a state of profound experience through the materiality of the barely seen and heard. Sound and light as matter on the threshold of becoming is the stuff that Turrell and Irwin sought to elicit transformation, in both body and consciousness. Yet where does this emergence of new perceptions take place? If, as Maurice Merleau-Ponty famously stated in the *Phenomenology of Perception*, the "theory of the body is already a theory of perception," then it goes to stand that audiovisual perception is located not just in the brain, in the purely cognitive realm of nerve endings, cortical regions, and neurotransmitters, but also in the body and its embedment in its surroundings.[11] But what constitutes this sensing body that Merleau-Ponty argues is so fundamental to the act of perception? Is it already given to experience in the world as an essence, or does it dynamically emerge through sensory experiences that bring about new perceptions?

Neuroscience has an answer. Advancing earlier physiologically based theories of sensation, many researchers now describe the formation of new perceptions at the distinct neurobiological level by means of the theory of so-called neural correlates of consciousness (NCCs). First discussed by DNA co-discoverer Francis Crick and neuroscientist Christof Koch, NCCs suggest a kind of mapping between the subjective or phenomenological experience of sensations and the *representation* of such sensations by way of distinct neural operations in specific cortical areas of the brain. With NCCs, Crick and Koch aim to turn the slippery slope of consciousness from the vagaries of philosophical thought into "largely a scientific problem."[12] Perception lies latent in neural structures waiting, so to speak, to be activated by the external world.

But this purely brain-centric view is increasingly under fire. Many scientists may still dwell on the neural basis of consciousness, but as early as forty years ago, in ecological theories principally described by the perceptual psychologist James J. Gibson, it was argued that perception does not take place through a given routing between external triggers and internal neuronal representations giving life to such external stimuli. More recent theories of "sensorimotor" action, however, go much further than Gibson's earlier conception of an exterior environment that provides sensory clues or "affordances" that the brain

9 Georges Didi-Huberman, "The Fable of the Place," in *James Turrell: The Other Horizon*, ed. Peter Noever (Ostfildern: Hatje Cantz, 2001), 45–56, here 54.

10 Ibid.

11 Maurice Merleau-Ponty, *The Phenomenology of Perception*, trans. Colin Smith (London: Routledge & K. Paul, 1958), 235.

12 Alva Noë and Evan Thompson, "Are There Neural Correlates of Consciousness?" *Journal of Consciousness Studies* 11, no. 1 (2004), 3–28, here 3.

picks up in order to inaugurate the processes of sense perception. Perception is increasingly seen as *co-structuration*—a simultaneous coupling of body, brain, and the lived spaces in which the body finds itself.

Given this dynamic, sensorimotor conception of the body and the self, the intertwining between body and environment, this essay asks what the repercussions are for artistic practice within the environments of audio-vision. Rather than analyze the fusion of sound and image outside perception, I wish to explore aesthetic encounters coupled with neuroscientific concepts of perception that challenge the fixed notion of body or self. What roles do cross-modal aesthetic strategies play in invoking synchretic perceptions? What happens to the "sensing self" and its embodiment in audiovisual environments that overload or reduce our perception, and how does this self expand or dissolve through such encounters?

Cross-Modalities: Plasticity, Leakage, and Merging

Audiovisual spaces like the one Turrell and Irwin researched aim to encourage a mingling of sensory impressions. Such cross-modal phenomena seem to be a given in the shaping of a total perceptual space of sound and vision. However, if theories of multisensory integration help debunk Müller's or, later, Hermann von Helmholtz's sensory separation by claiming that there are no separate, measurable intensities for sensory nerve energies, then why does vision still look like it does to one area of the brain while hearing resides in another location? As philosophers Susan Hurley and Alva Noë ask: "Why should differences in the peripheral sources of input, leading to differences in the cortical locations of the neural activity, make for the difference between what it is like to see and what it is like to hear?"[13]

Moreover, the fusion of image and sound so easily enabled by software has no simple one-to-one correspondence at the cortical level, particularly where and when such connections occur, due to the latency between the processing of audio and visual stimuli. For example, neural processing times range from a few milliseconds for auditory phenomena to upwards of half a minute for visual and other kinds of sensations. "Yet, sensory modalities have evolved to work in concert; and although the combination of two dissimilar physical cues, say light and sound, may have little direct effect on each other in the external world, they can profoundly alter each other's influence on the brain," write Barry Stein, Mark Wallace, and Terrence Stanford.[14]

While there exist different resolutions for the senses, more recent findings have examined the cross-modulation of vision and hearing in equally spatial and temporal manifestations. In physiological terms, vision has traditionally been seen to have a higher spatial resolution than hearing, whereas the ear has a higher temporal resolution than the eye; the two get mixed, however, in the process of perceiving complex sensory phenomena. For example, from perceptual psychology research it is well known that sound can influence the temporal behavior (the duration or rate) of vision. Tests involving the switching on and off of light sources with slight time delays and accompanied by different sequences of sound demonstrate that the subject's accuracy in identifying the

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13 Susan Hurley and Alva Noë, "Neural Plasticity and Consciousness," *Biology and Philosophy* 18, no. 1 (2003), 131–168, here 132.

14 Barry Stein, Mark T. Wallace, and Terrence R. Stanford, "Merging Sensory Signals in the Brain: The Development of Multisensory Integration in Superior Collicus," in *The New Cognitive Neurosciences*, 2nd ed., ed. Michael S. Gazzaniga (Cambridge, Mass.: MIT Press, 2000), 55–71, here 55.

order of the lights (i.e., the temporal resolution of vision) is either improved when an auditory signal comes slightly before and slightly after the visual cues or degraded when the signals are inserted between the visual cues.[15] Other tests involving the binaural motion of sounds together with almost static visual patterns indicate that the eye's spatial involvement in tasks is also swayed by audition: the eye pans left to right, following the horizontal direction that the ears perceive, even though the visual phenomena before the eye lies almost frozen in space.

Varying the level of intensity of auditory stimuli also has cross-modal effects on vision. Work in the early 2000s by Ladan Shams, a UCLA-based psychologist, and Shinsuke Shimojo, a Caltech neurobiologist, revealed stranger cases of *nontemporal*, cross-modal integration of sound modulating vision. Shams and Shimojo argue that cross-modal sensations defy the hypothesis of "modality appropriateness," which states that the "direction of cross-modal interactions has been thought to be determined by the modalities involved in the task."[16] The modality appropriateness hypothesis claims that when confronted with an intersensory discrepancy, a conflict between different sense modalities, one sense may "bias" another on the basis of the strength of its particular modality. In a multisensory situation, for example, attention to spatial stimuli would normally override attention to temporal phenomena, as vision is thought to have a higher spatial resolution than hearing. The eye, in this case, simply perceives space better than the ear.

The transient, discontinuous quality that invokes the experience of sudden change to the sensory neurons, however, appears to challenge the modality appropriateness conception. On the contrary, "the direction of cross-modal interaction depends, at least in part, on the structure [my emphasis] of the stimuli . . . the modality that carries a signal which is more discontinuous (and hence, more salient) becomes the influential or modulating modality."[17] This discontinuous salience of transient stimuli seems to be based specifically on visual or auditory stimuli's order of appearance in the brain. For example, in what Shams and Shimojo label the double or illusory flash effect, a single flash accompanied by more than one pulse of sound generates the illusion of multiple flashes in the visual perception arena of the visual cortex. In tests, subjects described one or more "illusory" flashes after the onset of an actual flash and the accompanying tones, suggesting that the two percepts appear to be the same to the visual cortex. The double-flash effect contradicts the idea that the spatial modality of vision takes precedence over the temporal modality of hearing. Instead, the discontinuous structure of the stimuli (the multiple sounds combined with the flash) serves to modulate visual perception.

While subjects verbally reported the illusory flash, Shams and Shimojo also utilized EEGs to measure the subjects' event-related potentials (ERPs): the differences in electrical potential from brain response to a particular stimulus over a distinct time-correlated period. Recorded at the scalp and measuring sizable populations of neurons, the ERPs for comprehending the flash and accompanying beep effects can only be derived by the stacking of time: averaging hundreds of trials together in order to extract signals that give us a hint of the electrical behavior of the brain over a specified duration. Consequently, the ERPs'

15 Ladan Shams and Shinsuke Shimojo, "Sensory Modalities Are Not Separate Modalities: elasticity and Interactions," *Current Opinion in Neurobiology* 11 (2001), 505–509. For the full text go to http://neuro.caltech.edu/publications/nbb408.pdf.

16 Ibid., 505. For more detail on the modality appropriateness hypothesis, see Robert B. Welch and David H. Warren, "Immediate Perceptual Response to Intersensory Discrepancy," *Psychological Bulletin* 88, no. 3 (1980), 638–667.

17 Shams and Shimojo, "Sensory Modalities," 508.

sophisticated signal extraction techniques reveal traces of electrical activity in the visual cortex even *after* the initial sensory phenomenon dissipates—ghosts of activity that haunt the multiple cortical areas of the brain dealing with vision. Here, sound transforms the perception of vision, and the concept that "'(m)odality specific' cortices function in isolation from other modalities" no longer holds.[18]

In these phantom flashes and binaural illusions, determining what is visual and what is sonic to the brain skirts the threshold of barely distinguishable margins. In what psychoacousticians and psychophysicists term the "just noticeable difference" (JND), temporal thresholds in perception are what may determine in part whether we call something auditory or visual. The JND represents the minutest intensity needed between the onset of two different sensory stimuli in order to differentiate between the two signals and not perceptually fuse them. It is thus the intensity limen between stimuli of different modalities that most likely gives us an understanding of what we experience as sound and what we experience as image.

