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Photo by: TONY BOCK/TORONTO STAR

Workstation analyst Steven Price prefers a recessed monitor. Researchers say monitors should not be above eye level but disagree about how high or low they should be.

## Set your sights a bit lower

Most users place monitors too high, say the experts

JOHN GODDARD  
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That diagram showing a person sitting military-style at the computer was never meant to be taken literally. In the classic drawing, a computer user sits head-erect and eyes-forward, the top of the monitor elevated to eye level. In different versions posted over the years, it became part of office culture.

At bank counters, public libraries, air ticket centres and corporate offices almost everywhere, monitors sit stacked on everything from specially designed stands to the handiest telephone book.

But posture was never meant to be as rigid as the diagram suggests. And although expert opinion differs on how high or low to set the monitor, the consensus is that most people set it too high.

"We have people going through incredible discomfort because of this mistaken solution," says Steven Price, a veteran Toronto workstation analyst who has spent his entire career lowering monitors on office desks. He suggests putting it as low as possible.

"The biggest mistake we see is people put the screen too high," says Brian Weir, technical editor for the guidelines, revised in 2000, by the Canadian Standards Association. "They're either sitting too low or they've stuck the screen on a platform."

The CSA suggests a monitor high enough for users to look down 15 degrees below horizontal.

So where did the original diagram come from?

Price says he knows. The recommendation to sit head-erect and eyes-forward at an elevated monitor can

be traced, he says, to a study done more than two decades ago by a certain Dr. Marvin J. Dainoff.

What Dainoff — a leading U.S. ergonomics researcher — proposed for the two people he studied in 1981 was perfect for those two people, Price says.

However, the same recommendations are bad for 95 per cent of office workers who look down frequently, he says, either because they are not touch typists, or they are entering numbers, or their documents don't fit into holders.

Asked about the study today, Dainoff does not defend it.

"My monitor is sitting flat on the desk," he says cheerfully by phone from Miami University in Oxford, Ohio, where he continues to research and teach as one of the top U.S. authorities in workstation ergonomics.

What might have worked well 20 years ago might not work well today, he says, and no fixed or universal standards apply.

"Ideally, you would have some adjustability," he says.

Like computer technology itself, Dainoff has moved on. But his 1981 study remains a good starting point for understanding how people are still using workstation equipment badly and in what ways they could be adjusting their equipment to suit their individual needs.

For the study, Dainoff hired two touch typists and set up two workstations for them in a lab.

One workstation he called "optimal." Chair and desk heights were adjusted so that a typist's feet could rest flat on the floor and the wrists could be held straight. A well-placed copy holder was provided, along with a palm rest at the keyboard.

The other workstation he called "suboptimal." The chair was so high that the typist's feet dangled. The desk was so high that the wrists were forced to bend. No copy holder or palm rest was provided.

At the optimal workstation, Dainoff also elevated the monitor. At the suboptimal one, he left the monitor on the desk. He never tried the other way around.

After one week of experiments for the U.S. National Institute of Occupational Safety and Health, he found that the typists proved 27 per cent more productive at the optimal workstation than the suboptimal one.

"The problem with that kind of study," Dainoff now readily admits, "is that you can't do all possible combinations of elements, or you'd still be doing the study."

Maybe elevating the monitor really was better back then. Monitors in 1981 had bright letters on dark screens, creating problems with glare. A low monitor tilted upward to avoid neck and eye discomfort would have reflected back the ceiling lights, while an elevated, vertical one would not have.

Certainly the head-erect, eyes-forward position would have made sense to a touch-typist copying a letter document from a copy holder.

In any case, the first U.S. study to link computer setup with productivity recommended the elevated monitor as standard.

In 1986, Dainoff and his wife, Marilyn Hecht Dainoff, included the study findings in their book, *People and Productivity*, along with a diagram of a typist sitting at an elevated monitor.

Two years later, a U.S. committee of specialists reinforced the idea with a 90-page report called "The American National Standard for Human Factors Engineering of Visual Display Terminal Workstations." The report recommended loosely that the top and bottom of the monitor be placed somewhere between zero degrees and 60 degrees below horizontal eye-level.

But the front showed the misleading diagram of a person sitting with head erect and eyes forward at an elevated monitor.

"We cannot do this again," says Dainoff, who helped draft the report and is currently vice-chairman of the committee to revise the standards.

"We didn't mean to say there was an ideal posture but a lot of people took it that way."

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## Just how low should you go?

All agree that monitors must be below line of sight Recommended angle varies from 5 to 50 degrees

JOHN GODDARD  
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Setting monitor height continues to be the most complex issue of computer workstation set-up.

"Everybody clearly agrees that you do not ever want the monitor above the line of sight," says Marvin Dainoff of Miami University in Oxford, Ohio. "You never want to be tilting your head backward."

Beyond that, the only universal agreement is that the monitor be read somewhere between 5 and 50 degrees below the horizontal line of sight, Dainoff says.

When considering the human visual system, lower is better, he says. On the other hand, the lower the monitor is set, the greater the tendency to bend the neck forward, risking headaches and fatigue.

In his landmark 1981 study, Dainoff originally recommended elevating the monitor and looking down at the screen 15 degrees from horizontal eye level. He now says he sets the monitor on the desk and looks down, wearing bifocals, 20 to 25 degrees.

"We've actually done some research that suggests, in terms of accuracy of detection, it's better when the characters are 20 to 30 degrees below (horizontal eye level)," he says.

