Sirens

In 1978 I decided to try to design a better set of sound signals for emergency vehicles. I suppose one of the first questions that comes to mind is why an artist, even one who works with sound, was interested in leaving the comfortable confines of the world of culture to design new sounds for police cars, ambulances and fire trucks.

I didn't find it strange. I found it a very interesting puzzle to try to solve.

Compared with many urban problems, sirens may seem a relatively minor one, but then again, maybe not. The sound track of a movie provides a good example of the impact that sound can have on the way we feel and act. Two different sound tracks applied to the same visual scene can easily create opposite scenarios and evoke contrasting emotions.

The history of emergency-vehicle warning sounds is linked to the history of man's ability to shape sound. In New York, before the turn of the century, the firemen themselves pulled the wagons carrying pumps and ladders, while one of them ran ahead through the congestion shouting and blowing a trumpet. After the turn of the century, the mechanical siren was invented – the slow rising and falling sound which we associate with air-raid warnings. It was mounted on the wagon and activated by cranking a handle.

When fire trucks became motorized, someone had the idea of putting a whistle on the end of the exhaust pipe and letting the engine-exhaust gasses blow it. It made such a horrendous shriek that it was finally outlawed. With the arrival of electricity the mechanical siren was motorized. The operator made it sound with a pedal on the floor; when he pressed it, the sound would begin to rise; when he released it, the pitch would fall.

In the 1960s, when it had become practical to make loud sounds electronically, our present-day siren arrived. The sounds of the mechanical siren and horns were synthesized electronically and projected from loudspeakers, mounted on the roof of the car.

Looking at the history of these devices, it becomes clear that the sounds themselves have never actually been designed. They are, instead, the product of whatever could be found to make a loud noise.

Yet, with the introduction of the electronic siren, a fundamental change had occurred: for the first time the sound possibilities were unlimited. It was as practical to synthesize one sound as any other. But, instead of searching for better sounds, the existing sounds were simply copied and the limits of the old sirens were passed on to the new generation.

It turns out these sounds have many problems, the major one being that they are almost impossible to locate. Universally people say that they cannot tell where a siren sound is coming from until it is upon them. Unable to find the sound and becoming more nervous by its

approach, many drivers simply stop and block traffic until they figure out what to do. Others ignore the sound until they are directly confronted by the vehicle, sometimes with lethal results. Obviously it is not enough just to let people know there is a police car moving somewhere in the city. They need much more information if they are to know what to do.

In New York, the most conspicuous characteristic of sirens is sonic hysteria. Police and firemen, reacting to the frustration of sounds which don't work, have demanded the development of louder and nastier ones. They have reached the point of saturation. And they still don't work.

Siren sounds in Europe and the rest of the world are not hysterical, but one must admit they are a bit banal. These more melodic sounds seem to have been determined by the instinct of amateur musicians on the engineering staffs of the siren manufacturers. Perhaps they got so carried away with creative rapture that they forgot to engineer them. The European sounds share all the functional problems of American sirens; they are also very difficult to locate.

It is interesting to note, though, that the European sounds may soon be replaced by the American ones. Along with the spread of broadcasts of old American cop shows on television in other countries, comes the desire of every policeman from Paris to Bombay to be just like the super cop, Kojack. The screaming sound of Kojack's New York City police car is a big part of the image. I've recently seen and heard some test cars with the American sounds in France, Spain and Italy. If New York's sirens become worldwide, they will be the sound track for a 'movie' none of us can walk out of.

It is not necessary to frighten people in order to get their attention. It is quite feasible to design a set of sound patterns which are noticed and located quickly, and there is no reason why these sounds have to be either hysterical or banal.

In the early eighties, armed with these ideas, I began to approach the powers that be. Through the mayor's office, I arranged a meeting with the directors of the New York City agencies involved. They were skeptical. Like most people, the heads of these departments were convinced that these particular sounds were unavoidable, that they were the best that could be done. The first stumbling block was convincing them that better sounds could be designed and they could make a big difference.

Actually, the police were so skeptical that they did not even show up for the meeting. Instead, they called me at my studio later that afternoon and 'invited' me to police headquarters. The implication was that if I didn't come, they would come and get me. When I arrived, after a short discussion about my old unpaid parking tickets to put me in the right frame of mind, they began a thorough interrogation: artists are not supposed to fool around with the New York Police Department even if they do have connections in City Hall.

