Sound and Space

WARREN BRODEY MD

A Washington psychiatrist who has been working with the blind finds a field for architectural research which should throw light upon the effect of spaces upon people

MOST ARCHITECTS would like to design a building that not only looks beautiful to the eye, but also sounds beautiful to the ear. Pleasing all the senses is important. But ordinary sounds are so familiar we are not accustomed to being aware how profoundly they affect us. "There is something just right about this space" may include acoustical characteristics for which we have, as yet, few words.

How does one break through what was so familiar as to be unmentioned, taken for granted and technically ignored? A visit abroad, a child's naïve question, a foreigner's insight—people who don't share our conventions can help us pay attention to what we have learned to ignore.

Our cities roar with noise we do not hear except on a tape recording. But mere suppression of bad sound, either loudness or jarring tones, does not create beauty. The sound of spaces once could not be technically designed: It could not be recorded. New refinements in materials, in tools, in what we can do encourages the reopening of a broadened awareness of new ways of designing our sensory environment so it will work with us.

Our capacity to design the responses of our environment is increased. The interior of a space capsule is a token of our skill in extending human environment design to optimize human sensory efficiency. But how can we break through the basic conventions of what it was "natural" to ignore because nothing could be done? How can we discover the new everyday questions about commonplace matters which our technology can easily answer, once asked?

The study of new kinds of foreigners—those foreign to our sensory conventions—is one way of breaking through. For three years now I have met bimonthly with a small group of blind people. The architecture of the sound world as they perceive it has particularly drawn my attention. The world they experience is often unlabeled with language and outside ordinary attention. They make us aware of something we have learned to ignore—the *sound* of spaces.

Acoustical Architecture

Blind people live in a world of sound. They see the distance with sound; they can use touch only within the radius of their arms. They use radiant heat and smell as additional sources of information. Their world is different.

People who have an unusual sensory skill can tell us, with new perspective, about the world that we live in. They can show us our world in terms of their building blocks.

A group of blind people is a natural resource if one wishes to locate skill at hearing. The world as seen with the ears can be made available by using the blind man as our guide; then, using his observations we can examine the nature of our own blindness to sound.

A blind man is familiar with the echo of his footsteps as they rebound from the boundaries of his room from walls and draperies, from rug and ceiling. He knows where an obstacle has interfered with this rebound. He knows the room where higher frequencies resonate and breath sounds seem more rasping. The sound of your breathing is one way the blind man knows you and where you are in relation to the objects of the room. He listens to hear sound as it is altered by the response of the physical environment. The different sound behavior of one space in contrast to another provides the blind man with an image of where he is.

If the blind man were a sound camera he could show us details of sound we know only by intuition. Let us proceed from his observations, as yet crudely measured, to our own observations of architectural sound.

Most clients are only aware that some spaces feel good. Others bother them. This difference is

Reprinted from the July 1964 Issue of the Journal *of the American Institute of Architects.*

customarily attributed by architects to the visual space. It is only attributed to acoustics when they are grossly distorted—or when there is music or public speaking or noise dampening to be considered. Shaping the experience of space by manipulating its sound is something more positive than this.

"Acoustical architecture" takes us beyond the measurement of materials and their effect on sound—to the science of how living people use their respective senses in different environments. All architecture is extending this way. The study of man-environment systems as an information unit is a modern way of thinking. This approach includes in architecture the technical study of man's senses as inseparable from what is available to be sensed. Architecture can stretch a man's use of his sensory skill. Color awareness for example is enhanced by using color. Good environmental design teaches the client to enjoy sense activities previously left unused.

Mood and Shapes in Sound

Blind people tell in vivid detail how some rooms have a kind of sound that is exciting and yet not too sharp; while other rooms have a sound that is soothing and yet not dull. I am aware that they measure sound in a way I have not learned. They talk of and remember the sound in a room as if they were talking of color.

