

Space-Dis-Place: How Sound and Interactivity Can Reconfigure Our Apprehension of Space

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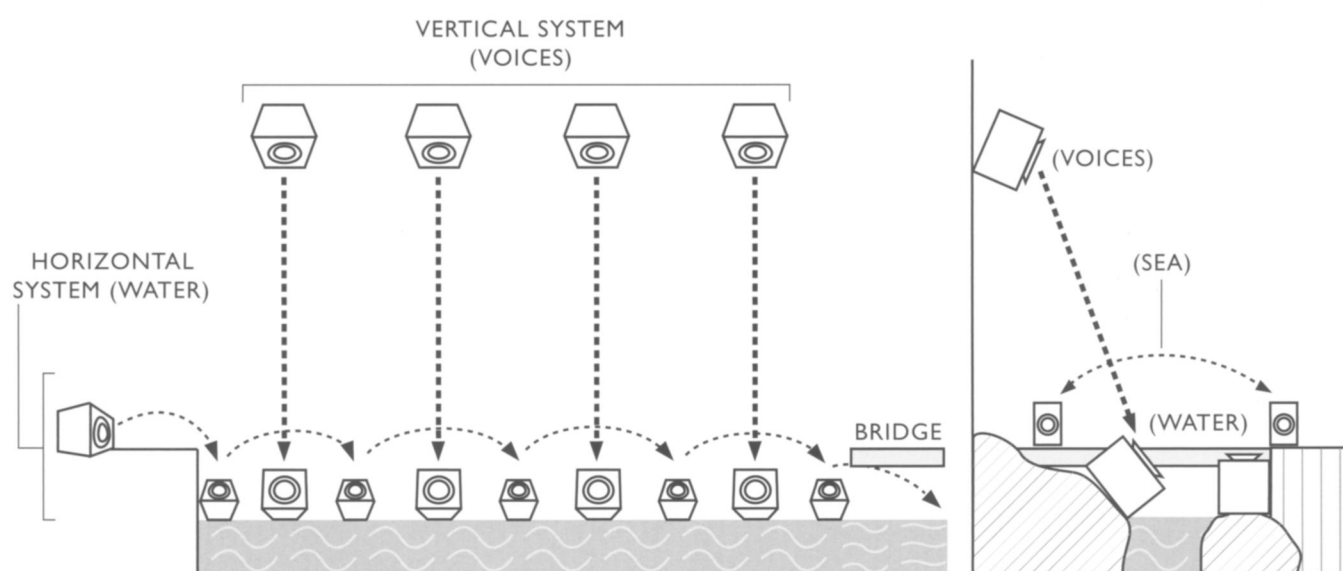
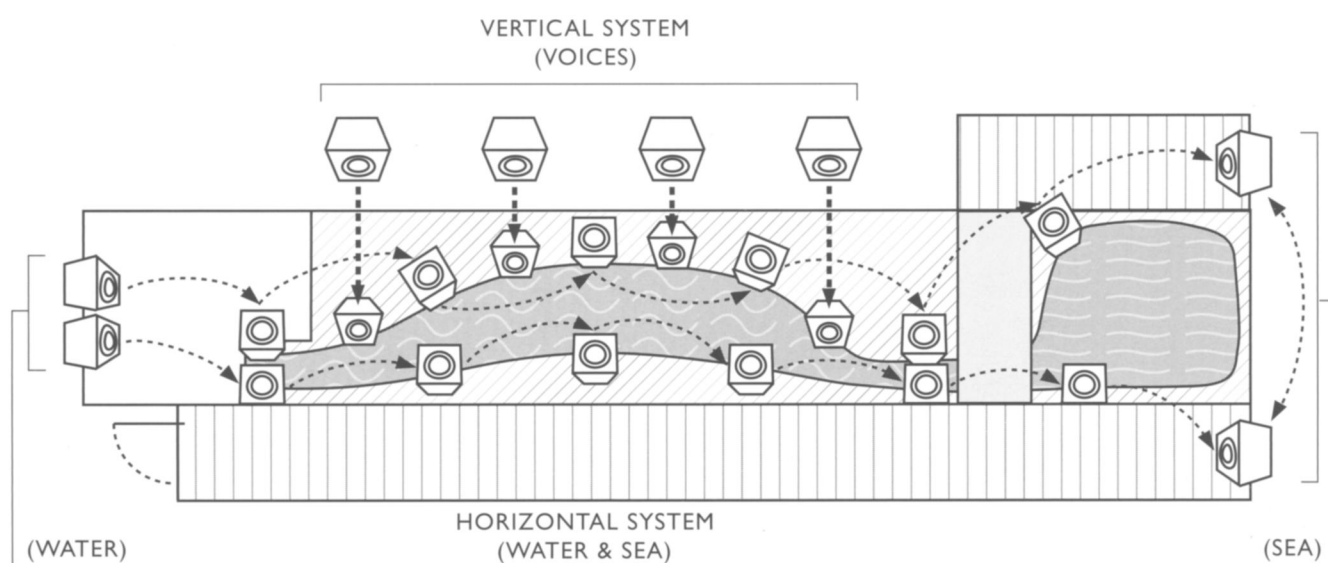
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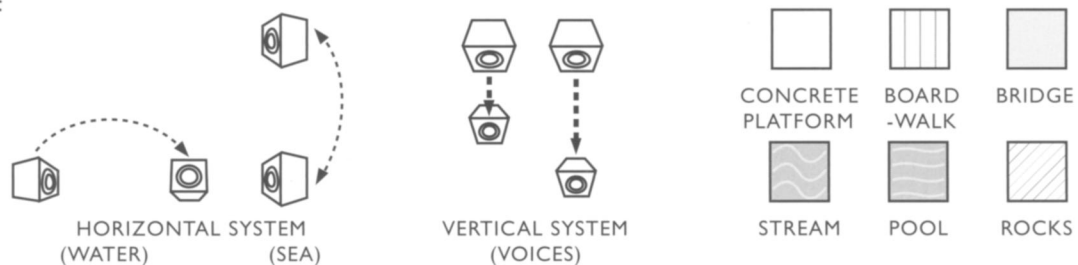