It turned out to be a fair fight. Although, while policing New York, they had encountered practically everything else in life, I do not think they had ever come across artistic obsession before. After three hours I walked away from it with two of their police cars. They volunteered to lend them to the project

and provide any other help they could. They are not fools; they realized it could make their working lives a lot easier. They also assigned a detective to keep an eye on me. I realized then that it was not going to be easy.

The new sounds could not be designed on paper; there were too many unknowns to be able to do it by theory. I was adamant about using the approach of working in a situation as close to the real world as possible – out of doors with flexible sound-synthesis tools producing sounds at realistic levels from moving cars – a procedure with the technical and logistic complexity of shooting a small scale film on location. It would also take time; I estimated eight weeks of working outdoors. It was clear that I would have to raise some money.

Being an artist didn't help. The scientific community was not interested. They felt threatened by someone with power who refused to acknowledge that quantification was the only truth. My own community, art sponsors, were always out to lunch. They didn't feel it was their purview. So much for the rhetoric of the union of art and science.

By 1981 I had raised just enough money to get myself into serious trouble. In an attempt to break through the lack of imagination, I decided to go ahead without the money – to demonstrate what was involved. I was sure someone out there would get it. I improvised some mobile equipment and, using the cars borrowed from the police, managed to organize some experimentation on an abandoned airfield in Brooklyn. It was not enough time to learn much; but I thought if we shot some video tape, while I was working, at least I could demonstrate the scope of what had to be done. It didn't work; no one came forward. I had bankrupted my non-profit organization, and people seemed surprised I hadn't finished making the new sounds.

I went back to being an artist and promised to behave myself in the future.

In 1988 I was commissioned to make a sound work in Aspen Colorado and give a talk at the International Conference on Design taking place there. I found an idyllic site, a grove of tall pines, stretching down a hillside to the edge of a fast-moving river. I was interested by the river's sound: a loud seemingly constant texture which in fact was always changing. I built another very subtle sound texture in the pine grove to match it. The two sounds were completely different but mixed in such a way that as you walked between the river and grove you could never tell where one changed into the other. It was quite beautiful.

It was assumed I would talk about this work for my lecture at the conference. I decided instead to bring up the siren subject again. Here was an international body whose concern was architecture, design and urban planning; yet its focus was completely visual. It seemed like a worthy public service to point out the other half of life.

Although there was a lot of public-spirited talk around, it was clear that I was not going to get anywhere with arguments about improving the world. By this time in America, the 'bottom line' had become quite hopelessly sacrosanct. Although introducing a new siren is a difficult way to make money – the market is not large, and the turnover slow – I would have to make a

convincing argument for the project in business terms if I did not want to commit heresy.

I described the problems, developed some marketing arguments, and then literally drove the point home by sending a very real aural illusion of a New York City fire truck roaring through the audience with its siren full on.

It worked. I found a backer. Fortunately he was not too 'religious'. I also found myself, exactly ten years after I began what I thought would be a simple project, with the wherewithal actually to do it.

I chose a site near the Salton Sea in the California desert to work in for two months. Its paved roads were largely unused, allowing the sound cars to travel at moderate speeds. It was also forty kilometers away from the nearest dwelling. Although I hoped to make a set of sounds that people could live comfortably with, the process of making them would not be pleasant for anyone nearby. There is a big difference between going to a concert and living underneath a piano player who practices all day. In any case, I felt my first task was to try and solve the safety problems. Making it sound good was something I had had experience with.

The week I began working, there was a tragic accident in nearby Los Angeles. Two police cars responding to the same emergency came around a blind corner from opposite directions and collided, killing seven people.

The first question one asks is why they didn't hear each other even if they could not see each other? If you think about it, the answer is obvious. If you are in a police car with the siren on, the ONLY thing you can hear is your own siren. All other sounds are covered by it.

People in cities say they can't tell where the siren sound is coming from until they see the vehicle. Yet we are born with a very fine ability to locate the source of a sound with our ears. It probably evolved from when we were living in forests where locating danger by ear was a matter of life and death. Why then do we have difficulty in finding these big dangerous sounds in the city? The answer lies in the nature of these sounds. Nothing like them ever existed in nature!