The sighted know that the sound qualities of a room carry different moods. The room with hard plaster or cinderblock accentuates the higher tones, and this, as the blind point out, can increase fatigue by making everyone sound as if they were speaking sharply. A thickly carpeted and acoustically tiled room can make a board meeting fall dead. Contagious enthusiasm is wet-blanketed by a dead sounding space which is also virtually large. The gaiety of a hotel ballroom requires the right kind of sound—just the right bounce. A visually small room can be stretched to a critical point by giving it large-room acoustics. After this point it becomes uncomfortable. Incongruity of the environmental responsiveness to different sensory modes, sight, sound or smell can be upsetting—it also can be used. How long people sit in a restaurant, how quickly they eat, how much they drink, is a function of sound as well as of other factors.

Sense the shape of a room before and after acoustical tile has been installed. This will give you a clear idea of how shape and acoustics are interrelated. The acoustically tiled ceiling drops down to give a more intimate or closed-in space, one in which you feel like intimate talking. Of course this effect is accentuated or diminished depending on the physical dimension and color and texture as well. New computers will soon allow these functional relationships to be analyzed into simple equations.

The human factor is more nearly constant as more of the human senses and their corresponding environmental variables are included together in equations. Overlooking the effects of sound may be costly if one needs to predict human responses to a given space. The prediction which does not consider sound will be more random. You can dismiss this error as simply human variation, but this is costly. Computer prediction is for the near future.

For the present let us review everyday experience which can be tested by everyday experiments. Let us seek out new questions. Check this out with many people: What happens to the shape of the room when wall drapes are drawn or open? Try it first with eyes closed, then open. You will be caught by the experience into devising more exploratory tests. You can find that without changing the measured dimensions, a space can be shaped as an experience not only by color and texture but also by the characteristic responses to sound.

Acoustical Rooms

A visually open area can be divided by changing the acoustics of one part of its space. This change may be in no way visually evident. But its effect will remain, and strangely, people will find themselves grouping and functioning differently as soon as they cross from one acoustical "room" to another. These rooms have clear boundaries: Listen to your own voice sharply change as you cross the sound wall in a room which has been only partially acoustically tiled. Once aware of this change in acoustics, instead of taking it for granted, new potential for designing spaces is revealed.

The acoustical room—a volume of air with different acoustical characteristics from its environment—may have no visual walls, yet it organizes space nevertheless.

A blind person will stop suddenly as he hits the wall of an acoustical room. To him it is as real as a sudden change in illumination to the sighted. Test out the effect of an acoustical room on your own senses.

If you will walk a few feet into your office, then turn and walk out again, snapping your fingers or humming or talking to create a constant sound and keeping your ears at attention, you will notice the acoustical wall where the line of your sound breaks and your sound returns with a different tone.

Acoustical rooms designed to fit their function are valued. The client may have no idea what it is that makes it so good. Ladies declare, for example, that they look different in different lighting—they care about lighting. The architect varies his lighting in terms of the functions for which he designs. He changes the visual message emitted by faces by changing their setting and the kind of light available for the faces to shadow and reflect. He changes the visual person by modulating his visual context. The design of the acoustical space can likewise change the context and quality of voices. The architect by his design changes the kind of auditory message exchange most appropriate to the space he has created. This happens even without intention: it is inevitable even if neglected.

We have few words and few scales for measurement of these kinds of characteristics. But there is no space which has not an effect on sound.

The acoustical design of a house can make a family happy or miserable. Some dining rooms make children's voices pleasant—some convert their chatter to screeching. This is not simply a matter of deadening the children's sounds. An architect whose ear is as trained as his eyes can anticipate the echo chamber that he provides with the sound spaces he designs.

There are many energy sources of the sound in a room. Windows are conduits that feed in information. Windows, according to blind people, are not simply places where heat streams in or is drawn out. Windows are ears which admit sound from the outside world. These sounds bring the outdoors into the room and enlarge the space. When well mixed, outdoor sounds provide a background which facilitates attention. This is important in a school or a library. Some people prefer the silence of a library to maintain their attention at a task like reading; but then the sounds of footsteps become enormous. Most people like a general background of noise which will fuse motors, voices and other interferences into a neutral background of sound. This background is apt to be supplied by sound coming through windows. A well-mixed background sound gently illuminates the walls of the space and resonates the air.