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LEGEND:



space-dis-place: How Sound and Interactivity Can Reconfigure Our Apprehension of Space

Stuart Jones

When the video artist Irit Batsry and I were making the linear video piece *These Are Not My Images (neither there nor here)* (2000) [1], one scene posed a particular problem. In it a woman was lying on a narrow sidewalk, hemmed in behind by shop fronts, with the camera looking at her from the other side of the road (Fig. 1). Pedestrians and vehicles crossed the scene in the foreground, briefly obscuring her as they passed.

The problem was a paradox: how to bring the audience into a position of closeness and intimacy in their contemplation of the woman while at the same time holding them at a distance from her? The second part of the task was easy: Throughout the movie, although there was no actual sync sound, I would construct fake sync sound at certain points, for strategic reasons. In this case I used the sound of passing vehicles and voices, synched to the image, to reinforce this traffic as a barrier between the audience and the woman. The first part of the problem was harder. To solve this I created a continuous whining ambience, oppressive but seemingly distant. This had to have the effect of both supporting the claustrophobic “hemming in” of the background and opening up a deep aural space behind the image, thus bringing it relatively much closer to the audience within the overall perceptual field. I did not provide the audience with any sound to associate with the woman, allowing them to participate in placing her in the perceptual field, which reinforced their intimacy with her. At the same time, when there was no passing traffic, the audience would be drawn closer to her, and then thrust back by something passing, giving an uneasy feeling of voyeurism and transgression. All in all, ostensibly simple sound-spatial devices worked with the image to create a complex relational space of anxious, uneasy, alienated, voyeuristic and contemplative intimacy.

In another scene, with figures in long shot at night, I had the sound of voices alternating abruptly between loud and soft, as if a door were being opened and shut on them, catapulting the audience backwards and forwards in relation to the image. In yet another, of a boy hammering nails in various extremes of close up, I had a hammer sound tightly synched to his action, and a background ambience of a workshop, which itself contained a lot of hammering sounds. I continually shifted the balance between the “sync” sound and the ambi-

ence, obliging the audience to re-adjust their sense of their position in relation to the boy. In both these examples the sound followed a temporal logic of its own, not necessarily congruent with that of the image.

All spaces, whether they are moving-image spaces, landscape spaces, architectural spaces or sound spaces, contain within them their own contours, features, dynamics and hence perceptual logics. In this group, sound space has a particular plasticity, and I am interested in how this plasticity, which is experienced both as a physical reality and as a psychological/emotional affect, can play with the dynamics of other spaces the sound space is cohabiting with.

Recently I was in a Moroccan restaurant, where there was music playing in the background. Every time the door opened the music got louder. I did not know what caused this, but the change in sound made the room seem larger or smaller. (It was an agreeable effect, even if perhaps a little disquieting for those eating.)

When I am making sound in a dynamic relationship with another “space” (e.g. moving image, architecture), I am in-

ABSTRACT

The author examines the plasticity of the perceptual spaces generated by sound and interactivity and how their dynamic relationships to other perceptual spaces, both mediated and physical, affect our overall perception of the space we are in. He does this by analyzing some of his own work, in the wider context of architecture and time-based art and design, referencing work by other makers.

Fig. 1. Still from *These Are Not My Images (neither there nor here)*, video, 80 min, 2000. Created in collaboration with Irit Batsry. (Still © Irit Batsry)



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Frontispiece. . . . upon the seas to which it eventually flows speaker, site-specific sound installation, 2002. (Diagrams © Damien Borowik) Layout (not to scale): (counterclockwise from top) plan, elevation view from boardwalk, elevation view from entrance end.

interested in what I call co-existence. This lies somewhere between Cage and Cunningham's strategy, in which the music and the dance were only related inasmuch as they were in the same place in the same time-frame, and the slavish relationship sound has to image in conventional Hollywood movies. I prefer to treat things, to put it rather poetically, as a dance in which the relationship between the partners is constantly shifting—at one moment in a close embrace, at the next spinning off independently, but always in touch with one another, within the dance. To me this makes sense because different media have different logics, in particular different space-time logics, and therefore (1) there are myriad ways in which they can play with/against one another, and (2) forcing one to conform to the logic of the other deforms and weakens it. I feel similarly in relation to the audience: I aim to set up strong parameters for them to operate within and strong invitations to them to do so. An invitation to the dance, so to speak. Although I am interested in how manipulative work works, and often enjoy it, I am not interested in making it.