Our mental processes for locating sound depend on a rather delicate (though automatic) comparison of the differences in the onset of the sound between the two ears. This mechanism works very well for the sound of a twig snapping, but is quite useless with either continuous sounds or those without clear beginnings.

I asked myself if there was any reason why the sounds had to be continuous. Using spaced bursts of sound with silences in between would not only provide a silent period in which emergency-vehicle drivers could hear each other, but also the many beginnings of a series of sound bursts would give the natural sound-locating system of the human ear something to work with.

I went on to ask myself what else besides continuous sound might be wrong with conventional sirens. A New York City police car disperses a swath of sound ten blocks wide and two or three kilometers long for every emergency call. In order to clear traffic, a very intense

sound is needed only directly in front of the vehicle to punch through to the sealed interiors of cars blocking the way. Pedestrians on the sidewalks need very little sound to know there is danger nearby. For most of the people in this huge area covered by a siren, though, the sound is irrelevant. There is no chance that they will cross paths with the vehicle. A large percentage are not even on the street.

A sound-reflective environment like the modern city is an acoustic hall of mirrors. The more sound you put in it, the more confusing it gets. It was clear that to reduce confusing reflections, the projection of the sound needed to be controlled both to the sides and upwards, placing the sound where it was required while reducing it in places where it was neither needed nor wanted. It was possible. In many ways sound can be focused just like light.
However, a brief look at the loudspeaker systems used by most sirens showed that they were primarily designed for looks rather than acoustics. One of the most common speakers was even promoted as a 'jet scoop', and was made to resemble the air scoop of a jet fighter, I suppose, to give the policeman the feeling he was a fighter pilot. But it was quite useless in directing sound. Those sirens which used directional horns had their directional axis oriented the wrong way with their long sides horizontal, so that the sound spread upwards towards those not even on the street rather than being directed ahead. These loudspeakers could have just as easily been mounted the other way, but of course that didn't look quite as nice.

It seemed to me that the present systems had all taken the brute-force approach – the louder the sound and the more places it reached, the better. By doing this, they had robbed the sound of its ability to carry information. Much of the sound was not only unnecessary, but actually added confusion to the situation. Yet the key question was giving people enough information to know what to do.

One of the ideas I had when I began the project was to build information into the sounds: not special signals that people had to learn, but things they would intuitively recognize about the situation through the character of the sound itself.

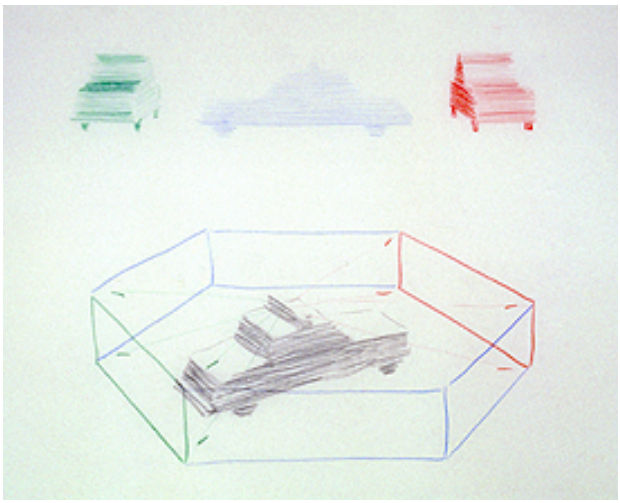
The meaning of a siren for pedestrians and automobile drivers differs according to where the siren is coming from. One needs to know, is it coming towards me or going away? If it is approaching, is it from the left or right, behind or in front? Why not try to clarify the situation with sound?

I realized that the directional-horn type loudspeaker itself had a characteristic which I could use to do this – the higher-pitched the sound, the more directional the horn becomes. Low sounds are projected in all directions while high ones become focused into a beam. This meant I could make the car sound different from the side, front and back. I could give the car an aural shape. Since high sounds generally have a more urgent character than low ones, I could also build this sound image so that it reflected the relative danger for each of its vectors. I could make the car sound more dangerous when you were in front of it than when you were to the side or behind it.

