Computers & Health: Designing a Responsible Plan for Action

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University of Vermont

8,000	undergraduates
1,050	graduate students
350	medical students
1,283	faculty
1,950	staff

University Computing Services supports academic, administrative, and library applications.
Staff: 50 FTEs (about 35 of which are professional positions)

Introduction

The question of whether computers pose a health risk is current, controversial, and almost certain to provoke an emotional response. Among the factors cited as health risks are stress, the restricted range of movements involved in computer use, the presence of static fields, and the possibility of low-frequency radiation. The alleged ill effects include skin rashes, visual disorders (eye strain, loss of focusing ability, cataracts), skeletal problems (back pain, repetitive strain injuries), and abnormal reproductive outcomes (conception problems, miscarriage, birth defects).

The severity of these allegations, combined with the sheer number of users potentially affected, has resulted in a certain amount of journalistic sensationalism. Some articles use attention-grabbing titles or graphic illustrations to emphasize the seriousness of the risks. Others take the opposite approach, denying that any risks exist at all.

To make matters even more confusing, members of both camps accuse each other of inaccuracies and deceit: those who emphasize the risks of computer use are accused of being irresponsibly inflammatory, while those who emphasize its safety are accused of intentionally concealing known hazards for commercial gain.

For those of us whose work involves advising other computer users, the topic has not only personal relevance, since most of us use a computer all day ourselves, but also raises a professional question: How, if at all, should we address the topic with our users?

University Computing Services (UCS) at the University of Vermont, although not known for its bravery, has taken a stab at the problem. Our approach is based on several assertions:

1. It is better to address the question directly than to ignore it.
2. Our coverage is likely to be more balanced than that of the popular press.
3. The most responsible approach that both we and our users can take is to become as well informed as possible, and act accordingly.

To that end, UCS has assembled as much relevant information as possible and distributed it to computing users on campus. That information is summarized here, followed by a bit of background information and some tips for other computing centers.

What We Tell Our Users

Some aspects of the topic are more clear-cut than others. Most researchers agree, for example, that ergonomics are particularly important in offices where computers are used. The intensity of the work and the limited physical move-

ment creates a higher potential for physical stress, stiffness, muscle strain, and related conditions.

Musculo-skeletal Effects

Repetitive movement such as keyboard use, in which the fingers move while the arms, shoulders, back, and legs are held static, actually puts greater strain on the body than more varied tasks such as filing, typing, or transcribing, in which more muscles are used more dynamically. As a result, the limited repetitive motion typical of computer use may contribute to back, neck, or shoulder pain or repetitive strain injuries such as carpal tunnel syndrome, a painful condition of the wrist.

Fortunately, it is possible to avoid or limit these effects. One of the most effective counter measures is to deliberately break up the repetitive motion by doing something else P performing some other office task, or walking down the hall, or just stopping to stretch periodically.

If the keyboard is to be used several hours a day, a comfortable chair with good lumbar (lower back) support is essential. Chair and table height should be adjusted to the individual user. If raising the chair to a comfortable typing height brings the feet too high, a foot rest can be used.

The height and tilt of the screen should be adjusted to avoid neck strain. Typically, the most comfortable viewing angle for the screen is slightly below eye level. (In the reading list at the end of this article, Grandjean, 1987 provides a comprehensive treatment of these and other ergonomic considerations.)

Lighting And Glare

Another controllable factor is lighting. Reflected light from windows or office fixtures can cause glare on the screen, making it difficult or impossible to read. Placing the computer desk at right angles to a window is considered preferable. In offices particularly blessed with windows, blinds or draperies may be necessary.

Even typical office lights may be too bright for effective use of the screen, especially if the light is reflected from bright walls or shiny desks. In this case, consider reducing the overall office lighting and using a desk lamp to illuminate paperwork without washing out the screen. Of course, the screen itself must have clearly formed characters, with high resolution and no flicker or distortion.

Effects On Vision

Even under favorable lighting conditions, reading a screen for hours on end can strain the vision. Focusing your eyes at the same distance for long periods of time may hamper their ability to refocus easily at different distances. Although most studies have found this strain to be temporary, there is some indication that very long-term use of computer screens (six hours a day for more than four years) may cause permanent focusing problems.

To reduce the risk of this or other visual strain, regular breaks are important. Looking away from the screen and focusing on an object 20 feet or more away can help. If a small work area makes that impossible, walking down a long hallway or looking through a window will vary the focal length.

Since using a computer screen, like any intense visual task, puts such a high demand on the vision, professional eye care is important. Users should inform their optometrist or opthalmologist if a computer is used regularly. In some cases, glasses or contacts prescribed specifically for the viewing distance of the screen may be helpful.

One or two reports have made the controversial suggestion that using a visual display terminal (VDT) may contribute to the formation of cataracts, a condition in which opacity of the lens interferes with vision. While all of the causes of cataracts are not known, heredity and age appear to be the strongest factors. Exposure to high levels of X-ray, microwave, or ultraviolet radiation also plays a role in the formation of some types of cataracts, but virtually all researchers agree that VDTs do not emit this type of radiation above background levels. The incidence rate for cataracts in VDT users does not appear to exceed that of the general population, and the prevailing scientific opinion is that there is not any link between VDT use and cataract formation.