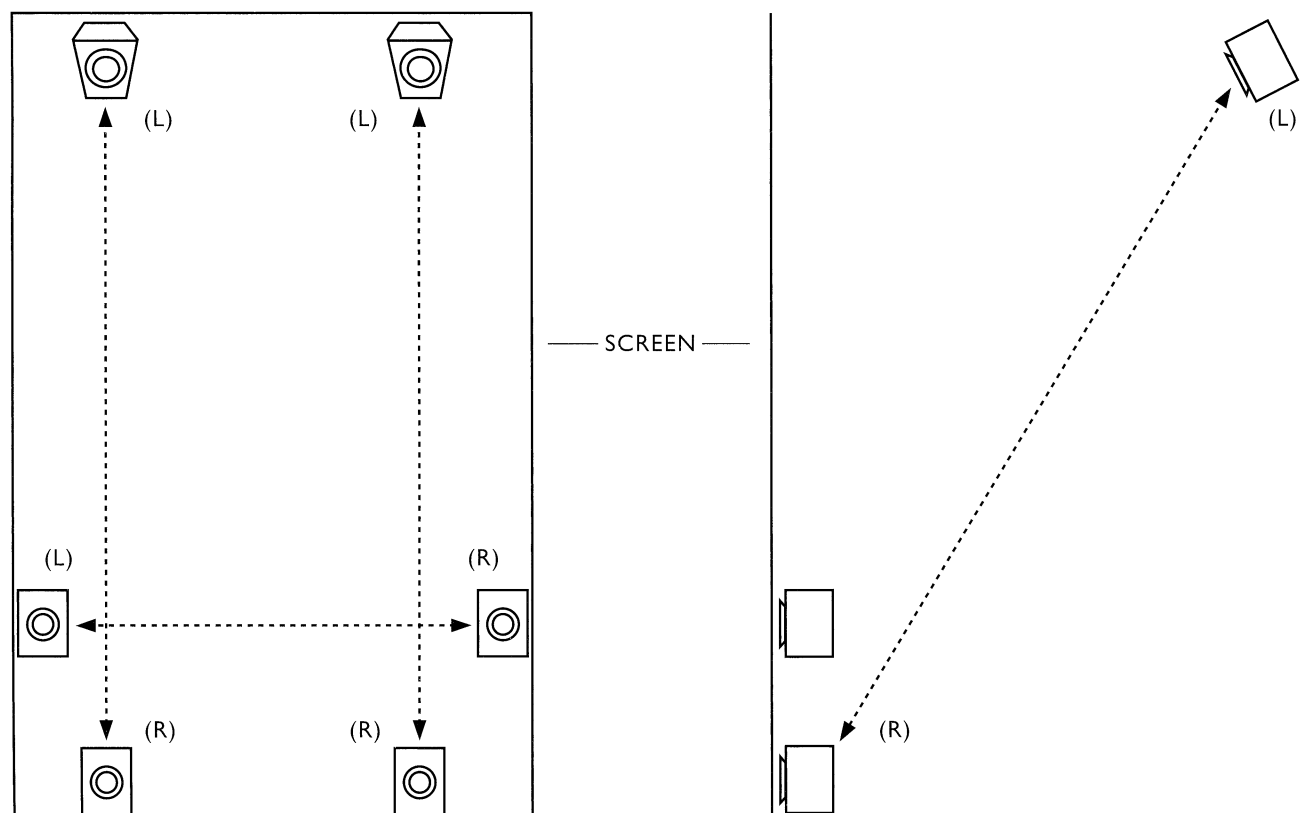
The plasticity of sound space and the very direct way we read it, which is dependent on a variety of things—most notably the way sound is physically prop-

agated, and our hearing apparatus and early neurological development—mean that sound has a particularly powerful ability to influence the perceptual and thence psychological reading of the overall space. In a movie theater, the image, no matter how much depth of field it contains, is bound in a two-dimensional box. Meanwhile the sound, even if it is a simple stereo image, is continually setting the boundaries of the perceptual space in a fluid way and can move around and occupy any part of that space or several at once. This varipresence and our way of reading it mean that sound is more capable than other media of setting the agenda for our reading of the total perceived "reality." For example, the Martin Scorsese film *Raging Bull* (1980) is justly famous for its soundtrack, particularly for the extraordinary soundscapes in the fight scenes, which are utterly strange and dreamlike. We experience them as strange but simultaneously accept them as "reality." This psychological/perceptual scope is the result of a series of strategic moves throughout the film in which sound is used to disrupt and reconfigure our reading of "reality." This starts in the very first scene: We hear jazz of the period playing, and because of its placement in the soundscape, we read it as coming from a radio in the apartment.

In the last moments of the scene the music gets slightly louder, for no apparent reason, to the level of "film music"; then, at the cut to the next scene in a boxing gym, the musical phrase is finished off by the first few punches landed in a sparring bout. In the next scene—set at a noisy swimming pool—the positioning of the conversational voices in the soundscape continually reconfigures our relationship to the image, and in the final shot of the scene—a subtle zoom-in with exposure adjustment onto the body of the woman being discussed—there is the barely perceptible sound of drums buried in the audio bedlam, which, on the cut to a nightclub, reveals itself as the intro to the music playing there. So it continues throughout the film. The point about these audio strategies is that they are pretty much imperceptible, except under close analysis, and therefore pass unnoticed on the conscious level. Thus, in a film that ostensibly presents itself to us as a depiction of reality, these myriad invisible surreal disjunctions accumulate below the surface, to the point that we are willing to accept almost anything under the heading "reality."