I began by building some metallic timbres with bright upper frequencies. From the side of the car, where you heard only the low part, they sounded

harmonic. As the car turned towards you with its front, where the upper frequencies were projected pointing at you, the sound became more harsh. As you entered into the dangerous zone directly in front of the car, the car actually sounded more dangerous.

Nice!

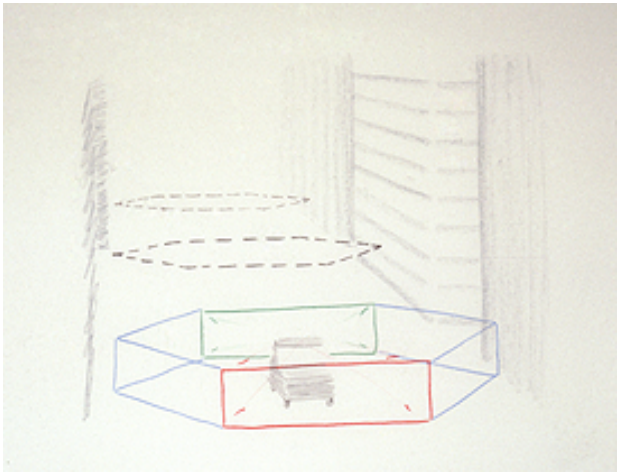


Controlled tone color dispersion and the resulting aural images of the car, Siren Project, Drawing #3, 1991

One of the basic principles of our psychology seems to be to ignore the status quo and react to change. Every emergency-vehicle driver I have ever talked to has told me about his technique of switching to a different sound pattern before entering a dangerous intersection, to regain attention. It didn't seem to matter which sound pattern was used – it was the change which got people's attention. A car with an articulated aural image of the kind I had just made, winding its way through city traffic, would sound different each time it turned, continually prompting attention.

Having decided on spaced bursts of sound, the next question was how much time should there be between sound bursts. It soon became clear that the crucial factor was not time but distance. Sound dies fairly quickly with distance, so it was necessary to insure a relatively short distance in the car's path between sound bursts, no matter how fast the car was moving. Then, why not link the burst-interval directly to distance? That way automatically, no matter what the car's speed, the sounds would always occur at the optimum distance: the faster the car was going, the faster the sounds would occur. All the sound that was needed, but no more than necessary. There was also the bonus that a faster-moving car would sound more urgent, as it should – two birds with one stone, again.

Very nice!



Spaced sound bursts at an optimum distance irregardless of speed, Siren Project, Drawing #1, 1991

Although breaking the sound into bursts and focusing its projection had done a great deal for its locatability, it was not enough. In dense cities with many tall buildings, the acoustic situation becomes extremely complex. Glass is such a good reflector of sound that it is easy to be

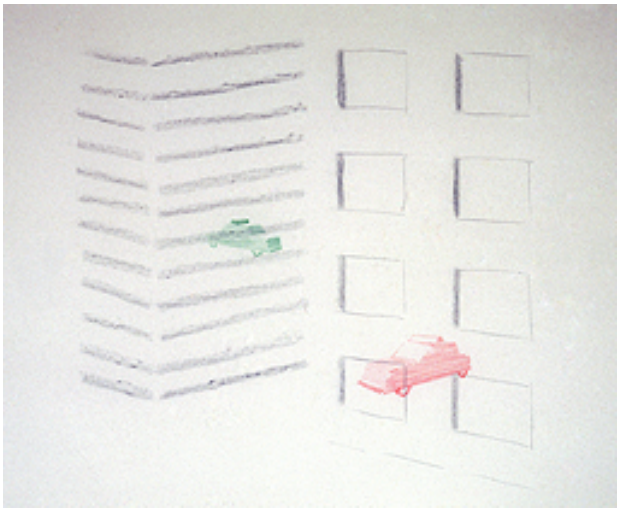
misled by false sound images. One had to be able to hear the location of a car clearly even if it was obscured by buildings, if it was really going to work. There was still more to be done.

One of the reasons I chose this particular place in the California desert as a work site was that the highway ran through a steep walled canyon with a double 'S' curve. The acoustics were surprisingly similar to the canyons of Manhattan, but even more complex. The canyon produced some of the most confusing sound reflections that I had ever encountered. If I could make a sound pattern that I could follow by ear through this canyon, it was a good bet it would work anywhere.

