and everyday space. This is an aspect of the ethico-aesthetic adventure of the work that greatly appeals to me and fellow experimentalists.

Now the same questions about the event also have a radical, microtextural inflection. Could technologies like computational media, real-time sound and video (re-) synthesis, cheap hobbyist sensors, and the like be added to the mise-en-scène of theater as Antonin Artaud dreamed, to extend the "theater of cruelty" in a way that is relevant to us today? In his "First Manifesto," Artaud proposed to expand each element of theater's arts according to its potential transformative power: stage lighting, language (intonation, symbolic code), musical instruments, set design, lighting, costume, stage, props.[23] Artaud's "theater of cruelty" would create a theater that would not drop out of our consciousness as soon as we've finished consuming it but would transform those who encounter it as utterly as the plague. By "cruelty," Artaud explicitly did not intend the meanness of human hurting human or animal, but the implacability and indifference of matter to our human ego. Stone resists, and a tree greens, and software breaks regardless of what we say. If we desire matter to perform differently, we cannot simply legislate or script it by brandishing a pen alone; we must also manufacture a symbolic material substrate that behaves differently from ordinary matter.

In what way could such an aesthetic challenge be met by finite beings, with finite resources? My response would be: Yes, we have finite resources, but are we finite beings? Granting humans infinity as Levinas did, the question refines to: How is it, with finite traces, finite energy, and finite time, that we can make the moves of infinity? There are many answers, one of which is Kierkegaard's assertion that there simply exist knights of infinity. Actually this question is the same as: How can humans do mathematics with infinite objects and processes using finite traces? Or, how can poets speak of unbounded passion and history with finite signifiers?

For me, the subclass of events on which to focus attention is that of intentional events in which improvisation, to be meaningful, is structured improvisation over prepared and decidedly not random conditions. Near the end of the film *The Empty Space*, Peter Brook described how actions, to have expressive power in dramatic event, must be *committed*.[24] In addition to this imaginative commitment, some other qualifications, by a *via negativa* different from that which led Grotowski to his poor theater, are that the participants must be physically copresent, the activities collective and essentially alinguistic, and the participants' experience *continuous*. In the wake of quantum mechanics, most nonphysicists forget or do not know that quantum models are selected for agreement with their continuum limits, which I would recharacterize as phenomenological limits to draw attention to the heart of the nonclassical matter. This heart is observation and measurement that inextricably intertwine (via an inner product in a Hilbert space) the observer and the observed.[25] It's necessary that a quantum theory agree with classical theory in their common scale of macroscopic energy.

Given that people have enormous amounts of sedimented experience with the physical world, we can leverage such noetic experience by using quasi-physical models. The ambient environment will be thick with media, filled with thick sound, thick video, dense physical materials, so that people will live in a dense matter that responds and evolves in the course of their activity. All of this activity can be conducted alinguistically without the need for spoken language. On the other hand, speech is not prohibited; it's just dislodged from its throne in favor of a plurality of modes of coordination among the bodies and media in the space, again as a way to estrange the speaking subject, and render more prominent the material dynamics of the lifeworld on the other side of the veil of the technologies of language.

By "thickness" I refer not only to perceptual thickness—density of video and sound textures—but also to the rich magma of social, imaginative, and erotic fields within which people play even in ordinary situations, situations in which we perform without first analyzing and cutting up our experiences into analytic layers: How did I smile? How did I rest my feet on the floor? Did my voice carry or resonate well? Did I stand too close to or too far from other people? Did I interrupt or listen or talk over or under other speakers? Is the light too bright? Thickness also, and by conventional measures more consequentially, connotes historical contingency in all its depth and density.

I say "thick" mindful of Clifford Geertz's sociological and anthropological approach to describing culture in all of its rich social patterns and dynamics without orthogonalizing it a priori into categories and schemata that we would bring to bear on that culture. The dynamical potential field of experience should be designed in a preorthogonalized way by the composers, and enjoyed by the participants without requiring that they make any cognitive model of their world in order to perform in it. Why? Engineering's power derives from the portability and extensibility of standardized schemas and methods that apply globally over phenomena and life. Our engineered systems are already built on taxonomies that must be navigated by grammars and operated according to rules that discipline our thought and action—the action of power to discipline humans into docile bodies has radically evolved under the impact not only of the informatic technology but the epistemic matrix that encases our imaginary. These taxonomies rest on fundamentalist distinctions such as signal versus noise, functional versus aesthetic, and syntactical versus nonsyntactical (relative to a grammar). It's not enough to side with noise as the opposite of signal, or idleness (the vacation) as the opposite of wage slavery, because that still leaves in force the distinction made by the relevant schema in power.