Human Orientation

Man must constantly locate himself in the air, just as a fish does in the water. We use our senses to locate ourselves relative to our environment. Air is not dismissed as invisible by the blind. Like percussion waves in water, air carries sound.

The sound that comes through the windows, my blind subjects say, helps them orient themselves. The current of sound, like light, shadows furniture. Like light it bounces from each surface or is absorbed by it. Each material has different light and sound reflecting properties. The spectrum of frequencies being selectively absorbed or reflected adds detail to the sound image.

For the blind the obstacle-finding usefulness of sound spreading from the window or from footsteps or beamed with the breath depends on what the blind subjects call the room's "sound glare."

The blind man finds some spaces easy to navigate; some spaces like a strongly-currented rocky seashore reflect sound so that it bounces and interferes with itself, building whirlpools and eddies. This room is tiring.

The sound of your voice as it returns to your ear is a servo or feedback loop. This part of the energy returning serves as a corrective control. You automatically vary your voice as you move about to keep it relatively constant to your ear. This is automatic—but too much corrective work is fatiguing.

When the sound image coincides with the touch image and sight image, the space is experienced differently from when these don't coincide. Poor orienting conditions make it more difficult for the blind man to know where anything is located. These conditions also make life uncomfortable to sighted persons who cannot easily know what is happening behind them without looking. Much of our 360-degree vision—our early warning system—is by earsight. In some situations perceptually uncomfortable spaces may be useful. Can we design them that way on purpose?

The senses do not operate separately; they exponentially reinforce each other. The variation in pattern between what they perceive is important to our judgments. A man's visual size, his detail, his heat radiation, the sound of his voice—all are a part of predicting his distance and the rate of his movement. The driver looking ahead on the roadway uses the sound of a car coming alongside as one warning system. Some houses behave badly and pop people into visual view without warning one's hearing of their approach; other thin-walled houses bring people's sounds into auditory view when there is no meaning to the sound contact. A corridor which resonates footsteps the way a blind man likes allows the sighted person to look directly at the face of his walking companion and give attention without fear of walking blindly.

Reclaiming Sensory Potentials

Technical instrumentation for reclaiming the sensibilities we have learned to deny is being designed. Meanwhile, you can enjoy an awareness of the fun of exploring the sound world you have forgotten. You will not likely be as expert at first as the blind. Before we were taught at school to ignore so much that was not in our lessons, we all played with sound. Blind children find delight in playing with the harmonics which resonate the volume of air in a particular room. They also know which kind of sound will bounce back off the walls with a sonar-like echo. All children are space musicians. To blind children, their school building is primarily a sound instrument. They love to bounce high-pitched sound up in a corner and angle the beams as if they were playing billiards. Blind men have told me that this play develops into their way of determining the height of a ceiling. If humans use their own sound as one orienting mechanism, it is not surprising that acoustical treatment will appear to change the height of a ceiling as it is reckoned by the auditory sense.

All the senses are mixed into a general impression which gives the "feel" of a space. Now we must devise systems of measurement so we can predict and design what will be sensed.

Man, with his progress, has earned the right to expect that scientists and architects will learn about his sensory system so that they can enhance his functioning even beyond the extent that he is now able to demand. Well-designed architecture can enhance man's awareness of his sensory skills. To receive this kind of compliment is a significant achievement. Man has become accommodated to sensory insults which bring more strain into his life than is necessary; he needs his energy to improve the quality of his life.

The architect and researcher together can go far beyond what is presently conceived as the optimal limits in providing for human comfort.

Man's "earsight" as an instrument of his effective functioning serves as a focus for one possible area of research. There is new and rich territory here, waiting for those with the knowledge, insight and enthusiasm to explore it. ■