This continual "intermodal gap" between different sensory modalities forces us to return to the question of why certain types of neural activity give us the experience of one sense over another.[19] Indeed, theories of neural plasticity also indicate that the brain itself has the ability to mix up such rigid distinctions between modalities by reorganizing its structure on the basis of interference loops with the environment. Brought on by the brain's adaptation through learning, maturation, deprivation, and/or physiological breakdown, the senses, in effect, rewire themselves. In the well-known Oliver Sacks story "The Case of the Colorblind Painter," for example, an artist used to working with bright colors suddenly has a crippling accident which destroys part of the color processing region of the cerebral cortex, leaving him with acute cerebral achromatopsia, or the inability to perceive color. The world, in its sensory modalities from sight, sound, and even taste, turns dull shades of gray, and the painter gradually adapts to a monochromatic place in the universe.

Changes to the organization of the brain are catalyzed not only through physical trauma. In another striking challenge to the sensory separation doctrine, some researchers argue that neural cross-modal plasticity is prevalent already in early life. Armed with advanced imaging techniques such as functional Magnetic Resonance Imaging (fMRI) and Positron Emission Tomography (PET), neuroscience increasingly investigates animal and, less frequently, human subjects who at birth are deprived of one sense but over time display the phenomenon of cross-modal reorganization in which other cortical neuronal areas rise to take the missing sense's place (e.g., in blind adults, the haptic activity of Braille reading triggers stimuli in the primary visual cortex [V1]). Far more invasive experiments with animal audition/vision perception have involved surgically rerouting retinal nerve axons to the auditory thalamus and cortex such that the animal (in this particular case, ferrets) becomes used to "seeing" by way of the auditory processing center of the brain.[20] While we might expect that the ferret would "hear" through seeing due to the auditory cortex receiving stimuli from the visual sensory system, what occurs instead is that the type of input from the environment (in this case, visual) causes a different set of internal cognitive networks to form in the auditory cortex as a result of the rewiring. In essence, "visual inputs routed to the auditory thalamus induce visual function in

18 Ibid.

19 For more on the "intermodal gap," see Hurley and Noë, "Neural Plasticity and Consciousness."

20 See Mriganka Sur, "Rewiring Cortex: Cross-Modal Plasticity and Its Implications for Cortical Development and Function," in *Handbook of Multisensory Processes*, eds. Gemma Calvert, Charles Spence, and Barry E. Stein (Cambridge, Mass.: MIT Press, 2004), 681–694.

subsequent 'auditory' pathways and networks";[21] the auditory part of the brain begins to "see" due to reorganization of sensory networks that again compensate for the loss of one sensory modality.

Another set of phenomena framed by the issue of neural plasticity arises in the mysterious, not well understood arena of so-called *abnormal cross-modal perception* (better known as synesthesia), whereby vision is manifested as touch or sound invokes color—the result of separate sensory channels in the brain somehow simultaneously "mingling" or "leaking" between apparently distinct sensory modalities. Philosophers and neuroscientists argue that synesthesia demonstrates *intermodal dominance*: the concept that interference between different sensory regions of the brain causes a dominant sensation in yet another region when an input leads to a new sensation in a cortical region normally used to another kind of input. A synesthete who hears spoken words, for instance, spontaneously demonstrates activity in the color detection area of the visual cortex. As neuroscientist V. S. Ramachandran reports in the case of one patient, "there is a pre-existing, non-arbitrary translation between the visual appearance of an object in the fusiform gyrus [a part of the temporal lobe that normally processes color information] and the auditory representation in the auditory cortex."[22]

Although the conceptual idea if not the actual cortical phenomenon of synesthesia has long been the inspiration for artists seeking to blend sensory impressions, such as Alexander Scriabin, Vladimir Nabokov, Wassily Kandinsky, Olivier Messiaen, and György Ligeti, synesthesia is heavily debated among different disciplines as to its existence, cause, and research value. Researchers such as Ramachandran, Richard Cytowic, Semir Zeki, Simon Baron-Cohen, Lutz Jäncke, and Jamie Ward describe multiple causes for synesthetic experience, which are similar to the numerous causes given for neural plasticity: brain plasticity, faulty cross-activation or wiring between the different neurons of the sensory cortex, chemical disequilibrium, accidental damage and severing of established links in the brain, and genetic carryover and change. For some, like Ramachandran, the "breakdown of modularity" that synesthetic experiences reveal helps shed light on what a "normal" brain is and how this mingling deviates from a normal context.[23] For other researchers like neurologist Richard Cytowic, however, cross talk between vision and sound, for example, is a function of normal perception originally situated deep within the paleomammalian limbic system, the most ancient part of the brain—one that has increasingly been studied as the center of emotional life in human beings. According to Cytowic, synesthetes are "cognitive fossils" because, while the potential of synesthesia lies in all of us, true synesthetes are the only ones who have managed to maintain such cross-modal perceptions—"the memory of how early mammals saw, heard, smelled, tasted and touched."[24]

Flickerings

The experiments detailed above that aim to produce cross-modal stimulations and synesthetic phantasms utilize extremely stripped down visual and sonic

21 Sur, "Rewiring Cortex," 690.

22 V. S. Ramachandran, *The Emerging Mind: The BBC Reith Lectures* (London: Profile Books, 2003), 91.

23 See Simon Baron-Cohen, John Harrison, Laura H. Goldstein, and Maria Wyke, "Coloured Speech Perception: Is Synaesthesia What Happens When Modularity Breaks Down?" *Perception* 22, no. 4 (1993), 419–426.

24 Richard Cytowic cited in James Geary, *The Body Electric* (New Brunswick: Rutgers University Press, 2002), 96–97.

phenomena, brief pulses and flashes devoid of expression and intensity, to catalyze cross talk in the brain. It is perhaps not by chance that so many investigations of cross-modal auditory-vision continually return to the rhythmic structure of the pulse or the flash. Like the transient, discontinuous attack of perceptual phenomena that upsets the brain's sensory modality hierarchies, a sudden flash in the visual field jostles the eye into another way of looking, disturbing its routine and challenging the assumption that we continually "see" the whole visual field before us.[25]

For the perceiver, the intermittent blasts of light emitted from an experimental test flash or the infinitely more powerful strobe embody the phenomena of acute but extremely fleeting blindness—a moment in which eyes and cortex are overwhelmed. The strobe's earlier manifestations, such as the phenakistoscope of Joseph Plateau and the Stampfer Disc—named after the Austrian Simon von Stampfer, who also coined the term stroboscope (*strobos* in Greek signifies the "act of whirling")—were disklike devices with a sequence of images and cuts inscribed on a circle that, when spun, gave the appearance of motion. It was the celebrated MIT physicist Harold Edgerton, however, who perfected a capture apparatus in 1931 that froze time by stopping motion through the means of electronically controlled bursts of high lumen light. Originally investigating the manner in which a sequence of powerful discharges of light could be used to examine the angular displacement of a rotating, high-speed motor, Edgerton happened upon the ability of an electronically controlled charge of light (the equivalent of forty thousand flashbulbs) to replace the speed and function of a camera shutter, and thus photographically rendered the invisible speeds of movement, like the swing of a golf club or the ballistic penetration of a soap bubble, that lay beyond the thresholds of human vision.[26]

In the hands of audiovisual artists in the 1960s, the strobe and its flicker effects were reappropriated as an instrument for the production of alternative states of consciousness. In combination with psychedelics like mescaline, LSD, and psilocybin, the strobe was hailed by influential psychologists and neuroscientists as opening "new frontiers into the borderlands of neurology and psychology."[27] Moreover, through avant-garde proselytizers like Aldous Huxley, Timothy Leary, and Allen Ginsberg, such "applications" as Brion Gysin's fabled Dream Machine and pseudo parapsychology experiments connecting stroboscopes triggered by the movement and frequencies of patients' alpha waves, achieved widespread recognition through such apparatus' characteristic, mind-altering flicker, which suggested the potential of limitless border experiences and "unstable zones where the visual merges with the visionary."[28]

This flashing instrument of luminous blasts has not only been synchronized to the banal tracks of canned disco and techno music, as is the case of the device's eventual popular entrenchment in club culture. In more experimental theatrical mise-en-scènes, the accompaniment of dazzling, fragmented light with simultaneous bursts of audio leads, on the one hand, to an intensification of the spectator's experience of totalizing audio-visual-spatial fusion and, on the other, to a spatiotemporal scattering of the performers' presence. In stage

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25 See J. Kevin O'Regan and Alva Noë, "A Sensorimotor Account of Vision and Visual Consciousness," *Behavioral and Brain Sciences* 24 (2001) 939–1031, For the full text of this article, visit http://www.bbsonline.org/documents/a/00/00/04/17/bbs00000417-00/index.html.

26 Harold Edgerton and James R. Killian, Jr., *Moments of Vision: The Stroboscopic Revolution in Photography* (Cambridge, Mass.: MIT Press, 1979), 2–10.

27 John Geiger, *Chapel of Extreme Experience: A Short History of Stroboscopic Light and the Dream Machine* (New York: Soft Skull Press, 2003), 25.