In *Halo* (1998) (a collaboration with the artist Simon Biggs), a site-specific multi-participant immersive interactive installation in a church, there were two

Fig. 2. *Halo*, site-specific immersive interactive installation, 1998. Created in collaboration with Simon Biggs. (Diagrams © Damien Borowik) Speaker layout (not to scale) (left) front elevation; (right) side elevation (mirrored for two screens).



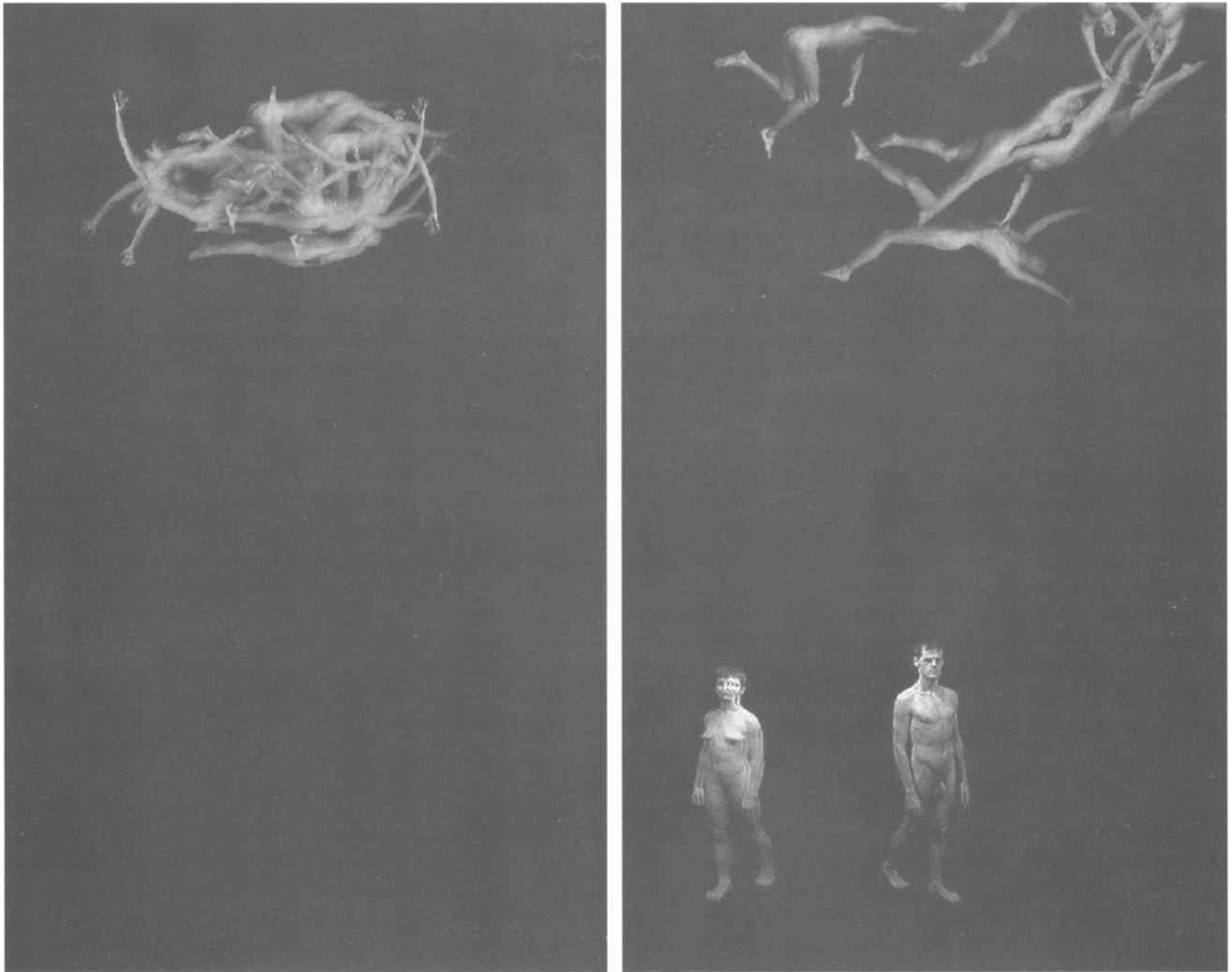


Fig. 3. *Halo*, site-specific immersive interactive installation, 1998. Created in collaboration with Simon Biggs. (Stills © Simon Biggs)
Still images: (left) figures circling above a user; (right) figures drawn down to ground level by the user.

huge screens, significantly taller than they were wide, which faced each other across a comparatively narrow space [2] (Fig. 2). Behind each screen the sound was relayed via two stereo systems, one oriented vertically from top to bottom of the screen, the other horizontally at head level. The speakers for the vertical axis were disposed in a plane angled to the screen. There was no light outside of the screens.

The same visual and audio material operated on both screens but behaved independently on each screen, depending on visitor interaction. In the initial state, naked human figures flew silently across the top of the screen (Fig. 3). As visitors approached, some of these figures might “notice” them and circle above their heads, singing. If visitors approached closer, the circling figures would descend and at a certain point fall to ground level, where they would move around in a deep perspective, whispering to themselves. Depending on visitor’s behavior, figures would advance to the “front” of the

screen, stop and “speak” to them. If visitors backed away, the figures would be released and float back up to the top of the screen. All audio material was derived by cutting recordings of readings from William Blake’s “Proverbs of Heaven and Hell,” from his *Marriage of Heaven and Hell*, into individual consonants and vowels, some of which were time-stretched, with a separate voice for each figure. The resulting material was randomly sequenced in various ways. In particular, when the figures were “speaking,” the software would randomly access a database of consonants and a database of vowels to construct “words” and “sentences” that sounded like spoken language but were, of course, gibberish.

