THE SOUND OF DATA: Data may fill your ears rather than your eyes

By Steve Nadis. *OMNI Magazine*, 1994 October, p. 26

Chaos theory Initially sparked musician and designer Gregory Kramer's interest in using sound to represent complex patterns of data.

In the late 1980s, while reading about chaos theory for the first time, Gregory Kramer had an idea that would change his life. He was pondering a problem relating to cognition: How could humans possibly comprehend complex, multidimensional systems with data pouring in from many separate tracks? The eyes can only assimilate so much information. Then the answer came to him: Why not convert data into a soundtrack that trained "observers" could listen to rather than watch?

Kramer possesses the right qualifications for turning data into sound. He taught at New York University's music department and is a National Endowment of the Arts Composition Fellow. He also designs equipment for playing and recording electronic music. In 1989, armed with this experience and his idea, he visited the Santa Fe Institute -- a nonprofit think tank devoted to the study of complex systems -- and met mathematicians and physicists working in the field of chaos. Intrigued by Kramer's proposals the institute invited him to become a member and work with its researchers on tools to help people comprehend complex data.

Kramer subsequently learned that he wasn't the first person to hit upon the notion of making scientific data audible, or "sonification." First discussed in technical literature in 1952, the idea has popped up, sporadically, ever since. In the past few years, an active group has formed at the National Center for Supercomputing Applications (NCSA) at the University of Illinois. "If you work in the field of computer music, representing data with sound is a pretty obvious idea," explains Illinois composer Robin Bargar.

Since the 1950s, composers have occasionally used satellite data and scientific equations to provide raw material for their music, caring nothing about the numbers themselves. "Sonification is the other side of the coin," Bargar says, where sounds have to correlate with data in an intelligible manner. That requires composing skills and an awarencss of how people listen to sound.

A group at NCSA has created sonification software that, when run on an IBM-compatible PC with a MIDI (musical-instrument digital interface) synthesizer, can turn just about any data into sound. In addition, NCSA's Alan Craig and Carla Scaletti of *Symbolic Sound* in Champaign, Illinois, have created a videotape that demonstrates the use of sound and graphics to represent data, including smog information in Los Angeles and forest-fire data in Yellowstone National Park.

Sonification offers obvious benefits for visually impaired people who are unable to see computer screens. David Lunney. a chemist at East Carolina University, is developing tools that will help blind chemists and chemistry students to analyze compounds by listening for specific sounds.

Clarity, the company Kramer founded in Garrison, New York, investigates more advanced applications in which sound represents several variables at once. *Clarity* may use the technology to create an audio system for operating rooms, which will broadcast a patient's blood oxygen levels, blood pressure, and other vital signs. *Clarity* has already "sonified" an ecosystem model for Apple Computer and a mock

nuclear-power-plant control room. The company has also spoken with financial-service firms interested in developing programs using audition to analyze stocks.

The rub is that it takes a skilled ear to be able to discern subtle sound patterns. "Sound blends together into a gestalt much more readily than images do," Bargar admits. "Another problem is that we tend to correlate what we see with what we hear."

Kramer sees training as a big challenge but not necessarily a show-stopper. "You know when your car is running well just by listening to it. A certain noise, like a rattle, might also tell you what's wrong. Sounds in a well designed sonification system could be interpreted in much the same way."