28 Ibid., 97.

works like the Japanese collective Dumb Type's *S/N* (1993), *OR* (1997), and *Memorandum* (1999), for example, the digitally enabled fusion of multiple strobes and almost infrasonic, high decibel sound succeeds in briefly washing out visuality while simultaneously puncturing holes in the acoustic flow of time. Indeed, Dumb Type's live performances oscillate between two extremes: intermittent salvos of light and sound that halt time's movement, and the use of an increasingly accelerating pattern of flicker which constructs a world of temporal microruptures where the performers' bodies undergo a progressive discontinuity, or what Sally Jane Norman labeled "registers of presence." "Light is often employed in live spectacle to visually atomise and recompose the acting body . . . strong punctuation here serves to isolate rather than fuse stage images . . . in these works, registers of presence are declined and heightened by moments of absence."[29]

This tension between a Bergsonian spatialized time, in which bursts of stroboscopic light and sound divide time's flow into a series of discrete instants, and the spectators' felt experience of duration taking place through the gradual acceleration of the strobe's frequency has equally been exploited by artists seeking to dislocate and inundate the bodies of their intended perceivers. But continuous accompanying sound may also result in an altogether other experience by "smearing over" the visual transients produced by flicker such that the eye no longer notices change in the visual field. Paul Sharits's flicker-based films and installations, such as *Ray Gun Virus* (1966), *Shutter Interface* (1975), *Epileptic Seizure Comparison* (1976), and *Rapture* (1987), generally employed filmic techniques of alternating colored frames allied with spatialized audio in order to "have as much physical effect as the visual patterning" in exploring "the abandonment of the self to heightened transportive states."[30] In a similar manner, Steina and Woody Vasulka's dizzying experiments with analog and, later, digitally generated images such as *Noise Fields* (1974) also used flicker effects in both image and sound to defamiliarize figure and ground through rapid sequencing and switching between fields of positive and negative visual and aural noise.

The erasure of the image and its substitution with flickering light produces another, even more startling effect. Just as James Gibson argued that light reaches our eyes only through its ambient characteristics, its radiation off physical surfaces in the environment, works like Tony Conrad's infamous *The Flicker* (1968) or, more recently, Kurt Hentschläger's fog-bound, luminous installations like *Feed* (2005) and *Zee* (2008) explore a similar effect, creating almost hapticlike spaces that immerse the perceiver's bodies not in the surround of two-dimensional projection surfaces but in an atmosphere of thickness; a density produced through the *spatialized* renderings of light through the medium of sound. Already with *The Flicker*, Conrad aimed to dissolve the screen, that surface that "radiates power and spectacle,"[31] by creating a film based on the principle of "intermittent or time modulated light" and composed strictly through a complex matrix of alternating empty and black frames running at frame speeds (i.e., frequencies) of between four and twenty-four frames per second.[32] Described by Gilles Deleuze as a film "that goes on in the head,

29 Sally Jane Norman, "Acting Bodies: Apparitions, Blood and Guts," in *Theater Etcetera: Zum Theaterfestival Spiel.Art '97 in München* (Munich: Spielmotor e. V., 1997), 104–109, here 107–108.

30 Woody Vasulka and Peter Weibel, eds., *Buffalo Heads: Media Study, Media Practice, Media Pioneers 1973–1990* (Cambridge, Mass.: MIT Press, 2007), 314.

31 Chion, *Audio-Vision*, 194.

32 Tony Conrad, "The Flicker," *Film Culture* 41 (1966), 1–4.

behind the pupils, with sound sources taken as required from the auditorium,"[33] Conrad's initial interest in flicker-based harmonic structures derived from his study of mathematics and music as well as an earlier experiment with a variable-speed, lensless projector.

In many ways, *The Flicker* inverts the relationship between the screen and the viewer by shifting the audience's visual perception away from the projection surface (the wall) and towards the flickering patterns of light in space. As described in Branden Joseph's 2008 study *Beyond the Dream Syndicate: Tony Conrad and the Arts after Cage*, in one specific iteration of the project Conrad experimented with dividing the audience in two, directly projecting the pulsating film onto one half of the group, which wore dark glasses, while the other half bore witness to the spectacle by watching the first half, thus transforming the act of cinematic perception from pure observation to participation. Although Conrad's experimentation with harmonic ratios in his own music provided a basis for exploring a set of phenomenologically rooted flicker harmonics, it is Conrad's soundtrack for the film—a series of spatialized pitches "bordering closely on the lower range of audibility" and accelerating rhythms at the same frequency as the pitches generated on a homemade electronic synthesizer—that both mixed up the perceptual difference between pitch and rhythm and provided the conditions to extend time into space; "to accentuate certain spatial and atmospheric qualities . . . using a pattern technique similar to that used with intermittent light . . . to expan[d] the filmic space . . . to give unexpected birth to a sense of aural vastness and spaciousness."[34] With the viewer's transformation through "the threshold experience produced by altering the speed of light to accommodate the maximum range of our alpha rhythms," *The Flicker* introduces not only a cinema without a screen but a cinema of perception that merges the body of the viewer into a luminous, fully inhabited space.[35]

Immersion

Deleuze's description of *The Flicker* as a "camera-less cinema" that operates no longer on the screen but in the body of the perceiver, articulates the long-standing tension inherent in screen-based audiovisual forms between the immobile body of the spectator and the flattened space of moving images, representations, and "opsigns" and "sonsigns" that pass before the spectator.[36] In *The Cinema Effect*, Sean Cubitt also addresses this opposition between stillness and movement. The "stillness of the image and the motion of the body become characteristic forms of modernity,"[37] writes Cubitt, whereas the industrial-age apparatus of cinema gradually yields the opposite effect: an acceleration of the image before the increasing stillness of the body. Citing the Brazilian theater theorist and director Augusto Boal's observation that the cinematic split between static body and moving image is already rooted in the Greek theater's division of performer and spectator, Cubitt sees the rapid introduction of technologies like the "protocinemas" of the magic lantern and the baroque theater machineries of the masque and pageant as part of the progressive industrialization of

33 Gilles Deleuze, *Cinema 2: The Time-Image*, trans. Hugh Tomlinson and Robert Galeta (Minneapolis: University of Minnesota Press, 1989), 215.

34 Conrad, "The Flicker," 1.

35 Geiger, *Chapel of Extreme Experience*, 177.

36 Deleuze defines opsign and sonsign as a "pure optical and sound image which breaks the sensory-motor links, overwhelms relations and no longer lets itself be expressed in terms of movement, but opens directly on time." Gilles Deleuze, *Cinema 1: The Movement-Image* (Minneapolis: University of Minnesota Press, 1989), 217–218.

37 Sean Cubitt, *The Cinema Effect* (Cambridge, Mass.: MIT Press, 2004), 6.

affect, which reaches its apotheosis in modern cinema's standardization of the "stasis of the audience in the movement of the image."[38]

If we are to believe that the origin of live theater in the West already cements a kind of stasis in the seated viewer, then we can also look to the stage as one precursor of an audiovisual apparatus of perceptual control. In his design for the Festspielhaus (Festival Theater) in Bayreuth, composer Richard Wagner's techniques—consisting of the dimming of gas lighting; reduction of the normally three-dimensional space of the stage to a flat, two-dimensional letterbox-like format through the architectural device of a double proscenium; and the sinking of the orchestra pit below the stage with a partial cover—all exerted untold control over the spectators' audio-visual-corporeal experience.

While the stage image was reduced to that of a "picture," Wagner's envelopment of the spectators' bodies in a continually transforming sea of sound through the acoustic techniques of a fan-shaped auditorium (which reduced resonance peaks and reverberation times), the construction of the auditorium with wood, and the hollowing out of space beneath the ramped seating area to serve as a low frequency resonator, ensured that sound would take on a three-dimensional quality that the stage image lacked. As Wagner himself described the aesthetic repercussions of his sophisticated manipulation of theater design: "Between him [the spectator] and the picture to be looked at there is nothing plainly visible, merely a floating atmosphere of distance, resulting from the architectural adjustment of the two proscenia; whereby the scene is removed as it were to the unapproachable world of dreams."[39]

Wagner's parallel amplification of the aural environment and reduction of the visual stage space to that of a flat surface at a distance powerfully directed the spectators' gaze and plunged their bodies into a darkness without peripheral visual distractions. Indeed, these manipulative techniques led Nietzsche to dub the composer's technical innovations as "the master of hypnotist's tricks."[40] Some 113 years later, Marshall McLuhan revived this audiovisual invocation of hypnotism in which the active eye overcomes bodily inertia when he observed that "We, who live in a world of reflected light, in visual space, may also be said to be in a state of hypnosis."[41]

Such "genres" and practices as expanded cinema, walk-through installations, and sensor-driven ambient media environments seem to be hybrid forms, however, between brain and body, ear and eye, actions and opto-sonic situations, representations and Deleuze's shock of forces that turn the body and consciousness inside out and attempt to invent them anew. The disembodied surface of the screen that Vilém Flusser once declared as *the* critical innovation for new media practices in fact already saw its eclipse beginning in the 1950s in the immersive audiovisual spaces imagined by filmmakers, architects, designers, composers, and theater makers in which the body was no longer situated before the image but instead thrust into inhabitable media in search of coherence, meaning, and pattern. Earlier works such as the groundbreaking Philips Pavilion by Le Corbusier, Iannis Xenakis, and Edgard Varèse (1958, Brussels), the audio-optic environments of Italian groups like Gruppo T and Gruppo N,

38 Ibid.

39 Richard Wagner, *Wagner: On Music and Drama*, ed. Albert Goldman and Evert Sprinchorn (New York: E.P. Dutton, 1964), 366.

40 Friedrich Nietzsche, "The Case of Wagner," in *The Birth of Tragedy and The Case of Wagner*, ed. and trans. Walter Kaufmann (New York: Random House, 1967), 147–189.

41 Marshall McLuhan, "Visual and Acoustic Space," in *Audio Culture: Readings in Modern Music*, ed. Christoph Cox and Daniel Warner (New York: Continuum, 2002), 67–72, here 68.

and the quasi cine-architectonic domes and rooms of Stan VanDerBeek, Event-structure Research Group, and Haus-Rucker-Co from the 1950s to the 1970s all consisted of environments in which image and sound swirled around an equally locomotive spectator.