In the last chapter, we will take up the phenomenological implications for this artistic and technical approach to performance. But now we take an extended tour of a responsive environment built to sustain events with such aesthetic and experiential qualities.

TGarden: Toward a Poetics of Performative Space

Vision

In this section, I discuss a series of installation-events called TGardens. These were tangible environments envisioned as physical spaces filled with computationally augmented video, sound, and luminous material that responded to the improvised gesture and activity of their inhabitants, called *players*. I conceived them as *phenomenological experiments* in interaction and response, agency, and intention. By definition, *Gedanken* experiments exist in thought, but they are performable in principle informed by material, corporeal practice. By phenomenological experiment I mean imaginative propositions made material, designed without presupposing topologically compact subjects or action sequences defined according to an a priori schema. I describe the architecture of these performative spaces in enough detail to be able to address certain phenomenological questions about agency and the continuum of intentional and accidental gesture in the dynamical substrate of calligraphic media without grammatical superstructure.

In particular, the return to the performative and the embodied offers an opportunity to reopen questions about the phenomenology of performance and about the phenomenology and poetics of performative spaces that respond to the activity of their inhabitants. These questions concern the thresholds of agency, gesture, and intention without reference to a grammatical or rule-based superstructure. The TGarden emerged from a conversation among members of an experimental art research group called Sponge, founded by Laura Farabough, Chris Salter, and myself in 1997. We had been building experiments exploring what I called deferred (delayed) agency and quantum performance—performance at the threshold of perception.[26] My colleagues set a challenge to make our discussions about interaction and media tangible rather than let them remain at the level of verbal theoretical discourse: to materialize some of these arguments so that other people could encounter them as powerfully as people have ever encountered theater. In order to understand the TGarden project, one should bear in mind that it started as a poetic response to a conversation extending over several years among artists and theorists affiliated with the Interaction and Media Group seminar at Stanford University, from which Sponge was formed. In 2001, Sponge realized a series of TGardens in collaboration with the FoAM art group in Belgium and the Netherlands, exhibiting the installation-environments ultimately in more than ten cities in North America and Europe.[27]

For the Ars Electronica Festival in Linz (September 2001), we staged one of the instances of the TGarden—TG2001—as a miniature theatrical event.[28] Before entering the heart of the installation, a visitor chose a sumptuous garment to wear from a set of instrumented garments, each with a different strangeness. One billowed in clouds

of fabric so that the wearer grew three times larger but no heavier. Another added an odd elasticity to the wearer's body so she tended to flop as she walked. The visitor was led into an antechamber draped in black curtains and was dressed by an attendant. The attendant belted the pocket computer and battery around her waist and strapped sensors of acceleration to her arm or chest. It could feel like a medical exam but with a more erotic charge. The attendant told the visitor little about how to move but suggested that when the visitor dons the costume, she assumes not only a new body but also a new voice. The attendant told the visitor: listen, move, and attend to what is happening as she moves. Each of these fantastical costumes served as a phenomenological experiment, defamiliarizing the visitor's body so she could more readily improvise gestures.

When a visitor walked into the installation, he noticed that there were a few other people costumed unlike him. It was hard to distinguish some of them from the projected visual textures sweeping over every part of the floor and the walls. As he moved he left trails of image and sound behind him. The air was filled with a hubbub of sound. Everything visual and auditory seemed somehow made by living processes, but he could identify the entities that made them. The room bore aquatic kinematics, but there were no identifiable creatures of the sea. (The floor was illuminated with projected moving shapes and lines and textures by video projectors mounted 20 feet overhead.) As he waved his arms he noticed, perhaps immediately, perhaps after a while, that some aspect of the room's aural texture varied according to his movement. But depending on the sensitivity of the visitor, it could take a fair amount of play to begin to understand what was happening.[29] In a responsive environment like the TGarden, a particular gesture may not always elicit exactly the same sound, and yet the effect is reproducible. If a visitor can learn how to move to generate some desired effect, then he can begin to write calligraphically and play as if he were "bowing" through the medium, much as if he were dragging his fingers or limbs across materials like wool or metal sheet or rubber.[30] He can try to create his own "voice" out of the ambient sound field as he moves and dances about. He improvises gestures that elicit meaningful sound or image patterns and develops a personal repertoire of gesture and movement.

