



A chair that undulates, a mouse that vibrates, a monitor that moves: Alan Hedge, international authority on office ergonomics, takes a serious look at the newfangled workstations designed to prevent repetitive motion injuries.

Ergonomic Expert Keeps Pace with Computer Challenges

BY METTA WINTER

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Alan Hedge gets requests from companies all the time. Common among them are ones like this: “What kind of chair can I buy for my people that costs about \$300?”

Such a question represents a false economy, the foolhardiness of which Hedge, a professor of design and environmental analysis who is an international authority on the behavioral science of ergonomics, inveighs against. He backs up his stance with three decades of scientific inquiry.

“The difference between a not very good chair and a really good chair is about another \$300,” Hedge explains. “Compared to a single injury—one carpal tunnel syndrome case can cost upward of \$100,000—that investment is trivial.”

Since the inception of the computer revolution, Hedge has applied the same rigor to designing and conducting experiments with people as he would were he observing any living species. His goals are twofold: to define what are the healthiest and most productive conditions for people to live and work in; and to use what is known about the human body, and its capabilities, to design the most effective equipment and work environments.

“When I first started out, my colleagues, who were focusing on the dangers of working in mining, oil drilling, and agriculture, couldn’t understand what I would find interesting about the comparatively comfortable environment of the office,” recalls Hedge, who trained first as a zoologist and then >>>

“I point out to companies that they wouldn’t expect everybody to wear the same uniform, to wear the same shoes, or to drive the same car. So why would they expect them to sit in the same chair behind the same desk?” says Hedge.

as a psychologist specializing in ergonomics.

Turns out he was prescient when it came to the dramatic shift in the types of compensatory injuries to come. A paper Hedge published in 1982 was among the first references in the literature of a demonstrable connection between computer use, gender, and adverse health effects.

“Today,” he points out, “as fewer people in the developed countries work in heavy industry, one-third to one-half of all compensatory injuries are repetitive motion injuries associated with office-type work.”

“Everything we do can be summed up in the phrase: good ergonomics is great economics,” Hedge says. “More than 90 percent of a company’s costs are people costs, so making small investments in improving the workplace—like very good chairs—pays huge dividends.”

The same trend holds true for back injuries, which account for one-third of all workplace injuries. A decade ago most of these were associated with heavy lifting. Today most jobs requiring heavy lifting have been eliminated but the incidence of back problems has not plummeted, as one would expect, because now more and more people are sitting for longer periods of time and none are getting younger.

The younger and younger onset of computer use makes the current rate of compensatory damage claims the canary in the coal mine. There is typically a 10- to 15-year latency before injuries start to develop, Hedge has found. In the early 1990s he gathered data from a well-known national information provider that showed the average age of workers reporting carpal tunnel syndrome was late 30s to early 40s. When he contacted the company again last year, the age of onset had dropped to an average age of 25.

“Now kids are using computers at age two, so by the time they enter the workforce they’ll already be primed for injuries,” Hedge says. “This is very serious because an injury can become life changing; carpal tunnel, for example, is not curable. They’ll have to manage this chronic condition for the rest of their lives.”

Hedge is seeing signs that vulner-

ability to unsafe computer use is beginning to show up even earlier. In an informal survey he made of Cornell undergraduates, one-third reported having problems. In response, Hedge posted CUergoPods—audio and video podcasts on his CUergo web site—to instruct students on how to use laptop and desktop computers safely. The web site (<http://ergo.human.cornell.edu>) presents information from research studies and class work by students and faculty in the Cornell Human Factors and Ergonomics Research Group (CHFERG). CHFERG focuses on ways to enhance usability by improving the

ergonomic design of hardware, software, and workplaces.

Hedge came to the College of Human Ecology 20 years ago from Aston University in Birmingham, England, where he’d spent the previous decade conducting studies and publishing the results—among them a groundbreaking 1983 paper in which he was one of the first scientists to show an association between the workplace environment (including the equipment) and productivity and health.

What sets CHFERG apart from other ergonomics research groups around the world (more research is being conducted in this field abroad than here in the U.S.) are the methods Hedge uses and his focus on design concepts rather than products.

Vibrating Mouse

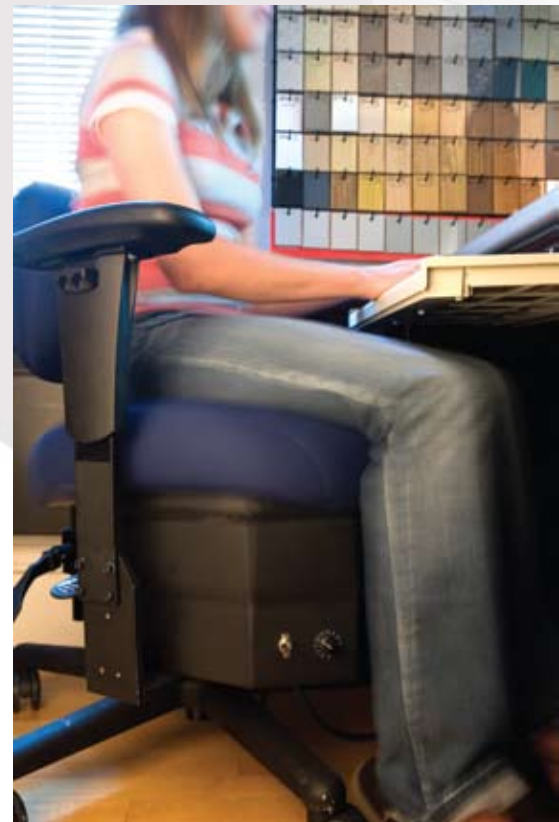
Hedge and his graduate student Christopher Moe recently studied a vibrating mouse, manufactured in the Netherlands by Hoverstop B.V. It wasn’t the mouse, per se, that intrigued them but rather the potential benefit of a device to halt the rise in upper extremity musculoskeletal disorders being seen now in computer users.