Furthermore, since the early 1990s, artists have employed techniques of sensor-based interaction with spatialized sound and screen-based projection to create the sensation of images and sounds leaving their surface and occupying space, or have replaced the image entirely in favor of fluctuating light and sound-based architectural constructions. Ryoji Ikeda's sine-wave-saturated installations *spectra II* (2002) and *dB* (2002) seek to "explode the senses" by rapidly alternating between extreme darkness and sudden stroboscopic bursts in a narrow, claustrophobic corridor in *spectra II*, or by generating a series of sensory extremes in *dB*: first, acute deprivation in an anechoic chamber, followed by ocular meltdown in a dazzling white space with 110 fluorescent lights.

Other audiovisual spaces deprive viewers of their sense of sight in order to amplify their "hearing perspective" (Sam Auinger and Robert Adrian X's *Deep Blue*, 1996) or explore the intense concentration and restlessness that occur in a body grappling with sensory loss (Chris Salter's *Schwelle: Schwarzraum*, 2004). Still others, like the Australian video artist Lynette Wallworth, seek to construct sensate audiovisual spaces that alter our body's experience of the flow between natural and cultural time cycles (*Still: Waiting 2*) or, as in Alex Bradley and Charles Poulet's *Whiteplane 2* (2005), command light and sound to produce an ever-undulating, intangible architecture that the spectator literally lies in between. Common among these diverse works is the continual play between immaterial and material presences: the use of the abstract and ephemeral to mutually transform space and body simultaneously through a perception that circulates between the physical environment that the spectator inhabits and the internal space of consciousness.

Embodiments

Through the aesthetic encounter with flicker effects and planes of light and darkness, blaring luminosity, or the radical diminution of sensory phenomena that confuses vision, touch, and audition, it is clear that no one sense dominates our experience. The hypnotized eye that appears to be cut off from the ears and the textures of the skin cannot be singled out as the primary modality in perception. In fact, recent research in the area of enactive cognition demonstrates that the eye is not even the sole anchoring point of what we think is its given territory—that of visual perception. Thus, despite the continued use of the term "retinal aesthetics" to describe the optical onslaught of pulsating pixels in much contemporary artistic work fusing image and sound, the conundrum of embodiment still remains.

Because the visual processing centers of the brain are spread among multiple regions, from the higher-level visual cortex and the parietal lobes where spatial representations are constructed to the temporal lobes where the experience of movement is played out, vision not only takes place in the realm of the retina but also is amplified by sensorimotor action. As James J. Gibson argued in *The Senses Considered as Perceptual Systems* (1963), the retina is only one element in a complex, ever evolving system of perception, action, and vision. Just as the eye is neither a camera nor an instrument ("'a keyboard' played by light"), so too is the body not just a passive organ picking up stimuli from the audiovisual environment. Instead, Gibson distinguishes between "the passive receptors that respond each to its appropriate form of energy" and "the active perceptual organs, better called systems, that can search out the information in the stimulus energy."[42] The sense organs are thus not channels of input but rather *perceptual generators*—systems that do not easily cut across the five sense modalities that we inherited from Aristotle on downwards but interrelate with each other through a wider range of modalities: orientation-gravitation, vision, audition, somatosensory (touch, proprioception, pain, pressure, temperature), and taste/smell.

We cannot think of these multiple sensations without a body to experience them. In his discussion of "sense experience" in the *Phenomenology of Perception*, Merleau-Ponty already suggests that it is by imagining the body as a mobile force in a surrounding milieu that we can grasp perceptual experience. The world starts and ends with the body situated in space, and it is that body that reveals what he later terms the "visible" and the "sensible." Sense perception is a continual making of the world, a "re-creation or re-constitution of the world at every moment."[43] This opening up of perception to the world through our body's relationship to the environment resonates with the views of many recent proponents of the enactive perspective in cognitive science, who understand seeing/hearing as directed to the world, not the brain.[44] Enaction as a method and research program challenges purely brain-centered ideas in cognitive science which maintain that perception of the sensory world is fundamentally an act of representation, a mental correspondence between what we are seeing and hearing out there and what is reconstructed as an *internal picture* inside the brain. Such vision-centered theories of representation take vision, for example, to be the creation of an internal pictorial representation inside the brain of a world outside it.

According to the enactive view, perception is not representation but *action*—a direct projection of the body into the environment and an ongoing "probing" of that environment with the sensor and motor capabilities of the active body. In this context, as leading enactive cognition researchers J. Kevin O'Regan and Alva Noë have suggested, vision or hearing does not come with sense-specific "handles" on how the perceptual apparatus should deal with such phenomena. At the neural level, there is no specific reason why a group of neurons should distinguish between haptic or visual versus auditory input. Rather, the unique properties of the sense organs, the *invariant* properties of what O'Regan and Noë call sensorimotor contingencies (later called sensorimotor dependencies), encode the brain with different experiences of perception. Audition, for example, may not be affected by blinking or rapidly darting the eyes back and forth, whereas such sensorimotor actions have a radical effect on the visual perception system of the world, bringing it into being and then, just as suddenly, wiping it away. "The sensory modalities are constituted by distinct patterns of sensorimotor contingencies . . . perception can be understood as the activity of exploring the environment in ways mediated by knowledge of these relevant sensorimotor contingencies."[45]

The separation of seeing and hearing thus may not be so self-evident. Backing up Gibson's claim that the senses cannot be seen simply as independent channels conveying sensations to the brain, research has shown that sound, vision, and tactility overlap in the phenomenon of sensory substitution. According to O'Regan and Noë, "visual experience should be obtainable via other channels

42 James J. Gibson, *The Senses Considered as Perceptual Systems* (Greenwood, Conn.: Greenwood, 1983), 1–6.

43 Merleau-Ponty, *Phenomenology of Perception*, 240.

44 Francisco Varela, Evan Thompson, and Eleanor Rosch, *The Embodied Mind: Cognitive Science and Human Experience* (Cambridge, Mass.: MIT Press, 2000), 52.

45 O'Regan and Noë, "A Sensorimotor Account," 8.

other than vision, provided that the brain extracts the same invariants from the structure of the sensorimotor contingencies."[46] In other words, even though there are different sensorimotor contingencies, overlaps between contingencies can and do exist, particularly when one missing sense has to be "substituted" for another. In the bizarre phenomenon of facial vision experienced by the blind, for instance, a kind of "tactile vision" of "seeing" objects or obstacles through the skin emerges. Although this could be attributed to a heightened sense of proprioception, it has been proven that auditory echo detection involving direction, speed, amplitude intensity, and frequency changes of reflective sound gives the sensation of feeling an object touching the forehead, face, or chest. With a sensory deficit, auditory sensations somehow have the same invariant property as that of tactile ones.

But sensory stimuli are not merely input, nor are sensorimotor responses maps to predetermined output. Indeed, the difference in perceptual experiences through different sensory modalities is not the result of discrete sensation states preprogrammed a priori in the brain and awaiting their triggering by the appropriate sensory channel. "For each modality of perceptual experience—seeing, hearing, touching—there is a corresponding pattern of sensorimotor interdependence that is constitutive of that modality." Evan Thompson continues, "what it is to experience the world perceptually is to exercise one's bodily mastery or *know how* of certain *patterns* [my emphasis] of sensorimotor dependence between one's sensing and moving body and the environment." In terms of perception, such "sensorimotor patterns seem more promising than mere neural correlates [what sensation is matched with what brain region] of consciousness."[47]

The central thesis of enaction—that perception is action through knowing—situates perception at the nexus of brain, body, and the environment. Perception does not consist of solely picking up information from the world but is *performed* as the animal actively explores the environment in which it is embodied. Perhaps such a concept of perception suggests radical new artistic approaches to audio-vision that go beyond the easy spectacles of media saturation. The frozen spectator before the flickering screen has gradually been joined by body-centric installations in which corporeality is brought into states of vertigo and disquiet, rapture and ecstasy. Enactive approaches to audio-vision may demand an even more concentrated, multisensory approach to the creation of aesthetic encounters where sensorimotor actions continually modulate and bring about new perceptions of a dynamic environment: an exploration into the nuanced dynamics of touch that expands our sense of space and transforms the body's perception of time; the composition of visual and sounding spaces that constantly reorient our motor actions and passive modes of seeing and listening; or the heightening of one sense to cross-influence the others. Enactive audio-vision thus proposes exploration of the patterns that bring about the spectator's multisensory self—the experience of its emergence, stabilization, and dissolution in the lived present.

Self-Dynamics: Absorption and Dissolution

In the aesthetics of the multisensory environments discussed in this essay, audiovisual perception involves multiple scales of overlapping machine and human temporalities: the lived, real time of the event experienced by the

46 O'Regan and Noë, "A Sensorimotor Account," 28.

47 Evan Thompson, *Mind in Life: Biology, Phenomenology, and the Sciences of Mind* (Cambridge, Mass.: Belknap Press of Harvard University Press, 2007), 257.

observer/listener; the technical time of the mechanical or electronic apparatus and their inherent delays and latencies; the micro and submicro times between successive frames or samples; the speed of sound, light, and motion that go beyond human perception thresholds, and their respective second lives produced by reflections, diffractions, and reverberations.[48] The spectators who circulated through the multimedia landscape of the Philips Pavilion's 1958 demonstration of electronic modernity and encountered the jarring experience of Varèse's *Poème Électronique* curving over Xenakis's hyperbolic-paraboloid surfaces while accompanied by Le Corbusier's rapid-fire, postapocalyptic montage of industrial civilization, easily met with such simultaneous scales of body and machine perception.

