Viewing Distance at Computer Workstations (Guidelines for monitor placement)

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A data entry clerk is comfortable with the monitor about 30 inches from his eyes. The company's ergonomic guidelines, however, say viewing distance should be from 18 to 24 inches. A member of his company's ergonomics committee says that the viewing distance should conform to the guidelines.

Who is right? 18 to 24 inches? 20 to 26 inches? An arm's length? Recommendations that place a maximum limit on viewing distance to reduce eyestrain all have one thing in common: They have no scientific basis. To understand why, let's look at how viewing close objects can contribute to eyestrain. When we look at any close object, our eyes do two things: They accommodate and converge. Both of these can contribute to eyestrain. (Collins 1975 and Fischer 1977).

So What's Accommodation?

Accommodation is when the lens capsule in your eye changes shape to focus on a close object. The eyes have a default accommodation distance, called the resting point of accommodation (RPA). That is the distance at which the eyes focus when there is nothing to focus on. In total darkness our eyes are set to focus at a particular distance, so that if the lights were turned on, an object at that distance would be in clear focus. The RPA averages 30 inches for younger people and gets farther away with age. In the mid 1980s, it was thought that people would have less eyestrain if the monitor were placed at the distance that coincided with a person's resting point of accommodation. More recent research has shown that the RPA is not the only consideration.

Convergence

Convergence is when the eyes turn inward toward the nose when we view close objects. Convergence allows the image of the objects to be projected to the same relative place on each retina. Without accurate convergence, we see double images. The closer the objects, the greater the strain on the muscles that converge the eyes.

The visual system also has a resting point of vergence (RPV). It is similar to the resting point of accommodation, but it's the distance at which the eyes are set to converge when there is no object to converge on. It's also known as dark vergence. The RPV averages about 45 inches when looking straight ahead and comes in to about 35 inches with a 30-degree downward gaze angle. Recent studies by Jaschinksi-Kruza (1988) and

Owens and Wolf-Kelly (1987) have shown the stress of convergence contributes more to visual discomfort than the stress of accommodation.

Jaschinski-Kruza (1988) divided subjects into two groups, near and far resting points of accommodation. The first (near) group had RPAs of around 20 inches. The second (far) group's RPAs averaged 40 inches. Both groups worked on computers at viewing distances of 20 inches and 40 inches. As expected, the near group had less eyestrain working at 20 inches than the far group. But both the near and far groups had less eyestrain at the 40-inch distance. Both groups judged the 20-inch monitor distance as "too near," and both groups accepted the 40-inch distance. Although their resting points of accommodation were different, both groups had far resting points of vergence. Jaschinski-Kruza concluded that "the stress on the convergence system may be the crucial factor for visual strain."

When Jaschinski-Kruza measured performance, he found that both groups performed better at the 40-inch distance than they did at the 20-inch distance.

Research by Owens and Wolf-Kelly (1987) found that after one hour of near work, the resting points of both accommodation and vergence shifted to a distance closer to the eyes. The size of the shifts depended on the resting points before the near work: Subjects who began the session with far resting points had the greatest inward shifts.

They found that the greater the inward shift in the resting point of accommodation, the greater the reduction in visual acuity, or keenness, when viewing a distant target. Changes in the resting point of accommodation did not correlate with subjective eye fatigue. On the other hand, greater inward shifts in the resting point of vergence were associated with greater eye fatigue, but not with changes in visual acuity.

When you work at close distances, the visual system adapts by bringing the resting point of vergence closer. That inward movement could be the visual system's reaction to fatigue. While continually viewing objects closer than the resting point of vergence has been found to contribute to discomfort, no studies have shown greater fatigue with viewing distance farther than the resting point of vergence. What does this mean in practical terms?

Farther is Better

If we just consider viewing distance, farther is better. So where do recommendations for maximum viewing distance come from? The arm's-length limitation most likely came from recommendations on monitor placement in cockpits. NASA Standard 3000 (1995) limits the displays that have associated controls. That is based on reach distance. While that is only for displays located close to their associated controls, the motion of reach distance has been used in other guidelines. Some try to justify a limit to how far away the monitor can be placed with the argument that if the screen is beyond a certain distance, you might not be able to read the letters.

It's clear that if you can't read the characters, the viewing distance is goo great. Or is it? Instead of moving the monitor closer, why not make the characters larger? In fact, guidelines recommending close viewing distances can only encourage the computer industry to maintain relatively small characters. That in turns forces closer viewing distances and can perpetuate eyestrain.

How close is too close?

It is difficult to set an exact limit for a minimum viewing distance. If sustained viewing closer than the resting point of vergence contributes to eyestrain, perhaps we should say that eye-screen distance should not be closer than the resting point of vergence. (On average, about 45 inches away at horizontal eye level and 35 inches away with a 30-degree downward gaze angle.)

But there are no cliffs in ergonomics (one inch closer and you fall): If your RPV at a 30-degree downward gaze angle is 35 inches, your eyes are not going to fall out with a viewing distance of 30 inches.

Somewhere between your resting point of vergence and 6 inches in front of your nose you are going to experience discomfort. That distance is a combination of gaze angle, how long you've been working at the computer, your individual visual system's capabilities, and a number of other factors.

Does this help to put an absolute number on how close is too close? I recommend at least 25 inches. But closer-viewing distances do not bother some people.

How Far is Too Far?

The reality is that there is no limit, based on visual fatigue considerations, to maximum viewing distance at computer workstations. From what we know about visual strain, farther viewing distances are better, at least up to the RPV. For example, if the RPV is 35 inches, an eye-to-screen distance of 25 inches is preferred to 20 inches. Thirty-five inches is better than 25 inches. Viewing distances beyond 35 inches (the RPV in this case) should neither increase nor decrease eyestrain.

To allow for greater eye-to-screen distances, we need software programs and monitors that allow font sizes to be increased easily. We need guidelines that don't force people to sit closer to their monitors than the distances at which they are comfortable.

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