Here there is a new space—the interaction space. Here interactants have power over the figures in the space: They can attract their “attention,” evoke their voices, summon them, bring them close and release them. The visitor thus actively engages with this space and in the process enters a more intimate and pow-

erful relationship with the totality of the perceptual space. This intimacy and power are not without uneasiness. The lack of visual boundaries (the image is mostly black), the narrowness of the floor space, the height of the screens and the remoteness of the high loudspeakers coupled with the extremely resonant acoustic all combine to undermine any sense of scale or location, so that the space is both vertiginous and seemingly limitless; the flying figures seem much further away than they are. When the visitor is close to the screen and the figures therefore approach and start to speak, they are larger than the visitor and their voices are commensurately loud, which can be awe inspiring. They confront the visitor, but at the same time they seem detached—not talking to the visitors but into a void. This sits uneasily with the intimacy of the interactivity, the sense of having made this happen. This uneasy intimacy is deepened by our ineluctable drive to understand—to make sense of utterance. We do it with cats, we do it with

whales and we do it with these large human figures who are making sounds so like sense, at the same time as we recognize that this is not sense. The piece sets up dichotomies at the level of experience (intimate/remote, close/edgeless) and understanding (expression/contentlessness) that encourage us to simultaneously become immersed in and deconstruct it. At the experiential core, it is the interactive participation that generates the space for us to do this.

Another aspect of this interactive space is the relationship that subtends between visitors. This is explicit in the piece, in that visitors are effectively in competition with each other for the “attention” of the figures and thence control over them. What happens is that visitors move from interacting with the piece to interacting with each other, using the piece as a medium. I explored this in a different way in another collaboration with Simon Biggs, *The Waiting Room* [3] (1999). In a room lined with mirrors in which visitors and screen activity were multiply reflected, figures sitting on one screen were caused by visitors to move to another screen where they danced a tango, the moves of which depended on user interaction. Meanwhile, in the sound, a tango was played by a quintet of (MIDI) instruments: accordion (melody and accompaniment), trumpet, piano (melody and accompaniment), bass and drums. “Hot” areas spread across the dance floor acted as controls for the instrumental parts. If visitors moved into these “hot” areas they would trigger the instruments to play phrases of melody, harmony and rhythm, which would be sequenced and varied according to their movements: They could play the instruments by dancing them. The invitation here is to cooperate rather than compete, to collaborate in making the music of the piece. In fact the music worked best if there were

enough participants to play all seven parts [4].

In the examples above (movies, immersive installations), the perceptual dynamics generated by the visual, aural and interactive space are contained within the “virtual” boundaries of the piece rather than the “real” boundaries of the physical space. Both *Halo* and *The Waiting Room* were site specific, but in both, architectural properties and atmospheres (the high ceiling and resonant acoustic of the church in *Halo*, the mirrors on the wall in *The Waiting Room*) were incorporated into the pieces and became part of their “virtual” perceptual space. This is a very powerful resource, but I would now like to look at what can happen if, conversely, the architectural space creates the boundaries, and the piece is incorporated into its real space.

... upon the seas to which it eventually flows (2002) was a site-specific sound installation for the interior garden in the Biosphère in Montreal. The Biosphère was built by Buckminster Fuller and Shoji Sadao as the U.S. Pavilion at Expo '67 and is the largest existent geodesic dome. It currently houses a research center and museum dedicated to the study of water use and conservation. Given Fuller's internationalism and wide-ranging thought, and the current use of the building, I decided early on to use voices reading his texts in various languages, as well as recordings of water that I had made all over the world. Before visiting the building, I imagined that the garden would be lush and circular in shape, and I thought I would make a dome-like structure with sound coming from loudspeakers hidden in the foliage. However, when I visited the site, I was surprised to find that the garden was relatively barren, consisting mostly of rocks, in a long, narrow space with a boardwalk on one side for the public, and a small stream running through

it parallel with the boardwalk, which flowed under a bridge into a pool in a wider courtyard at the right-hand end (Fig. 4 and Frontispiece).

The stream was an inspirational opportunity. I decided to use it as the focus for the piece, having all sounds flowing into and along it. On the horizontal axis, at the level of the stream, one stereo system went from the beginning of the stream to the pool, with sounds of trickles, streams, rivers and lakes moving left to right along the stream. A second horizontal stereo was positioned at the far side of the pool, with sounds of the sea. Four vertical stereo systems were placed along the length of the stream, facing the boardwalk, with “left” at about a 3-meter height, and “right” at the edge of the stream. Because of the rocks in the garden, the “right” speakers were significantly nearer the boardwalk than those on the “left.”

