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Video-Computer Combo Helps Pianists Compensate for Stress Injury

By DONALD G. McNEIL Jr.

As Gene Rohrer, a professional accompanist, plays a C major scale in the back room of a medical suite near Lincoln Center, even the untrained ear can tell that something is off. The untrained eye notices his ring finger curling stiffly to let the others pass.

But it all goes by so quickly that one might not be sure. The piano, however, knows very precisely what Mr. Rohrer's fingers just did.

In fact, the Yamaha Disklavier, a \$57,000 grand synchronized to a videocamera and a laptop computer, can let Mr. Rohrer cross his arms and watch as it plays back the notes exactly as he did, the keys tap-dancing beneath ghostly fingers as the video of his hands plays on the laptop.

With a bit of number-crunching in Excel, Dr. Kathleen Riley, his therapist at the Miller Healthcare Institute for Performing Artists, prints out a graph of each key-stroke. It shows each time that the weakened third finger of Mr. Rohrer's right hand dragged on a key or that his ring finger, moving in to help, accidentally pressed a second note.

The Disklavier-video combination and software offers a new approach to the diagnosis and treatment of repetitive stress injuries. Its focus is narrow. It is used only with pianists. But it opens the possibility of more exact methods of handling other stress injuries, like those caused by computer keyboards and violins.

Mr. Rohrer had little formal training. His father, an Air Force trombonist, made him teach himself.

He did, but eventually developed focal dystonia, the loss of control of an individual limb or finger. It is the same problem that damaged the careers of well-known pianists like Gary Graffman and Leon Fleisher.

(Mr. Fleisher eventually regained the use of his right hand, and Mr. Graffman has given many performances of works played with the left hand alone.)

Unlike carpal tunnel syndrome, dystonia does not cause pain or numbness. But it is "generally not thought of as having a good

prognosis," said Dr. Lillie Rosenthal, a psychiatrist at the Miller institute. "It's very often a career-ending problem."

Because a still undefined mental component remains, it can be harder to treat than nerve damage. It tends to crop up when a performer is upset by too much work, bad reviews or repertory changes, she said.

"It's an organic disorder of the brain, a neurological disorder," said Dr. Mark Hallett, chief of the human motor control section of the National Institute of Neurological Disorders and Strokes, part of the National Institutes of Health. "Repetitive activity predisposes one to it. But the strain is in the brain rather than the arm."

He also theorizes that some people are genetically predisposed and, if they are not musicians, develop it as writers' cramp or some other disability.

His institute has been using a similar piano for a decade, Dr. Hallett said, although without a synchronized camera.

Mr. Rohrer said he first noticed his dystonia when his fast passages got sloppy.

"I just couldn't get the velocity I needed," he said. "Handel gave me nightmares."

He developed "compensating maneuvers," like stiffening his second and fourth fingers to brace his weak third. Sometimes his arm moves forward minutely to add force to a stroke, and sometimes his fingers bend from his second knuckle instead of his third, which he calls "scratching the keys."

The most common treatment for focal dystonia is retraining, an often lengthy and difficult process in which a patient learns new ways of using the affected muscles. For instance, as therapy, Dr. Riley has Mr. Rohrer do exercises like repeating one note hard or playing while wearing thick paper rings to separate his fingers.

The patients at the institute use other therapies. Some, Dr. Rosenthal said, use braces to hold up individual knuckles, while others have botulinum toxin injections to stop small muscles from going into spasm.

Before going to the institute, Mr. Rohrer tried another training method and rejected a neurologist's suggestion that he take a

A modern player piano that knows precisely what keys a musician hit.

powerful drug used for Parkinson's disease.

Seeing his fingers from below as he hears how he played the notes helps him visualize the faults he needs to correct, he said.

The Disklavier looks like — and is — a grand piano. But inside is concealed the technology that can raise the price as much as \$30,000. A tiny metal shutter on each hammer passes through two light beams on the way up and down, recording its speed in more than 1,000 gradations. Another instrument records 128 possible positions for each pedal.

The signals can be recorded or sent over the Internet. To replay, each lever, which connects the key to the hammer, has a solenoid, a plunger that slides when an electrical current runs through it.

The best of these 21st-century player pianos capture a performance so faithfully that last June two were used in the first international "e-competition."