The eyes prefer to look down, not straight ahead, agrees Dennis Ankrum, an ergonomics consultant in Austin, Texas, and a leading advocate of a low monitor height. He is also chairman of an occupational health and safety subcommittee of the standards association ASTM International, formerly the American Society for Testing and Materials.

"Try this," he says, offering a demonstration. "Hold a business card at arm's length in front of your eyes.

Bring it forward until the letters just begin to blur. Without moving your head, gradually lower the card in an arc, keeping it a constant distance from your eyes. You'll notice the letters getting sharper."

The point is that looking down enables the eyes to focus more easily at close range and helps both eyes converge more easily together, reducing eyestrain.

Looking up or straight ahead also exposes more of the eye surface to the air, causing tears to evaporate faster than when looking down, a 1993 Japanese study found. And a downward gaze helps the eyes to produce more tears in the first place. For both reasons, looking down also avoids "dry eye."

Ankrum recommends looking down 20 to 50 degrees below horizontal.

Similarly, the International Organization for Standardization, or ISO, recommends that the reading area be

35 degrees below horizontal, plus or minus 15 degrees — in other words, a range of between 20 and 50 degrees.

Tim Springer, another veteran authority — the former chairman of human environment and design at Michigan State University and now an ergonomics consultant in the Chicago area — recommends setting the top of the monitor at chin height.

Toronto workstation specialist Steven Price emphasizes that most people look down at the keyboard and down at documents on the desk. The smaller the distance they are forced to look up at the monitor, he says, the fewer problems they experience with eyestrain and nausea.

"I have sold thousands of workstations over the years in which the monitor is recessed (below the desk surface) and I have never once made anyone look down," Price says. "What I do is reduce the distance they have to look up."

The Canadian Standards Association, or CSA, has developed guidelines on office ergonomics, including monitor height.

The guidelines, last revised in 2000, recommend that the computer user look down at the monitor at about 15 degrees and as low as 35 degrees. Beyond 35 degrees, the guidelines say, bending the neck forward is required, causing discomfort and fatigue.

But most people do not set the monitor too low, says Brian Weir, technical editor of the CSA guidelines. "Often, when we look around at the different set-ups, the biggest mistake is that people put the screen too high," he says. "Either they're sitting too low or they've stuck the screen on a platform."

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**'A monitor should be tipped back at least one degree for every degree its centre is lowered from eye level'**  
***Dennis Ankrum, ergonomics consultant***

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The Institute for Work and Health, a research institute primarily funded by the Ontario Workplace Safety and Insurance Board, concurs with the CSA guidelines of about 15 degrees and not more than 35 degrees. "There is a point of balance of the head, a neutral position," says Donald Cole, a medical doctor and senior scientist at the institute. "The head does not have to be rigid," he says, but bending too far forward or back strains the neck muscles.

"It's much easier to have that neutral position — and you can still have your eyes down — when the monitor is a bit higher," he says, recommending that the top of the monitor be set at or just below eye level.

Like Weir, Cole says many people set their monitors too high, partly because monitors keep getting taller and desk height stays the same.

All authorities agree that monitor height must work with other workstation elements, adjusted to the individual. What might work for a tall person might not work for a short one, or one who wears bifocals.

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Monitor tilt: "Sometimes when you have people with a monitor on a desk and they have neck pain, someone will recommend that they elevate the monitor and their neck feels better," Ankrum says.

"This is actually true. Why? Here's another little demonstration.

"Take a piece of paper with print on it. Tip it back. You can still read it fine, right? Now tip it forward at a right angle to your eyes and keep tipping it forward. It becomes more and more difficult to read."

The point is that if the monitor is lowered, it must also be tilted back. "A monitor should be tipped back at least one degree for every degree its centre is lowered from eye level," Ankrum says.

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Viewing distance: Many workers set their screens too close to them, some research suggests.

Springer recommends setting the monitor at fingertip distance when sitting at the keyboard with one arm outstretched — a distance of 16 to 28 inches.

Ankrum recommends setting the monitor "at least 25 inches from the eyes, preferably more." Sitting too close is a major cause of eyestrain, he says.

"If you can read the monitor, it is not too far away," he says. "If you can't read the characters, it's usually better to make them larger than to bring the monitor closer."

The Canadian Standards Association recommends between 400 mm to 700 mm, or 16 to 30 inches.

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Right angled posture: The important thing is not to take postural instructions too literally, Ankrum says. "Keep the forearms parallel to the floor" is an instruction meant to encourage straight wrists. If the keyboard is too high or too low, the wrists will bend and the value of maintaining straight forearms is lost. "Keep the feet flat on the floor or on a foot rest" is an instruction meant to avoid excessive pressure on the underside of the thighs behind the knees, pressure that tends to cut off circulation. Touching the floor also offers support when shifting postures.

Ankrum says shifting posture frequently is valuable and rewrites the instruction as, "Can the feet be placed flat on the floor or on a foot rest?"

All authorities emphasize that a person be seated against the back of the chair when working, with the chair adjusted for proper lower-back support.

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*For more information, consult Steven Price, [steven.price@workrightdir.com](mailto:steven.price@workrightdir.com) , Tim Springer's site <http://www.hero-inc.com>, a general information site <http://www.office-ergo.com>, the Canadian Standards Association at <http://www.csa.ca> and Dennis Ankrum's soon to be launched site <http://www.AnkrumAssociates.com>.*