Today, we equally confront multiple scales of perception through even more precise, technologically enabled spectacles: surround-cinematic experiences like IMAX, the interactive visual scenography of Nine Inch Nails' 2008 "Lights in the Sky" tour, theme park attractions utilizing motion simulators, three-dimensional stereography, time-delayed multichannel audio, and even reactive public art projects involving sound and light that convert urban environments into gigantic play spaces. Our rendezvous with the shifting interdependencies of different time scales in the audiovisual environment is not merely the result of exogenous technology; it also takes place in the deep recesses of cognition. At the basis of what UC Berkeley neuroscientist Walter J. Freeman calls a "neurodynamical" model of brain processes is the increasingly accepted principle that perceptual/cognitive processes take place as a result of a complex, decentralized organization of neural groups that coordinate cognitive acts over time scales ranging from approximately five milliseconds to a few seconds. Perception can only be understood as a macroscopic, global activity brought about by specific recurrent patterns that take place among ever changing ensembles of neuronal clusters, or what Freeman labels "nerve cell assemblies"—patterns that emerge on the basis of a delicate choreography between external environmental stimuli and the brain's own self-organizing structures.[49]

Work by the late neurobiologist Francisco Varela, cofounder of the well-known theory of cellular autopoiesis with Humberto Maturana in the 1970s, also focuses on the embodied neurodynamics of perception and cognition. Using models from the mathematical area of dynamical systems theory focused on the time-based evolution of systems, Freeman's work on mass-scale integration of neurons in the brain, and philosophical frameworks from phenomenology, Varela's interdisciplinary research program of "neurophenomenology" examines the interplay between temporal awareness at the level of direct experience and the neural dynamics of such temporal shifts at the brain level.

In developing one of the main theses of enactive perception—that a "cognitive agent's" coupling to the world is the result of sensorimotor actions and that continually reorganizing patterns of neural activity in effect may give rise to that cognitive agent's sense of "self"—Varela asked what kind of *evidence* enables us to prove that such perceptual/cognitive acts actually are based on such dynamic reorganization of neural structures; "coherent activity of a subpopulation of neurons at multiple locations?"[50] These spatially distributed

48 See Curtis Roads, *Microsound* (Cambridge, Mass.: MIT Press, 2001), 3–41, for a discussion of the time scales of music composition.

49 See Walter J. Freeman, *How Brains Make Up Their Minds* (New York: Columbia University Press, 2000).

50 Francisco Varela, "The Specious Present: A Neurophenomenology of Time Consciousness," in *Naturalizing Phenomenology: Issues in Contemporary Phenomenology and Cognitive Science*, eds. Jean Petitot and Renaud Barbaras. (Palo Alto: Stanford University Press, 1999), 266–316, here 275.

subpopulations of neuronal cell assemblies that construct percepts and generate meaning for sensory experience create connections (i.e., are held together) by way of a specific physiological phenomenon: the *frequency coherence*, or rate and synchrony of neural firings, between the assemblies by means of a process called *phase locking*. Such phase-locked oscillations suggest that assemblies of neurons tentatively hold together through simultaneous oscillations within similar frequency bands (the gamma range between 30 and 80 Hz), indicating that distributed parts of the brain suddenly recognize each other across distance and integrate this recognition in time. Yet, just as suddenly, these synchronies dissipate in what dynamical systems theory calls a *bifurcation*, or relaxation period, in order to prepare themselves for the next perceptual act in which they may form anew.

The central concern in Varela's model of neurodynamics is the manner in which we experience the flow of time. "Time happens as in the rising of a wave that then subsides, like a wave that comes from the sea."[51] The experience of duration, the movement from past to future, operates over three different scales spanning the threshold distinctions between different sensory percepts on the order of 10–100 milliseconds or less (the 1/10 scale), to the manifestation of such percepts through the time of "long-range integration," which involves the formation of cell assemblies over the course of 200–250 milliseconds (the 1 scale). Finally, the completion of a perception/action-oriented cognitive act lasts potentially seconds (the 10 scale), or what Varela terms the scale proper to "descriptive-narrative assessments."[52] The present moment is therefore constituted from one time scale sliding into the next—the "slow arising of combinations which forms the complex assemblage . . . [the] now lasts, now is a lasting time, one-third, one-fourth of a second."[53]

We finally arrive at a critical juncture in trying to relate internal processes of neurodynamics to felt perception. If perceptual processes arise from a dynamic and transient chaotic network and are contingent on the simultaneity of temporal scales and sensorimotor loops, then is our direct experience of a sensing self as temporary and fleeting as these nerve cell assemblies which form, synchronize together, and then dissipate? Where is the self located in this unstable dramaturgy of neural and phenomenal transience; of the ebbing and flowing of time over and under the thresholds of perception? Can artistic works like Turrell and Irwin's, which sought to explore these perceptual performances of formation and dissolution, bring on a conscious, lived encounter with this oscillating self?

An aesthetic event brings us into another state. The sudden entrance of a deep, infrasonic vibration that suspends the moment or the unexpected switch of visual polyrhythms in a shifting electronic image initiates an altogether strange but tangible experience; a sense of swelling of the air occurs at the edges of the skin, a rapid bursting forth brings on flashes of color or evanescent shapes into the total visual field. In what neurologist James Austin in his mammoth 1991 work *Zen and the Brain* described as "quickenings," or *makyo* in Japanese, we may even experience that breakneck, momentary suspension which Catherine Clément describes as "syncope": the faltering of time and sudden "absence of the self."[54] Sharp psycho-physical sensations such as sudden warmth, a shudder, swooning, fainting, detachment from the body, envelopment by a flash of

51 Francisco Varela, "The Deep Now," in *Machine Times: DEAFOO*, eds. Arjen Mulder and Joke Brouwer (Rotterdam: NAi, 1999), 6–27, here 12.

52 See Varela, "The Specious Present."

53 Varela, "The Deep Now," 13.

54 Catherine Clément, *Syncope: The Philosophy of Rapture*, trans. Sally O'Driscoll, with Deirdre M. Mahoney (Minneapolis: University of Minnesota Press, 1994), 1–23.

light or indeterminate intensities of brightness, blanking out, or the dropping off of conscious, everyday experience suddenly takes place without reason or pattern.

For Austin, such quickenings signify a heightened sense of perception in which the brain internally sharpens its sense of attention but produces what we might call hallucinations or sensory illusions. Such altered states of consciousness are usually experienced by early-stage meditators as “side effects” or “by-products” in their struggle with the sudden reduction of external input in their environment and the flood of experiences and thoughts that courses through the brain and body during the elastic time of meditation. Historically, Zen priests disavowed such epiphenomenal states, remedying *makyo* by plunging young monks who experienced it during meditation into freezing cold ice baths.[55] Perhaps, then, artists facilitating with audiovisual cross-modality through the intertwining of media, environment, and perceiver seek similarly to instill or render such momentary lapses and quickenings, creating breaks or micro hallucinations of self by way of techniques that consciously challenge perception: spaces and forms that are barely perceivable, fleeting swatches of color or light that confuse the eyes, deprivation and then total saturation of vision through blinding light, monochromatic swings between black and white and silence followed by high decibel bursts.

The effect of such startling shifts may be to evoke so-called triggers, or the abrupt onset of events that can result in enhanced sensory perception and rapid shifts of mood, consciousness or feeling. In her 1968 study of ecstatic experience, psychologist Margharita Laski described certain kinds of fleeting “intensity experiences,” such as feelings of intense joy; feelings of loss of place, time, desires, or self; quasi-physical sensations; and the internal sense of building to a climax. According to Laski, such experiences are partially the result of external triggers such as “objects, events or ideas” in the form of artistic experiences, environmental shifts, or multisensory stimuli and the like.[56] These sudden experiences or “epiphanies,” as German scholar Hans Ulrich Gumbrecht suggests, are indeed “moments of intensity” which occur in the context of *aesthetic experience* that cannot be found in the historically and culturally specific realms of the everyday or the historically and culturally demarcated realm of the self.[57] But these aesthetic moments of intensity are not only sensations that are gained but also feelings, objects, and forms that are lost.

Imagine the field of sight expanding beyond the periphery of vision, towards an all-encompassing awareness of a space that has no edges or ends; a space that has no frontal or side planes but instead is constituted of an immense volume without depth. This description of what Austin labels “ambient vision” sounds familiar. It is the onset of the perception of vastness and crumbling of orientation in the ganzfeld, or what Brian Massumi labels “chaos in the total field of vision,” that we have already encountered in Irwin and Turrell’s lost experiments and that became an essential element of Turrell’s later light (and sound) environments.[58] In describing psychological experiments with the ganzfeld, an undifferentiated, monochromatic expanse, Massumi writes that “although subjects had difficulty putting what they had failed to experience in properly visual

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55 See James Austin, *Zen and the Brain* (Cambridge, Mass.: MIT Press, 2001), 374.

56 Ibid., 25–27.

57 Hans Ulrich Gumbrecht, *The Production of Presence: What Meaning Cannot Convey* (Palo Alto: Stanford University Press, 2004), 99.