In a TGarden, each player was associated with his or her own set of computational media synthesis processes, and the entire room was associated with its own process as well. The entire room was treated as just one more player, but a decidedly nonanthropomorphic one. At the finest scale, the many streams of sensor signals were deliberately designed to include both data from physical sensors (such as acceleration forces) and numerically derived measures (such as energy or period) in the same processing ontology, reflecting an agnosticism with respect to the distinction between putatively internal and external sense data.

As a technical aside, the TGarden hosted a circle of concurrent activity: moving bodies; camera, sensors, radio; *softwear* (electronically augmented clothing or acces-

sories); software instruments computing statistics, dynamics, visual and sound synthesis; sound processor and interface, speakers, video mixer, projectors.

The visitor noticed that there were no well-defined objects in the room, but as she played in it minute after minute, or day after day if she were to return, she learned certain ways of playing that characteristically elicited more or less well defined entities, whether they were acoustic or visual or socio-psychological objects. She could observe more experienced or expressive players as they invented ways of playing and engaging the responsive space, and learn from their more deft action and response. Most of this intertwining could occur without verbal exchange. In the imagined ideal situation, as one body passed other bodies, it would leave behind material traces of itself: shadow, hair, echoes, and air currents. Even if one did not explicitly and actively acknowledge a passerby, one's shadowing matter intertwined with the others' residues, conducting material conversations in the wake of one's passage.

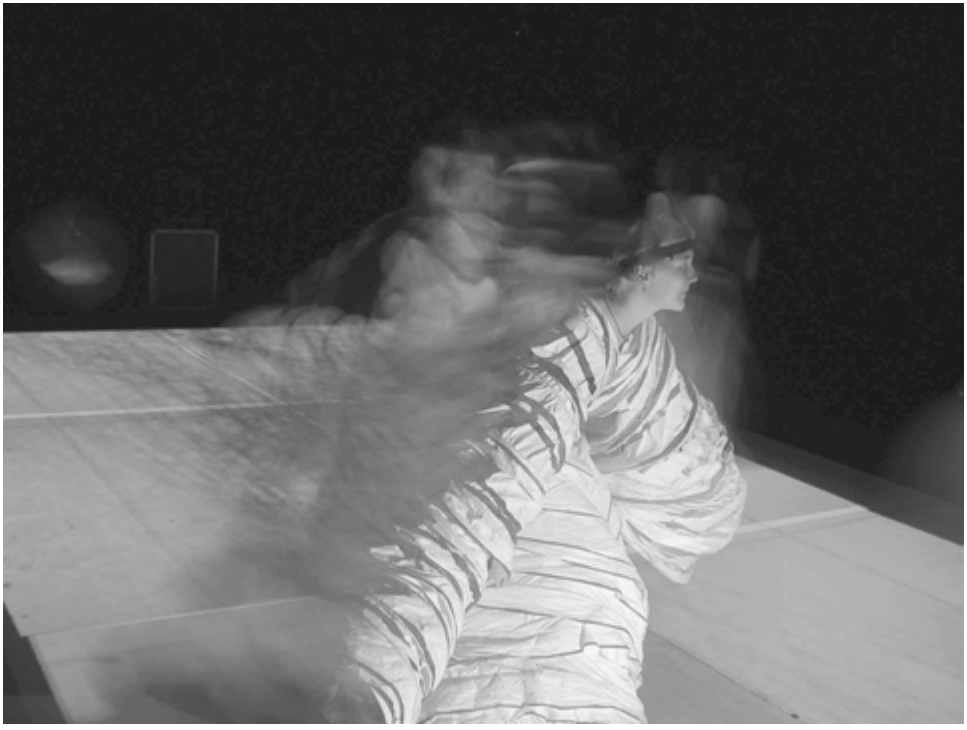

Figure 3.2
TGarden/TG2001, Ars Electronica, Linz, 2001. Nonprofessional visitors, costumes, wireless sensors, camera tracking, responsive sound and video, speaker array, projector array. Image courtesy of Sponge.