These vertical systems carried the voices. I selected a number of passages from Fuller's writings and invited friends, colleagues and students to choose one, translate it into their native language and be recorded reading it. One long text, about a crucial moment in Fuller's life, was read alternately in both French and English (Montreal is a mainly French but bilingual city). This voice moved gradually from left to right across the four systems, descending toward the stream as it did so, and was untreated. For each of the other, much shorter texts, in Brazilian Portuguese, Swedish, Spanish, German, Italian, Czech, Hebrew, Farsi, Tibetan, Chinese, Korean and Japanese, I found a river or stream sound that matched as closely as possible the overall tone and articulation of the voice, and edited fragments of it together to match as precisely as possible the actual rhythm and intonation of the reading. Each voice entered in turn, untreated, at the top of one of

Fig. 4. The Biosphère Interior Garden, two views, from either end. (Photos © Alex Martin)



the four vertical systems, and then repeated over and over again, moving toward the stream. As it repeated it was gradually transformed, by a process of vocoding and mixing, into its matching water sound, finally disappearing into the overall water sound at stream level. The voice sounds were mapped in time and space according to dymaxion [5] principles invented by Fuller.

I should add that I made no attempt to hide the speakers: They were almost brutally present, rather like strange technological outcrops on the wall or among the stones at the stream's edge.

I have gone into all this detail because I want to make clear how important it was to map the soundscape, both in its physical spatiality and its metaphorical and poetic connotations, onto the actual space of the garden, and how necessary detail was for that: the fact that the voices came nearer as they disappeared, the balance between the recorded water sounds and sound of the stream, their positions and rates of flow, the position of the sea sounds, the visibility of the loudspeakers, all contributed to locking the sound to the spatial reality of the garden, to containing it within it. This was necessary so that the wide-ranging physical referencing of the waters (intimate trickles to roaring sea) and extensive human referencing of the multiplicity of languages and Fuller's inventiveness, philosophical richness and spirituality did not disperse outward, but, being rooted in the garden, expanded and enriched it while it remained itself.

In my current work I am focusing on ways of integrating both sound space and interactive space into architectural space—not so much to create “art things,” but rather as ways of expanding and reframing the spaces we inhabit and use. Goethe famously described architecture as frozen music. No doubt he meant well, but if we freeze music, it is dead. I prefer Buckminster Fuller: “A room should not be fixed, should not create a static mood, but should lend itself to change so that its occupants may play upon it as they would upon a piano” [6]. Music is alive in time, and it is experiencing architecture as a flow in time that brings it alive. I am interested in exploring how the fluid spaces of sound and interactivity can enliven our relationship to the fixities of built space. To go back to the earlier anecdote about the Moroccan restaurant: On a subsequent visit I discovered that the increase in volume of the music when the door was opened occurred because there was a loudspeaker

on the porch playing the same music as inside, presumably to attract customers. No doubt the effect was unintentional, but it was audio interactivity: User activity (someone coming in) precipitated a change in the sound space, which changed user perception of the total space.

The fact that it was not intentional does not invalidate the event (it happened) but does bring us up against questions about users' awareness of the consequences of their actions and author awareness of the consequences of what they set up. The fact is, most interactivity in buildings is at the mundane level (automatic doors) and is pitched at the level of user unawareness. Most architects, furthermore, have no idea how sound works, even at the level of acoustics. To continue discussion of restaurants, in London the current fashion is for large concrete boxes, which means that all sounds bounce around the room, so people cannot hear what their tablemates are saying. Thus, they shout, so the sound level goes up and so on. No room here for subtle effects or romantic tête-à-têtes; this is more like an acoustic Darwinism: survival of the loudest. It is a far cry from the delicate acoustics of the Moroccan restaurant (cushioned benches, soft chairs, drapes in a tenting effect on the ceiling) which allowed me to hear the sound change; a far cry from the (intentional?) audio interactivity of the Whispering Gallery in St. Paul's Cathedral, London; a far cry from Carlo Scarpa's Brion-Vega Cemetery [7], where every aspect of the sound has been considered, from tuned steps to a “borrowed soundscape.”

My current efforts are focused into three strands, one of which I would call “data auralization” [8] in a project that has just started, one using sound diffraction and which is at the experimental stage, and one based on the use of mobile communication technology, which is at proposal stage.

In the first, called *Bop!—making sense of space* [9], I am working in a consortium of scientists, engineers, programmers, architects and designers to implement a network of sensors and self-configuring microcomputers in an existing design/creative research center that will provide streams of data generated by the activity of people using the building and the building itself.

This data will run around the network directly, instigating visual, aural and tactile manifestations that are resultant from the computer processes but not necessarily direct expressions of them, and also

go to a relational database, where, because the system as a whole has a learning capacity and a modicum of “machine intelligence,” it will recognize correlations between data streams and will execute data fusion processes that result in new sets of more complex data, while keeping the original data streams discrete. This last is of great interest to me as a potential infrastructure for a building-system with a level of independent intelligence capable of interactive conversation. That lies in the future; what I am immediately working on is direct generation of sound from the data streams. Two points have bearing on this. One is that we are much better at handling, and keeping discrete, multiple strands of information with our hearing than with our sight (if we could not, all Bach's efforts would have been for nothing). We can listen to the totality and understand it, or we can focus on a single strand (someone talking to us), or several unrelated (someone talking, the traffic behind us, music coming out of a shop door to our left) or related (the parts in a fugue). We are good at doing this, which makes sound a very suitable medium for relaying simultaneous strands of information to be immediately comprehended, something that remains a problem in the field of data visualization. The other is the issue of interactive immediacy: In complex, multi-user environments, immediacy is essential: If users cannot discern the effect their behavior has on the behavior of the work, the thread is broken and the connection dies. In this instance, to achieve speed and transparency, I intend to capture data streams at the code level and use software to render the code directly into sound rather than using it to trigger existent sounds. The question is how to characterize the audio iterations of the data streams so that they (1) are interesting to listen to; (2) can be conceptualized back to their sources; (3) can tell something about those sources; and (4) can coexist aurally in a comprehensible way. If I can manage that, then someone whose behavior is generating one of those audio strands will be able to contextualize it, pick out how their actions are shaping it and start doing things with that.