58 Turrell returned to his ganzfeld research in the 1990s with a series of self-contained light and sound environments for one person at a time, entitled *Perceptual Cells*; see “Work Series: 1966–1998. Perceptual Cells,” in *James Turrell: The Other Horizon*, Noever, ed., 142–151.

terms, they were relentlessly prodded to do so by experimenters. Most described an unfocusable 'cloud' or 'fog' of no determinate shape or measurable distance from the eyes. Some just saw 'something,' others just 'nothing.' One acute observer saw 'levels of nothingness.'"[59]

According to Austin, such moments of nothingness, of pure blankness, go far beyond the quickening and into the territory of what is called "absorptions." Whereas quickenings function as micro breaks in self-experience—most likely the neurochemical result of a "surge in the activities of messenger molecules in the brain"—absorptions involve an attentiveness that produces a spontaneous detachment and near dissolution of the physical self as "one's attention is enhanced far beyond its ordinary limits."[60] An "external absorption" suggests that attention to an external event reached through perception becomes acutely heightened to the exclusion of other events. An "internal absorption" results in more profound shifts of consciousness; ones in which spontaneous thought stops, the bodily self fades away along with a shutting down of sight and sound, and awareness expands into the surrounding ambient space. "It is a singular state, this sensate loss, combined with an awareness amplified to brilliant intensity."[61] Internal absorptions present almost contradictory audiovisual experiences when the balance between inhibitory and excitatory networks in the brain breaks down. Attentiveness accelerates while visual stimuli become filtered and reduced as lower-level processes block out newly arriving visual impulses—a consequent utter blackness in which sensory awareness falls away.

Perhaps such a vacuum of blackness may be not unlike the experience one has in the first encounter with the profound emptiness of Mark Rothko's fourteen enormous black paintings that hang in the Rothko Chapel (Houston, Texas) designed by architect Philip Johnson. While staring into the contemplative darkness of Rothko's final works, the accompanying soundtrack is akin to John Cage's silent work *4'33''*—the acoustic silence broken by the footsteps of visitors walking around the concrete floor of the octagonal room where the paintings hang or by the occasional cough and rustle of a sole observer sitting in the contemplative atmosphere. Here, audio-vision is mute, with no external soundtrack or auditory pulsations to merge with the visitors' experience of seeing Rothko's tenebrous canvasses—a kind of painting, writes Rothko scholar David Anfam, that "proves the opposite of everything it seems at first to be: not simple, not monolithic, not static, not colorless, but ambiguous, organic, crafty, and sentient, albeit only in the eyes of an observer who is willing to meet its dark demands."[62] Consisting of fourteen enormous works, the paintings, while appearing pitch black, actually constitute complex chiaroscuro interplays of shadowy grey, reds, and rusts achieved through Rothko's custom mixtures of paint, egg, turpentine, resin, oil, and rabbit skin glue.

The dissolution of audio-vision that occurs in perception under the conditions of absorption is in a strange way not unlike the atmosphere of the Rothko chapel. While ambient vision expands and the eye falls into layers of darkness due to the loss of depth in the visual field, auditory input descends into a vacuum of deafening silence, the probable consequence of auditory signals somehow stopped en route in the lower-level subcortical areas of the brain while travel-

59 Brian Massumi, *Parables for the Virtual: Movement, Affect, Sensation* (Durham Duke University Press, 2002), 146.

60 Austin, *Zen and the Brain*, 474.

61 Ibid., 475

62 David Anfam, quoted in Shaila K. Dewan, "Restoring Rothko's Chapel and His Vision," *New York Times*, June 15, 2000, Arts section, New York edition, online at http://www.nytimes.com/2000/06/15/arts/arts-in-america-restoring-rothko-s-chapel-and-his-vision.html.

ing towards the higher-level auditory cortex. Furthermore, in his account of audiovisual blankness, Austin discusses an even more bizarre occurrence. In a state of absorption in which signals moving towards higher-level processing arenas of the brain are halted, we lose not only our sense of audition but also our *exteroceptive* sense: the ability of an organ like the ear to locate the position and direction of sound inhabiting the space beyond the body. But while the loss of the exteroceptive sense that helps us locate sounds by way of triangulation in space is thrown into question, the breakdown of our *interoceptive* sense suggests something more bizarre: the loss of our own proprioceptive abilities to feel the position of our bodies in space. In this disorientation, both the perceived and the invisible, the neural and the experienced, embodied self momentarily seem to fade away.

Momentariness

In the final analysis, we are still haunted by a central question. What consequences do these theories of the microdynamics of perception, the momentariness of experience, and the minute breaks of self that a growing number of neuroscientists, philosophers, cognitive scientists, psychologists, and biologists take seriously in research have for future artistic practices that engage with audiovisuality? Do the notions of suddenness, immersion, saturation, and denudation achieved through the mixing of human/machine perceptions give the phenomenal and aesthetic possibility to amplify the same kind of momentariness that Varela describes constitutes our direct experience in the world?

Past and contemporary audiovisual artists who employ the strategies of both saturation and denudation, undifferentiated space and sudden explosions of intensity, may indeed seek to catalyze a momentary loss of selfhood, a quickening of ecstatic affect, or an amplification of the unstable spatiotemporal dynamics of neuro-corporeal perception at the level of *direct, felt experience*. It is a rare work of art, particularly audiovisual art, however, that brings about the far more profound conditions of absorption that normally occur only under the influence of psychedelics, in desynchronized (REM) sleep, or after prolonged periods of deep concentration, such as meditation. In the hands of many creators, audio-vision is about the productive processes enabled by the machinelike layering, mixing, and reappropriating of media, yet many shy away from the generation of gaps, holes, and disjunctions in the aesthetic event that would bring the perceiver into palpable confrontation with his or her own experience of slipping away; with the felt experience of impermanence. With this challenge in hand, we come full circle to Turrell and Irwin's unrealized experiment of ambient vastness; of the slow invocation of presence through absence. "The experiencing act itself . . . is the 'thing' or 'object.'"[63] Perhaps then artistic events and aesthetic experience must strive to go further in their exploration of the thresholds of human and machine perception in order to grapple with the liberation of self that comes from enaction in a cross-modal world.

63 Tuchman, *Report on the Art and Technology Program*, 132–133.

James Turrell, Robert Irwin, and Edward C. Wortz
Irwin/Turrell/Garrett project under the auspices of the Art and Technology Program at the Los Angeles County Museum of Art (1968–1971)

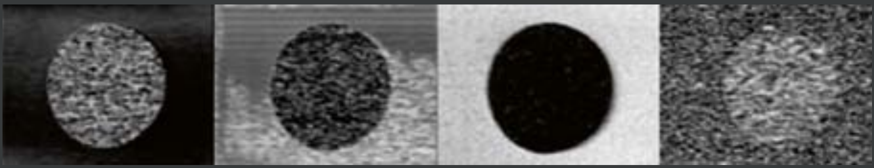
– Robert Irwin, James Turrell with Gail Scott and Maurice Tuchman, Ganzfeld Demonstration, 1968.
All photos Malcolm Lubliner.
Robert Irwin, James Turrell, and Edward Wortz, Meeting at Garrett Aerospace, 1969.
Robert Irwin and James Turrell, Tests in UCLA Anechoic Chamber, 1969.

In 1969, with an invitation from curator Maurice Tuchman, artists Robert Irwin and James Turrell embarked on a research investigation to produce a light and sound installation as part of Tuchman's Art and Technology Program of the Los Angeles County Museum of Art. After several unsuccessful attempts at creating what was called "artist/corporation matches" through the initiative, Turrell and Irwin met with experimental psychologist Edward Wortz, then head of the Life Sciences Department at Garrett Aerospace. On the basis of their mutual interests, Turrell, Irwin, and Wortz agreed to embark on the production of a "sensory chamber" for the museum which would involve an installation "with four periods of perceptual change, plus and minus, each working with the states of consciousness."[1] The sensory chamber project would have combined two core concepts: (a) an anechoic chamber, which is an enclosed acoustic environment that absorbs all sonic reflections, and (b) a ganzfeld, which is a complete, 360-degree visual field of purely homogenous color producing the illusion of infinite space. In the installation's dramaturgical structure, visitors would progress one at a time into the space of the anechoic chamber in order to experience subtle, barely perceivable shifts of sound and light and, eventually, be mechanically lifted up in a chair into a separate chamber which held the ganzfeld. Perception itself, "the sense of sensing," would constitute the work's experiential structure and content and act as the guiding principle for the development of experimental investigations at several sites: a UCLA-based anechoic chamber as well as various tests and procedures involving so-called alpha conditioning, the examination of brain-produced alpha waves of subjects under various sensory stimuli that took place at the Garrett facility.

According to the official record, the project abruptly halted in August 1969 when Turrell withdrew from the project. Despite the fact that the two artists had developed a long list of perceptual experiments that would lead up to the realization of the museum installation, all that was realized were tests in the UCLA anechoic chamber with a number of subjects over varying durations and the alpha-conditioning experiments with EEG recording and analysis of brain waves by Wortz at Garrett. Although framed by larger issues of consciousness arising in 1960s counterculture, the unrealized project by Irwin, Turrell, and Wortz to this day challenges the typical synchronous and saturation-based practices of so many artistic explorations with sound and image through its emphasis on sensory denudation and the performance of perception as the work of art itself.

1 Cited in Maurice Tuchman, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971* (Los Angeles: Los Angeles County Museum of Art, 1971), 129.

Steina and Woody Vasulka
Noisefields (1974)



– Stills from *Noisefields* (1974) by Steina and Woody Vasulka.
© The Vasulkas.