In one concrete moment, in the TGarden video entitled "hopskip,"[31] the rhythmic beat of the background sound enticed the player to jump. The accelerometer values mapped the jump to the 3D graphics, which in turn opened and closed the winglike pattern projected onto the floor. To the jumper, the pattern projected onto the floor felt astonishingly like an elastic rubber sheet, even though it was merely light cast onto an unyielding flat surface. Instead of simulating physics of elastica, we focused our engineering effort on optimizing the on-body sensor processing and reducing the latency to the point where the size of the holes of the projected pattern seemed concurrent with the motion of the jumper's body. Thus, there was no need to simulate the dynamics of a rubber sheet, because the dynamics came directly from the physics of fleshy bodies under physical gravity. The player interpreted the dynamics as elasticity that he ascribed to the projected graphics, which encouraged him to leap about the floor as if it were a trampoline. Our lesson was to minimize the software modeling to the "semantically shallowest" possible computation, and to reduce the layers of computational processing to the minimum.

TGarden as a Phenomenological Experiment

One of the key experimental purposes of the TGarden was to explore how we could make possible a compelling experience without relying on prescripted, linguistically codable narrative structure.

Having described the aesthetics of the living experience of this performative space, I pose three phenomenological questions:

(1) *How can people coordinate transformative and compelling experiences without relying on conventional linguistic categories such as verbal narrative*? The technical analog to this is: How can people create sense together in a responsive environment without resorting to grammatical structures? This question may seem a purely technical concern, but it has extensive ethico-aesthetic implications. For example, it impels us to seek alternatives to procedural if-then logic and to the locally linear syntax of time-based scripts and scores, including patterns found in conventional genres of interactive art and fiction. The material, one expects, makes a difference.

(2) *How could people improvise meaningful gestures collectively or singly in an environment that is as alive as they are, an environment that itself evolves over time as a function of its inhabitant life?* Interaction modeled on a particularly reduced notion of computationally mediated action and response is a far cry from animism and alchemy. What I propose to ask is how expressive gestures can be sustained in sensate and animate matter, some of which may in fact be computationally animated.

(3) *How could objects emerge continuously under the continuous action of inhabitants in a responsive space?* This question of novelty itself comes from a larger critique of technology, which I encapsulate in the motto "a rich but not complicated life," with a nod to Clifford Geertz's thick, preanalytic, preorthogonalized descriptions of the life-

world in all of its nuanced fields and relations and influences.[32] But instead of restricting ourselves to observation, in the studio-laboratory we attempt a potentially complicated immanent practitioner analysis. So in the Topological Media Lab we have built elements and techniques of responsive environments that can serve as apparatuses for exploring phenomenological questions in live experiments.

Humberto Maturana and Francisco Varela observed that a continuously self-reproducing autopoietic system cannot draw an objective distinction or operational boundary between exterior and interior stimuli. As Maturana and Varela were generalizing from nervous systems and cellular organisms, it seems that their observation should pertain to any autopoietic system, which the TGarden was designed to approximate. Therefore the TGarden's creators and players were by design and in practice themselves participant-observers of their responsive play spaces.

The significance of these three questions about compelling nonverbal play, improvised meaningful gesture, and the emergence of objects from fields is not confined to theater or experimental performance alone. Nor are the questions merely technical in the sense that they only help the professional performer or creator of performance spaces ply his or her craft. I believe that drawing from performance practice conversely refines philosophical questions about gesture, agency, and materiality.

In the course of building a TGarden that materialized the phenomenological investigation, we uncovered a number of technical questions, of which I will discuss three: How can voices be mixed and a causally individuated voice be foregrounded? How can multiple player agencies sum together? And how can the responsive environment detect the intent of a player? I discuss these questions because they constitute precise, concrete entries into the phenomenological experiment that a TGarden was intended to sustain.

Mixing Voices

One of the TGarden's purposes was to explore the erotics of the formation and dissolution of bodies from continuous fields of movement, sound, air currents, and video as textured light. Early on, the creators decided that resynthesized sound, being quintessentially temporal, was an ideal medium within which to blend multiple "voices" and sonic textures, so that the movements or gestures of a player would tease out traces in the sound field that the player might associate with his or her own voice. But since sound is an additive medium and diffuses around obstacles, superposing sound works only too well—multiple sonic elements blend into a single field of sound. Similar attempts to match sounds with individual players in a responsive space typically run aground on the same problem: How can players, the subjects in a dynamic field of audio that they cocreate with the music synthesis software, distinguish their own voices in a field of mixed sound? The naive approach would be to assign a pitch or a rhythm or some basic mechanical musical parameter to each person. But this