Seven judges listened to the competitors in the usual way, on a nine-foot concert grand Disklavier in St. Paul that cost \$153,000. An eighth, Yefim Bronfman, the touring pianist, listened to replays on an identical Disklavier in Yamaha headquarters in Hamamatsu, Japan, and after some initial skepticism, found it "a completely natural experience," he said.

As Dr. Riley does, the contest added a video camera on the hands that was synchronized using movie-sound technology that corrects itself 30 times a second.

"I've worked with a lot of pianists," she said, "and they'd rather play on a real acoustic keyboard like this."

Mr. Rohrer, who started using the Disklavier in October, "is now able to control a lot of things he couldn't," Dr. Riley said.

Later, she printed out the proof — a scale that he had played back then and one that he had played that morning.

Retraining Erratic Fingers

Dr. Kathleen Riley, a therapist, uses a specially equipped piano as a diagnostic system to help treat Gene Rohrer's dystonia, a nerve disorder that hampers control of his fingers. By viewing Mr. Rohrer's performance on video, and analyzing play-back data, problems can be isolated and treated.



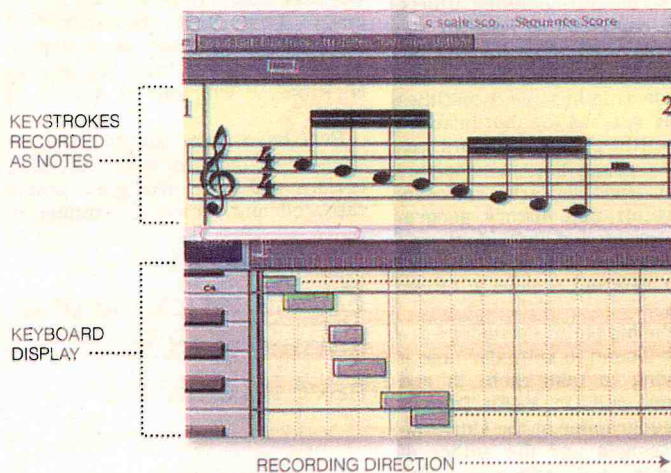
Carol Halebian for The New York Times

COMPONENTS OF THE SYSTEM

- LAPTOP COMPUTER**
Loaded with music editing software.
- YAMAHA DISKLAVIER**
Grand piano outfitted with a system that can record and play back music.
- VIDEO CAMERA**
Records hands as they play on keyboard for analysis.

RECORDING EVERY STROKE (AND ERROR)

Special software connected to the piano displays and records the keystrokes both as musical notation and bars. The software is normally used for music editing and composition, but its representation of music on the screen makes it a powerful tool for analyzing playing problems.



KEYSTROKES RECORDED AS NOTES

KEYBOARD DISPLAY

TIMELINE

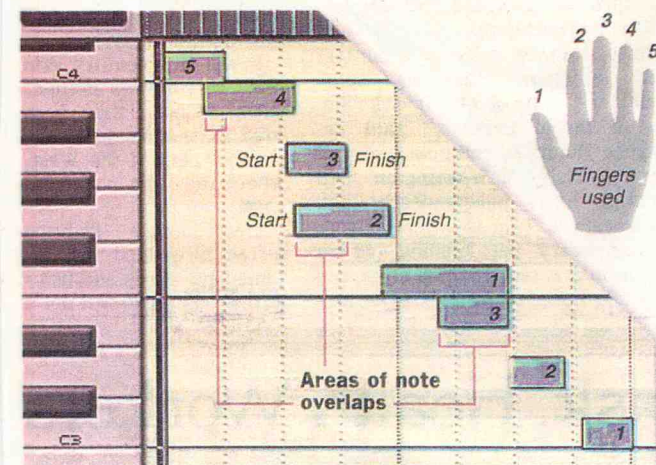
Synchronization of computer, piano and recording devices.

BARS RECORDED AS KEYSTROKES

Keys pressed on the piano are recorded as bars aligned with appropriate key on the keyboard, displayed to the left. The beginning and end of each note are shown relative to other notes played.

EVALUATING THE DATA

Below, a close-up of the C major scale that Mr. Rohrer played with his right hand in October 2002, showing flaws in his playing. Most of the bars overlap, indicating that a new note is played before the previous one is finished. As a result, the notes sound blurred, lacking the clarity of a properly executed scale.



IMPROVEMENT SHOWN

The same scale played in June 2003 shows marked improvement. There is almost no overlap of the bars, as the notes are mostly spaced out separately and evenly. The scale sounds crisp and cleanly executed.