Vespers (1968) by Alvin Lucier consists of players using hand-held echolocators to find their way to the stage in a darkened auditorium. This explores (with typically beautiful economy) a key aspect of the relationship between sound and space: that one cannot hear a sound ex-

cept as it is shaped by the space and one cannot “hear” the space unless sound reverberates in it. This dynamic sound-event/space relationship means that although one may see space as an object (frozen music?), one hears it as activity. We appraise and decode space continually through this process, although most obviously in the dark, as demonstrated in Lucier’s piece. I want to explore this faculty with diffraction, a physical property of waves, in which in-phase copies of the same waveform alternately reinforce and cancel each other out. This is a common phenomenon with light (consider, e.g. a film of oil on water or the surface of a CD), but difficult to produce with sound, owing to its relatively long wavelengths and the fact that sound waves need a medium (air) through which to propagate [10]. The aural experience is extraordinary: If there is a single wavelength, the tone is alternately heard and not heard as one moves transversely across the space. If there are multiple wavelengths, the tones are heard in a repeating pattern as one moves (like the rainbow effect on the surface of a CD). This phenomenon, which is so unlike how we are used to hearing things, is interesting in its own right, but I want to harness its directionality and grid-like nature to explore new ways of mapping space and apply interactivity to it in order to dynamize our relationship to that mapping. My current experiments are focused on developing robust diffraction that can be usefully implemented outside of laboratory conditions, initially as an installation.

The “proposal” strand is intended to explore ways of building on the existing functionality of mobile telecommunication devices to make them simple tools for audio capture, manipulation and dissemination. It relates to existent activities such as podcasting, urban mapping and online gaming. To give a picture I quote below from a fictional story in the proposal that seems futuristic but may not be so.

I’m on the phone to a friend in France, watching a match on TV, my screen is flashing up a weather update, my diary is reminding me that I’ve got a meeting in half an hour and that I should have sent that photo I took an hour ago, my GPS tells me to turn left.

Turn left? Where am I?

I’m downtown in a city I’ve never been before, and the live/work space I’m inhabiting is my mobile.

The only problem is that it’s so homely, familiar, supporting and comfortable that I’m in danger of a) missing out on

the culture that’s around me, b) being run over by a bus.

So, I close down the telephone conversation and TV, call my appointment to say I’ll be late, and using the GPS and a website, do some exploring, all the while picking up virtual text/audio/video graffiti that others who’ve been here have left on the site, and inputting my own responses to the neighbourhood and its virtual graffiti-web. One graffiti leads me to a local café where I talk to a fellow musician who tells me about a site where I can download some open source software and midi tools for turning the mobile into an audio recorder/processor/playback device, with which I can sketch/improvise/compose as I go. It’s fun, and I’m sending the results to my daughter to listen to and to my home desktop for storing. As I’m playing with this I get a text from the guy who put me on to it, inviting me to participate in a city-wide mobile improv next day. I call him back to say yes and he tells me it will be broadcast from a web site and even, rather paradoxically, played live to an audience in a venue.

Most of the above functionality is already in place. People could even now do audio co-creating in a basic way, using the phone microphone, conference calling and real-time transmission to a web site. Software superstructure is needed to develop the existing functionality to a more usable, flexible and playful level. What is interesting here is that this is a new kind of space: that of a possibly enormously distributed, networked community, behaving together in a shared virtual space, where members are bringing to that virtual space their relationships to the real spaces they are in. I like this mix of the individual, the community, virtual space and real space, and the dynamic possibilities of it.

This seems to me just a potential part of an existing energy generated by people increasingly taking an active and intentional stance in relation to their world and evolving it. One can see this in the development of the World Wide Web, particularly Web 2.0, and phenomena such as the appropriation of SMS (short message service) to generate the new medium and dialect of texting.

When I was young I had the privilege of working with John Cage. Once we stood on a traffic island in a busy street listening to the traffic. He said, “Beautiful, isn’t it.” It was. I have always enjoyed the vitalization of the quotidian and familiar that comes when the attention is reframed. Sound is a superb tool for engineering displacements that make this happen, and I have continually returned to this in my work. Nowadays technology

is making it possible for us not just to enjoy but also to be active, responsive and conversational with an increasingly responsive environment. All my current activities are based on a belief in the value of us having a dynamic relationship with the space we are in, whatever it might be. Buckminster Fuller said: “I seem to be a verb.” This sounds good to me, and if we are being verbs, it is going to be easier and more fun if the spaces that surround us are being verbs too.