I began by stationing myself in the middle of the double 'S' and having my assistant drive the car projecting sounds back and forth from one end of the canyon to the other. I changed the sounds on every pass and listened. When I found one sound pattern that I could track better than another, I would try a variation to see if I could improve it. Gradually I began to get the feel of it. I began to know what kinds of sounds would work.

After several weeks I had developed sound patterns which could be tracked easily. One could clearly hear where the car was in the canyon, but it was difficult to tell whether it was approaching or going away. Both directions of movement sounded the same. Obviously a very important piece of information was missing. I realized then that I had made only half of the car's aural image: the front half. So I mounted another horn facing the rear and built contrasting sound patterns for it.

I had my assistant take the sound car to the far end of the canyon and drive it in a small circle. It was a wonderful moment. I could easily hear the front and then the rear as the car turned, more than a mile away through the acoustic labyrinth.

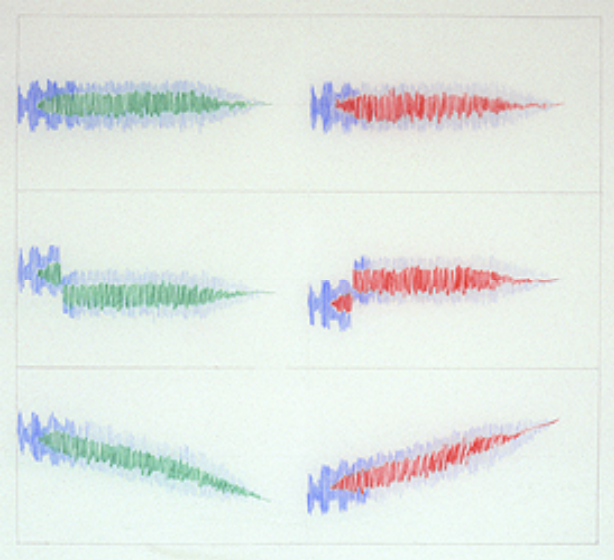


Aural images of hidden cars, Siren Project, Drawing #4, 1991

It was time to start defining the actual sound patterns, now. This idea of regaining attention by switching between different sounds made it clear that a set of different patterns was required. As long as I was making different patterns, why not have them mean something also? A graduated set of different degrees of urgency was what was needed to give the driver something to work with – an acoustic accelerator and brake, so to speak.

In evolving these specific sound cues I began with the least urgent: one sound burst for every distance interval, high from the front, low from the back. I constructed the burst for the front speaker so that its onset was a specific tone, and as it faded its after-ring

became more complex in timbre. This after-ring contained the bright upper frequencies which were only projected directly in front of the car, forming the aural danger zone I mentioned earlier.



Sound burst patterns, Pitch contour, amplitude and tone color over time, Siren Project, Drawing #2, 1991

The next pattern became two of these bursts of different pitches in quick succession – the front speaker going low/high, and the rear, the opposite, high/low.

For the third and most urgent pattern, I made a frequency sweep, again distinguishing the front from rear with opposite patterns – the front speaker sweeping up, the rear one sweeping down.

By this time I had had enough talking with pebbles in my mouth like Demosthenes. I wanted to try the sounds in a real city. Under the guise of making a movie, I commandeered a section of downtown Oakland for several evenings. Testing safer siren sounds on city streets turned out to be bureaucratically impossible, but you can commit murder anywhere if you offer a chamber of commerce the publicity of making a movie in their city. Hiring off-duty local police and fire personnel as drivers confused the situation enough so that when they realized we were doing more than just shooting a film, there wasn't much they could do about it. The policemen on duty were the friends of those driving the cars.

Another reason, of course, for hiring real emergency-vehicle drivers was to get their reactions and talk to them about the new sounds. These people worked daily with sirens, and their lives depended on them. They were very impressed at being able to hear each other's sirens. They also brought up some new points. While running to an emergency with the siren on, they frequently have to get instructions over their radios. With these new patterns, they could hear their radios clearly for the first time. They also spoke about a decrease in their own level of tension with these new sounds. For my part, I was tremendously relieved to find that it was much easier to track the sounds in a city than in my torturous canyon.