“If you keep a muscle in tension over time—as we’ve seen when people grip the mouse and hold onto it even when

not using it for cursor control—you’re going to increase the likelihood you’ll injure the structures associated with those muscles,” Hedge explains. “The idea here is that the vibration will signal the person to take their hand off and there will be a benefit to that.”

What they found, however, is that while subjects did remove their hands more often than with a conventional mouse, few placed it in a position (resting in the lap, for example) that would actually relieve muscle strain. (Moving the hand to the keyboard, as many did, didn’t help either.) The most unexpected finding, however, was the marked increase in unsupported hand hovering. When signaled by the vibration, subjects let go and held their hand just above the mouse.

“This position is potentially more detrimental to users’ health because of a potential increase in static muscle activity required to hover the hand,” Hedge notes in the discussion section of the paper.



To reduce static load on intervertebral discs from prolonged sitting, the seat of this prototype chair makes a continuous wavelike motion; Hedge’s research shows that the rotary dynamic seat shows promise.

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Because Hedge's goal is to improve the well-being and productivity of workers, his studies go beyond, say, merely counting the number of times a subject removes their hand or measuring the muscle activity in the superficial flexors and finding a "5 percent change."

"That's the way a lot of research papers are written and you read them and you go, 'And that means?' We get a complete picture of what people actually do, which is often not captured in conventional ergonomics research. And we look for the consequences to comfort and productivity," he says.

Hedge notes that in the world of engineering design, the assumption is made that if something is built, people will know the right way to use it. But his career's worth of work has shown that education is needed for people to use tools properly.

"You can't just pull the mouse out of the box and assume that because something vibrates, people will know what to do with their hands," he says.

This study, published under the title, "Effects of a Vibrating Mouse on Computer Users' Work Behaviors and Performance," was presented at the Human Factors and Ergonomics Society 51st Annual Meeting held in Baltimore in October 2007.

Undulating Chairs

Two other studies were presented at the October conference: one, a study on a prototype of a new chair design called, "Effects of a Dynamic Seat Pan on Torso Movement, Back Comfort, and Task Performance"; and the other, a field study titled, "Effects of a Flat Panel Monitor Arm on Comfort, Posture, and Preference in an Architectural Practice."

The study involving the chair addresses the same risk factor as the study on the vibrating mouse—static load on muscles. In this case, the load is on the intervertebral discs due to

prolonged sitting. Other researchers had previously noted that workers often have difficulty remembering to shift their posture while working, let alone to get up and walk around now and then. Hedge and his graduate student Erin Lawler asked: What if the seat of the chair moved, which would automatically cause a person's body to make small continuous adjustments using different muscle groups? The intended end result would be movement without having to think to do it.

Hedge's subjects sat on a chair in which the seat made a continuous sinusoidal (wavelike) movement at a rate they could adjust. Would this interrupt concentration or make the person feel motion sick or otherwise uncomfortable? Most important, would it alleviate back pain for people whose pain increases when they are seated?

The findings regarding each of these specific questions were mixed, but overall Hedge concluded that the movable seat was a concept with promise, particularly for individuals with back problems. He ends the paper by stating: "Long-term research is warranted to understand the true physiological effects of using a rotary dynamic seat."

This kind of recommendation for further research on a novel idea can have a huge impact commercially in terms of design and products, as was the case with Hedge's seminal work on keyboard trays when he studied innovative approaches for computer input. These ranged from voice control to vertical keyboards and a chair that incorporated a split keyboard into its arms.

Movable Arms for Monitors

The third study—on monitor arms, a popular commercially available product—also produced unanticipated findings. In this case, a change in social behavior and in workplace design occurred. The field study was conducted in an architectural practice in Manhattan. The question Hedge and his graduate student Katie Boothroyd asked was: How would suspending a flat panel computer monitor on a movable arm affect people's comfort, posture, and preference?

The test subjects unanimously liked the monitor arm because it allowed them to optimally position their LCD screen.

In addition, suspending the monitor freed up prime real estate on the desktop, allowing documents to be placed in front of the body rather than on the side.

"So we saw fewer complaints about neck problems and fewer complaints overall about the workstation because people had more space," Hedge says. Usable space on the desktop has implications, too, for a more space-efficient workstation design in which desks could be more shallow.

The big surprise came when Hedge observed the way that the screen's mobility eased working in groups. Frequently architects need to show drawings to groups of their colleagues; with the monitor on the desktop, people had to crowd around, hunch over, and squint at the screen. With the arm, people could sit in a circle, and the screen could be moved in front of one person, then the next. The same held true for accounts staff who could turn their screen around to show figures to a person sitting across their desk.

"This simple change has many potential benefits associated with it," Hedge concludes.

These studies are designed with control groups and all the other protocols that produce reliable findings. Hedge wants companies to have sensible policies for ergonomics in the workplace and for Cornell to be the resource they trust for giving them impartial information.

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For more information:

Alan Hedge
ah29@cornell.edu
<http://ergo.human.cornell.edu>