Noisefields is a single-channel videotape from video artists Steina and Woody Vasulka which was revised and adapted into a physical installation format by Woody Vasulka in 2002. The original videotape is an early yet remarkable example of the attempt to manipulate a hybrid, camera-based, and electronically generated image (the electronic signal) and the material and phenomenal repercussions associated with such an exploration. In what scholar Yvonne Spielmann has described as "the Vasulkas' concept of video as it departs from photographic images and narrative references and forces the electronic medium into abstraction,"[1] the audiovisual content of *Noisefields* is the modulation of signal itself: the tension between a material object picked up by the camera (a sphere) and its gradual dematerialization by the keying in of video noise and rapidly switching between the object and the interference pattern through the use of a custom-designed electronic sequencer and colorizer. The oscillation between the material object as image and the electronically produced noise not only generates the expected flicker effect in both image and sound but also challenges the eye and ear, which attempts to fixate on an object-field that continually appears and disappears. In the 2002 installation version, the spatial and temporal intensity of the earlier, screen-based flicker effects is amplified through the positioning of the screen in a physical installation space where light and sound take on further material quality in relationship to the bodies of the observers.

1 Yvonne Spielmann, "Video and Computer: The Aesthetics of Steina and Woody Vasulka," online at http://www.fondation-langlois.org/html/e/page.php?NumPage=461.

Paul Sharits
Shutter Interface (1975)

– Installation view of *Shutter Interface* (1975/2001–2009) by Paul Sharits. © Paul Sharits, courtesy South London Gallery.

Shutter Interface is a film installation created by artist Paul Sharits in 1975 during a residency at the Artpark center in Lewiston, New York. Inspired by his philosophical interest in perception as well as his experience with bipolar disorder, *Shutter Interface* typifies a series of works that Sharits called "locational" film environments. For Sharits, the concept of location describes filmic environments which bypass the traditional frontal viewing perspective of the cinema and instead extend the possibilities of cinematic experience toward a more open spatial and "interactive play between various synchronies."[1] "'Film,'" according to the artist, "can occupy spaces other than that of the theater; it can become locational (rather than suggesting representation of other locations) by existing in spaces whose shapes and scales of possible sound and image 'sizes' are part of the wholistic piece."[2]

The original physical installation of 1975 consists of four 16-mm film projectors with loop cartridges for the continuous projection of four colored film loops lasting five to six minutes each. The projectors sit atop four black platforms, making the apparatus of projection an integral part of the installation's visual environment. Projected onto four screens mounted on a single wall, each screen 162 centimeters high by 60 centimeters wide, each looped film overlaps its neighbor and contains a series of alternating color and black frames that produce flicker effects—visual rhythms that appear to be created through what Sharits notes in his work descriptions as "the basic intermittency mechanism of the cinema: the shutter."[3] The "pulsating dialectic"[4] produced by the asynchronous film loops is accompanied by an equivalent auditory "flicker": a 1,000 Hz tone accompanying the black frames on the film loops and spatially diffused through four loudspeakers, each located on the floor directly below the four projected wall images. The asynchronous audiovisual polyrhythm produced by the combination of extremely reduced sonic material and the alternating color flickering thus creates what Sharits labels "a 3-D metaphor of the space of the brain in an epileptic state, brought under control and harmonized."[5]

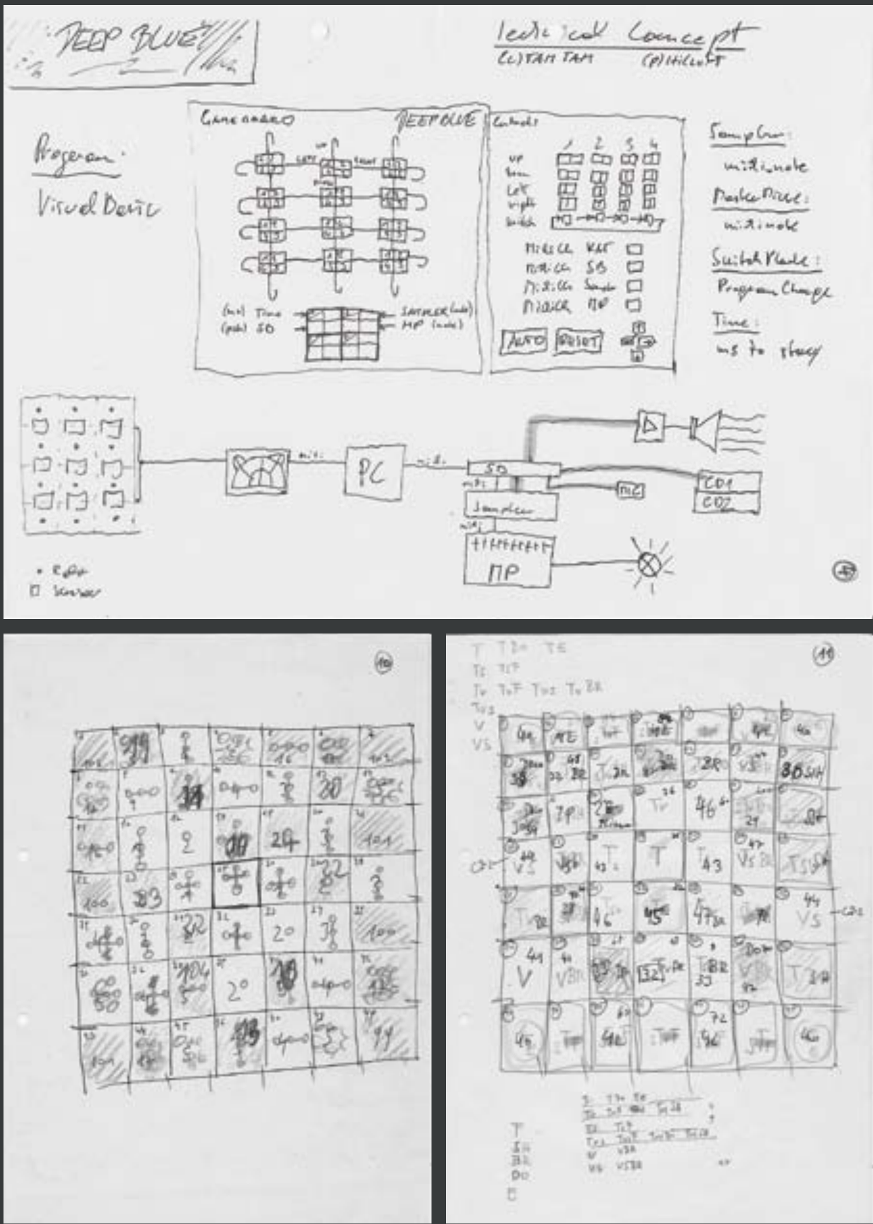
1 "Paul Sharits," in *Buffalo Heads: Media Study, Media Practice, Media Pioneers, 1973–1990*, eds. Woody Vasulka and Peter Weibel (Cambridge, Mass.: MIT Press, 2008), 247.

2 Ibid.

3 "Paul Sharits on Shutter Interface," in *Buffalo Heads*, 345. First published in "Filmography," *Film Culture: Paul Sharits* 65/66 (1978; special issue), 115–124.

4 Ibid.

5 Ibid.



– Diagrams and plans for *Deep Blue* (1996) by Robert Adrian X and Sam Auinger. Courtesy the artists.

Robert Adrian X and Sam Auinger
Deep Blue (1996)

Deep Blue is an interactive light and sound installation created by Canadian-born, Vienna-based media artist Robert Adrian X and composer Sam Auinger. Produced by the OK Zentrum in Linz and premiered at the 1996 Ars Electronica Festival, the installation is a poetic meditation on "the way things—molecules, ecosystems, cultures—swing back and forth between stability and instability, chaos and order, meaning and nonsense."[1] The installation consists of a darkened room with nine large hanging tubes containing blue LEDs, live and pre-composed audio, and a grid of infrared motion detectors that enable changes in light and sound triggered by the movement of visitors. As visitors enter the installation, their vision is abruptly reduced through the striking contrast between the bright waiting area outside and the pitch-black darkness inside. At the same time, a new "hearing perspective" (Auinger) is produced by means of a deep harmonic drone passing through the space, which is generated by a resonating "tuning tube" mounted on the Linz city hall, whose live acoustic feed is carried to the installation through a high-speed ISDN line. The sound behaves according to Hermann von Helmholtz's resonator principle, with the length of an open-ended vessel determining the fundamental frequency and upper harmonics of sounds entering the resonator. A deep 110 Hz (A) tone created by the outside environment saturates the installation space, its musical overtones composed in real time through urban noise.

As visitors move in the installation, the sensors register changes in the body heat given off by the visitors and send data on these changes to a custom I/O matrix and a computer running 49 preprogrammed "modules." These modules act as compositional tools that organize various combinations of filters on the live audio feed as well as trigger other sampled, sonic material. Simultaneously, the resulting changes in motion are also relayed through the logic system to the LEDs, which gradually change their brightness. The room thus operates, in the words of Auinger, as a kind of Cagean "intentionless musical automaton" generating a world that is forever on the border between order and chaos.

1 Adrian and Auinger (1996), cited in OK Offenes Kulturhaus Oberösterreich, ed., *Sam Auinger & Friends: A Hearing Perspective* (Vienna: Folio, 2007), n.p.

– Photographs of the performance *OR* (1997) by Dumb Type.
Photo: Arno Declair, courtesy the artists.

Dumb Type
OR (1997)

OR is an approximately 80-minute dance-theater-multimedia performance conceived and created in 1997 by the Japanese collective Dumb Type. The work is performed by a group of seven performers in a pure-white stage environment, whose central scenographic feature is a large, semicircular screen which acts as a visible cyclorama and upon which large-scale, synchronized video images are projected from a series of three video projectors positioned on the floor of the stage.