I have spent the last half hour talking about the functional aspects of these sounds. As important as these are, the other half of the question is equally so. What should a siren sound like, what about its aesthetic character?

In primitive societies, authority was often designated literally by wearing a threatening costume: the witch doctor dressed as a monster. Visually, our ideas about the signification of authority have evolved. We don't dress policemen as monsters. Why then do we think they should sound like them? Aurally, we are

still in the stone age. The general feeling is that in order for a police car to have authority, it must sound threatening. Yet if we made it look as ugly as it sounds, we would all laugh at it.

The aural threat of a conventional siren as it passes through a city is essentially subliminal for the large number of people not directly confronted by it. Its effect on this uninvolved group – how it makes them feel or changes the way they live their lives – is not something we can measure. But no matter what it is, it is unnecessary. It is possible to make loud sounds which do not threaten and still clear traffic.

The sounds I tested in Oakland are the equivalent of aural sketches of what the final sounds could be. Along with testing the functional aspects, I also wanted to test the other part of the idea. Their general character is familiar, not alien. They sound bell-like, and are neither hysterical nor banal. They are, in fact, a little nicer than necessary. One of them is even pretty. I wanted to be very sure that a threat was not necessary in order to get people to move out of the way – to demonstrate that a sound could have authority without being authoritarian. I am happy to report that it can. Although none of these sounds had ever been heard before, and the test was not publicly announced, all the drivers we encountered pulled to the side of the road without hesitation.

The next question, of course, was how to implement these new ideas. One would think it should not be too hard, after all: something which saves lives and improves urban living conditions.

However, the public agencies which control emergency vehicles have rigid purchasing procedures involving competitive bidding, maintenance contracts and other bureaucratic processes. An organizational structure to manufacture, distribute and maintain the sirens was necessary. The ideas had to be protected by a patent and taken over by a manufacturer.

The patent office reflects the same misconceptions about sound as everyone else. The idea that a sound can do something seems strange to most people. A patent, by definition, is a new method of doing something. My proposal that these sound patterns constituted a new method of moving emergency vehicles through urban traffic seemed to puzzle them at first. No one had ever patented a sound before.

Two years after I finished testing the sounds, on April 30, 1991, the U. S. Patent Office issued Patent Number 5,012,221, embodying forty-six ideas on how to use sound to move an emergency vehicle through traffic.

One would think the final step would be the simplest. What siren manufacturer would not jump at the chance of a new product which would revolutionize his industry?

Unfortunately, the world does not work this way. New ideas that require a fundamental change in the way we think – that shaping something as intangible as a sound can actually do something, for example – go against the grain. It takes a long time for them to find acceptance, if they ever do.

Siren manufacturers insist that police, fire and ambulance drivers want loud nasty sounds in order to reinforce their image of self-importance. This may or

not be true. In 1989 the New York City Police Department asked to test the new sounds versus the old in one of their precincts. So far, no siren manufacturer has shown interest in making a set of prototypes they could try.

Siren manufacturers are not really interested in disturbing the status quo. They are content to think up some new gimmicks every year to take to the police chiefs convention, like speakers which look like jet fighter air scoops, or spacey new continuous sounds. In a society ruled by a short-sighted mercantile mentality, a new 'product', which challenges the habits of all potential buyers, is considered somewhat worthless.

Of course behind the lethargy there also lies the question of money. The market for new sirens is relatively small. They don't wear out quickly; and often when the vehicle is replaced, an old siren is just reinstalled in the new car. It will cost money to put a new siren into production and the potential return, even with an increased market share, won't make anybody a millionaire.

There is no pressure from government for a safer siren because the manufacturers are on the government committees that are supposed to regulate them. There is no civic pressure because the public doesn't know that a better alternative exists.

The passage of a siren through a city is one of the largest sonic events in daily life. In dense urban centers it usually occurs more than one hundred times a day. In cities like New York, it is almost always present.

A better set of sound signals could not only save lives, but as world population becomes more and more dense they could also go a long way towards making future urban life livable.

Although you can lead a horse to water, you cannot make him drink.

Max Neuhaus, 1991
(with addenda in 1993)

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