References and Notes

1. *These Are Not My Images (neither there nor here)*, video, 80 min, premiered at Rotterdam Film Festival, 2000; broadcast premiere: Arte, 2000. Awarded Grand Prix du Société des Auteurs Multimedia, France, 2001; Whitney Biennial Bucksbaum Award, U.S.A., 2002. Irit Batsry is a video and installation artist. We have collaborated on several linear works since the late 1980s, most of which have won major prizes.
2. *Halo* (1998) was produced in two versions, one at Harewood House, Leeds, the other at Fabrica, Brighton. It is the second version that is discussed. Simon Biggs has worked in a variety of ways using the computer since the late 1970s. See <www.littlepig.org.uk>.
3. *The Waiting Room* (1999) was created for the Old Dining Room, Sheffield Railway Station.
4. We used three applications in these works: two (BigEye from STEIM and Director from Macromedia) were used in *Halo* and *The Waiting Room*; a third (LickMachine from STEIM) was used in *The Waiting Room* only. A customized version of BigEye was used to detect and track users in the space. That information was sent to Director and replicated as coordinates on the Director stage for invisible “proxy” sprites that represented the users. For the sound in *The Waiting Room*, I programmed BigEye with “hot” areas for each instrumental voice, mapped to the space. As users entered these areas, musical phrases were triggered in LickMachine. As users moved in the areas, phrases were played in random sequence. Speed and direction of movement changed values of MIDI continuous controllers. All phrases were kept in sync by a clock running in BigEye. It was extremely difficult to write the phrases, as all of them had to work with each other both “vertically” and “horizontally.” It was a bit like a very complicated version of *The Dice Game* by Mozart.
5. “Dymaxion” was coined by Fuller from “Dynamic,” “maximum” and “tension.” He used the word variously and fairly loosely (dymaxion car, dymaxion house, etc). I use it in the sense that he did when creating his dymaxion world map, in which “up and down” is replaced by “in and out.”
6. Buckminster Fuller, Chronofile 36/1929. For an explanation of the Chronofile, see the Buckminster Fuller Institute web site at <www.bfi.org/node/105>.
7. For an account of this remarkable work of architecture see Sergio Los, *Carlo Scarpa* (Benedikt Taschen, 1994).
8. I use this term in preference to the more common “data sonification” because its parallel—“visualization”—describes something both the maker and experiencer are doing; auralization is also something they both do; sonification is something only the maker does.
9. *Bop!* is a sort of acronym for the rather horrible “Building Awareness for Enhanced Workplace Performance”: One needs such titles to get money from government departments in the U.K. The consortium working on the project, The Aware Building

Group, includes companies (Arup, British Telecom), academic institutions (Central Saint Martins, Imperial College, Brunel) and independent makers and thinkers. Our long-term aim is to make built environments that are "intelligent," "aware," even "conscious."

10. This kind of multiple-source sound diffraction is distinct from the commonly experienced diffraction of sound "bending" around pillars or corners or spreading out through a slightly opened door.

Manuscript received 23 December 2005.

Stuart Jones started his career in the late 1960s, co-founding Gentle Fire and working with most of the European and American avant-garde, notably Cage and Stockhausen. After a period of working with musicians in Africa and Iran, he has been based in the

U.K., working as a composer and performer and as a sound artist creating installations and linear work, both on his own and with the video artist Irit Batsry and the computer artist Simon Biggs. He is a Senior Research Fellow at Central Saint Martins College of Art and Design, working on interactivity in the built environment.

Happy 40th Birthday, Leonardo!

Forty years ago in Paris, a group of artists, scientists and engineers got together and decried the lack of professional venues where emerging work bridging the two cultures could be presented, debated and promoted. **Frank Malina**, himself a research engineer and a professional artist, convinced publisher **Robert Maxwell** of Pergamon Press to take on the challenge of publishing a peer-reviewed scholarly art-science-technology journal, the first time such a project had been attempted. Thus was the journal *Leonardo* born.

In celebration of *Leonardo's* 40th birthday, we will be organizing and co-sponsoring a number of events and projects as one way to bring artists, scientists, engineers and scholars into creative friction, face to face, on-line and through publication and dialogue:

Leonardo Celebrates Leonardo da Vinci

Special Section of Leonardo, 2007–2008, edited by David Carrier

What, building upon Leonardo's ways of thinking, can artists and scientists tell each other today?

Full call for papers: <www.leonardo.info> (under Events and Projects, click "Leonardo 40th Anniversary").

Inquiries and proposals: David Carrier: <david.carrier@cwru.edu>.

Leonardo in Spain: Expanding the Space (October 2006)

We are pleased to co-sponsor Expanding the Space, a conference and workshop on space exploration and the arts: <www.expandingthespace.net>.

New Ideas in Art and Science II (Prague, 2007)

Leonardo will co-sponsor conferences and exhibitions in Prague, organized by the International Centre for Art and New Technologies (CIANT): <www.ciant.cz>. Info: <rmalina@prontomail.com>.

Leonardo in New York (2007)

Panels and events at the 2007 College Art Association meeting. To get involved join the Leonardo Education Forum: <www.leonardo.info/isast/educators.html>.

All 40 years of Leonardo Articles Now Available On-Line

Volumes 1–33 available through JSTOR: <www.jstor.org>.

Volumes 34–39 available through MIT Press: <www.mitpressjournals.org>.

Also planned: Events in India, as well as the first Leonardo International Conference, to be held in 2008.

If you are interested in being involved, or have ideas of how we can celebrate the work of the new Leonardos, send e-mail to <rmalina@prontomail.com>.

WHAT YOU CAN DO TODAY

We know what Leonardo da Vinci could have used for his 40th birthday in Milan: **a gift membership in the Leonardo organization and subscription to the Leonardo journal**. If you know any budding Leonardos, buy them a gift at <www.leonardo.info/members.html>.