The performance was originally conceived as a series of nine short, vignette-like episodes ("Edge," "Operating Room," "More Wings Wheelers," "Anesthesia," "A Song of Sevens," "Flash Card," "Zero Radius," "40 Winks," "Mutilate") whose overarching themes are the religious, medical, cultural, biological, and philosophical perspectives on the subject of life and death. As the last project conceived by Teiji Furuhashi (one of Dumb Type's founders and the artistic director for the group) before his death from AIDS during the work's development process, *OR* is an intense, emotionally charged performance tightly synchronizing video, light, high-decibel audio, and human bodies into a space of visual white-out, phantasm-like projections, and almost futile, repetitive gestures, movements, and words from the performers themselves. The visual and auditory design of the performance marks a further development of the collective's formal and stylistic experimentation, which in the mid-1990s encompassed more mechanically complex stage environments and forged an aesthetic negotiating the "static visual arts and performance dependent on dialogue,"[1] while charging the resulting work with a compelling strain of political activism and cultural critique. As a performance involving "an advanced technique of combining electrical images, sounds, lighting, and performers, Dumb Type's specialty,"[2] *OR* seeks to address the following question:

> When your life flashes before your eyes,
> which direction does it go?
>
> The burning rope. The flickering frame.
> The empty cascade between this moment and the next.[3]

1 Quotation from the Dumb Type website: http://dumbtype.com.
2 Ibid.
3 Ibid.

– View of *spectra II* (2002) by Ryoji Ikeda.
© Ryoji Ikeda. Photo: Robin Reynders,
courtesy Forma (http://www.forma.org.uk).

Ryoji Ikeda
spectra II (2002)

The work *spectra II* is an immersive architectural and sonic installation by composer Ryoji Ikeda that exemplifies the Japanese artist's interest in the phenomenal relationships between audiovisual media and seeing/hearing subjects. Deploying Ikeda's favored techniques of extreme minimalism in compositional and visual aesthetics together with an almost mathematical precision of execution, the installation is the second part of the *spectra* series of architectural installations (*spectra* in 2001 and *Spectra for Terminal 5* at New York's JFK Airport [the TWA terminal designed by Eero Saarinen]). These installations use sound and light to vary the physical and imaginary boundaries between physical and perceptual space.

Invoking Bruce Nauman's infamous corridor works from the late 1960s, *spectra II* consists of a ceiling-topped hallway, about 27 meters in length, that can accommodate one visitor at a time. Laser lines mark out distinct regions in the space, which is continuously altered perceptually in size and depth by shifting between near darkness and blinding stroboscopic light that is synchronized to a series of sinusoidal tones emanating from speakers located throughout the corridor. While the laser lines serve to mark out a solid geometry in the narrow space, the disorienting synchresis of the sinusoidals, the stroboscopic light, and the intensely reflective quality of the white space serves to briefly blot out the linear geometry of the corridor, replacing its borders, edges, and surfaces with a continuous field of brilliant, monochromatic luminosity. Simultaneously, Ikeda's interest in psychoacoustic principles inherent in the perception of pure sinusoidal tones as relative to the listener's position, as well as similar phenomena such as binaural illusions, masking, and resonance/standing waves, is materialized through the process of physical and perceptual disorientation. As the listener/perceiver attempts to navigate the changing visual environment, his or her own perception reveals an equally dynamic and fluctuating acoustic space on the basis of the interaction between sound and listener.

Chris Salter
Schwelle: Schwarzraum (2003/2004)

– Photograph of *Schwelle: Schwarzraum* (2004) by Chris Salter.

Schwelle: Schwarzraum is a responsive environment consisting of barely perceivable levels of light and sound. The project confronts visitors with a direct experience of physical embodiment, intense concentration, and restlessness arising in the process of breathing during meditation. The installation consists of four technical elements: (a) four individual tunnels, one by six meters long, outfitted with a series of fabric screens featuring progressively larger rectangular openings; (b) a series of very bright, blue LEDs installed in the back of each of the tunnels; (c) a CO2 sensor, micro-controller, and computer; and (d) an audio system of parabolic speakers/reflectors and full-range speakers/subwoofers. The experience lasts around 20 minutes. The visitors are brought individually into the pitch-black environment and shown their places on the floor by an attendant with a small flashlight. The visitors are told nothing about the technical system in the room, only to keep mindful of their breathing. Once all of the participants have entered, the room is in total darkness for three minutes. Gradually, the LED brightness increases from 0 to 40% over the course of eight minutes. Simultaneously, the system begins to measure the level of CO2 in the room every minute and, on the basis of a lookup table of values, begins to adjust the various audio parameters. After eight minutes, the CO2 measurements begin to affect the lighting parameters as well. Sound, barely audible at the threshold of hearing, begins to fill the space from loudspeakers positioned in the corners of the space, its amplitude and frequency almost imperceptibly altered by the minute changes of carbon dioxide in the room's atmosphere and the individual breathing of the participants. Over the course of the 20 minutes, the barely perceivable lit surfaces slowly appear in the distance. The changing intensity of the light's color temperature makes these surfaces simultaneously flat and deep. The room, made apparent through the imperceptible changes of light and sound, appears to expand and contract, locked in a dynamic coupling with the participants' own breathing patterns as the room moves in and out of the visitors' threshold of perception. Space becomes a screen for mental projections and hallucinations.

Alex Bradley and Charles Poulet
Whiteplane 2 (2005)

– Installation views of *Whiteplane 2* (2005) by Alex Bradley and Charles Poulet, from a concept by Alex Bradley, Charles Poulet, and Johnny Goodwin. Courtesy the artists.

Described as a "collaboration in sound and light" and "theater without actors" by its creators Alex Bradley and Charles Poulet,[1] *Whiteplane 2* is an immersive audiovisual installation originally produced at the BALTIC Center for Contemporary Arts in Gateshead, UK, in 2005. The installation is comprised chiefly of two large, horizontally suspended planar surfaces which form the environment's ceiling and floor space. The floor and ceiling act as continually changing surfaces of light, which materialize by means of thirty LED fixtures embedded in each surface, behind which stretched projection screen material (the ceiling) and thick and opaque Perspex covering a steel frame (the floor) diffuse the light. As audience members come and go during the course of the continually cycling installation, they sit or lie down on the floor, which constitutes one of the luminous surfaces. A specially designed multichannel sound system employs ambisonic spatialization techniques over twelve loudspeakers which are positioned in a 360-degree circle. The ambisonic technology enables precise control over the position and the reflection of sound, giving the impression of a spherical sound field engulfing the visitors. In this way, the relation between sound and image is set into tension between the flat planes of light above and below the perceivers and the spherical audio surrounding the entire space.

1 Quotation from the *Whiteplane 2* website: http://www.whiteplane2.org/old/project.html.

– Still from *Still: Waiting 2* (2006) by Lynette Wallworth.

Lynette Wallworth
Still: Waiting 2 (2006)

Created by Australian media artist and filmmaker Lynette Wallworth, *Still: Waiting 2* is a poetic interactive video and sound environment that explores the ways in which human and natural time cycles operate and influence each other. The installation focuses on and seeks to capture a specific event taking place in the Flinders Ranges and outback of South Australia: the mass flocking, nesting, and departure of white Corella cockatoos in the Red River gum eucalyptus trees that line the riverbeds in the area. Upon entering the installation, the visitors experience a large, high-definition image of the birds roosting in a single gum tree in silhouette, obscured behind a veil. As the visitors enter the area of the projection, their motion triggers a new image: the sudden departure of the massive flock of birds from the tree, filling the room with an incredible burst of noise delivered in surround sound.

As the visitors face an empty tree, their experience of time and space is momentarily suspended in their waiting for the birds to return. The image of the barren tree remains as both a reminder of the past moment (the birds roosting and departing) and a marker of the present, frozen duration of time. Through the possibilities of interaction, *Still: Waiting 2* uses audiovisuality to explore the connection between human time and the temporal flow of nature, bringing both together in a complex, immersive world that fuses culture and nature.

– Photographs of *Zee* (2008) by Kurt Hentschläger.
© Kurt Hentschläger.

Kurt Hentschläger
Zee (2008)

Zee is an immersive audiovisual environment by Austrian artist Kurt Hentschläger whose elements include fog, stroboscopic light, and audio. A successor to the artist's *Feed* performance, *Zee* consists of an extremely dense space of fog which, when pulsed by four stroboscopes flickering at different frequencies, appears to the visitor as a "psychedelic architecture of pure light." Small groups of visitors are led into the "void, the absence of space" through a narrow passageway.[1] Once inside, the visitors encounter a landscape without defined geometry or boundaries—what Hentschläger describes as "kinetic space in continual flux."[2] Color changers attached to the powerful stroboscopes alter the color of the fog, creating an atmosphere of flickering color. An ambient soundscape serves to create its own aural density, in effect intensifying the spatial disorientation of the visitors.

Zee plays primarily with the flicker fusion rate. When the strobes flicker slowly, the visitors perceive a kaleidoscopic image with a few large geometric shapes; as the flicker becomes faster, they perceive a more dense pattern, with smaller shapes. These visual patterns are created almost entirely by the loop between the environment and the perceiver, specifically, the perceiver's primary visual cortex. Interference patterns developed between the (external) strobe frequencies and the (internal) "refresh rate" of the visual cortex are produced in the brain, most likely the result of different speeds of temporal integration taking place at different locations in the visual cortex. The result of such interference patterns is that through its own processes of self-organization brought on but not determined by the external flicker, the brain itself begins to produce patterns that may mimic the patterns of the external environment. In this way, *Zee* challenges the divides between perception and sensation and interior and exterior space. Audiovisual perception takes place not only in the physical environment but also in the sensorimotor loop between the environment's production of sensory stimulation and the brain's own pattern production.

1 Quotation from Kurt Hentschläger, personal correspondence with the author, November 13, 2009.

2 Quotation from the Kurt Hentschläger website: http://www.hentschlager.info/portfolio/zee/zee.html.