Static

There is some indication that electrostatic charges generated near VDTs may contribute to skin rashes in some users. One possible mechanism for this is that static fields in front of the screen may cause ions and pollutants in the air to become positively charged and head for the nearest negatively charged surface: the user's skin. To reduce the possibility of static problems, pay particular attention to the floor covering and humidity level of the area. Anti-static shields are also commercially available.

Low-Frequency Radiation

Perhaps the most controversial aspect of the entire topic of potential computer health risks is the possibility of damage caused by low frequency electromagnetic radiation.

When video display terminals were introduced, the possibility of high-energy ionizing radiation (X-ray) emission was studied and generally dismissed as a health risk. Although radiation within the X-ray band is produced in VDTs, it is absorbed by the thick glass of the screen before it can be emitted.

Likewise, microwave and ultraviolet radiation were studied and found to be well within the limits of safety.

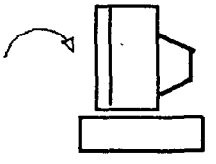
Quick tips

The following checklist summarizes suggestions described in more detail in the accompanying article.

✓ Sit in a comfortable chair that provides lumbar support.

✓ Adjust the chair height and table height to your size. Use a footrest if necessary.

✓ Adjust the screen angle and distance for easy viewing.

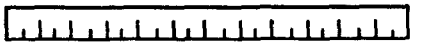


✓ Adjust the room lighting to prevent glare on the screen. Consider using a desk lamp to illuminate paperwork without washing out the screen.

✓ Get up and move around periodically. Walk down a long hallway or look through a window at distant objects to vary your focal length.

✓ If you wear glasses or contacts, ask your optometrist to make sure the correction is appropriate for your viewing distance from the screen.

✓ If you are concerned about the possible risk of low-frequency radiation, consider sitting about 24-28 inches away from the front of your monitor and at least 40 inches away from the sides or back of any other monitors, including those behind walls or partitions.



✓ If you notice symptoms such as eye strain or neck, shoulder, or wrist pain, pay attention to them. Identify and eliminate the causative factors (such as poor posture, poor lighting, insufficient breaks). If necessary, seek treatment early.

These frequencies of nonionizing radiation could cause damage by raising cell temperature, as a microwave oven heats food or overexposure to a sunlamp causes sunburn, but the amount of this kind of radiation generated in a VDT is far below the established safety thresholds.

As a result of this exoneration, most researchers and computer users satisfied themselves that any discomfort or health risks associated with computer use were a result of other problems P such as poor posture, lack of movement, job stress, eye strain, or other ergonomic factors P and were therefore avoidable.

More recently, however, attention has focused on very low frequency (VLF) and extremely low frequency (ELF) nonionizing radiation P frequencies which were previously believed to have no biological effect. Most video display terminals emit both VLF and ELF radiation. VLF and ELF radiation levels are highest at the sides and back of the VDT. The strength of the field decreases with distance from the unit.

This radiation has recently become cause for concern because some studies indicate that even weak VLF or ELF fields can cause miscarriage or birth defects in chicks and mice. In particular, weak pulsed signals similar to those found near VDTs have been associated with arrested development in chick embryos and fetal death in mice. Early stages of development seem to be most sensitive to the effects.

In addition, VLF signals have been found to cause detectable changes in protein patterns and production at the cellular level. This raises the suggestion that RNA transcription, such as that found in developing embryos, may be particularly sensitive to specific electromagnetic signals.

These effects are by no means undisputed. Critics have argued that the shape and frequency of the pulses used in these experiments are not identical to those found near VDTs and that the results of chick or mice studies are not necessarily applicable to human embryology. Some studies have failed to replicate the effects.

Epidemiological studies, in which the reproductive outcomes of women using VDTs are compared to those of women not using VDTs, also offer mixed results. Several "clusters" of problem pregnancies n VDT users have been reported, but it has been argued that such small clusters are simply a result statistical chance P that they could be found in any group of women, not just those using VDTs.

A study released in 1988 by the Northern California Kaiser Permanente Medical Care Program (Goldhaber, et al., 1988) was less ambiguous.It found that pregnant women who reported using VDTs more than 20 hours per week during the first trimester were significantly more likely to have miscarriages than women who performed similar work without using VDTs. (The relative risk factor for miscarriages in the VDT group was in fact 1.8 times that of the non-VDT group.) Although the study has been criticized for relying on recall (the women reported their VDT use from memory), it is considered by many as the strongest study to date. As in any epidemiological study, however, these results are based on a large group of people, and are not predictive for any individual.

Clearly, more research is needed, and it is in fact being carried out. In the meantime, users concerned about low frequency radiation may want to take certain simple steps.

The electromagnetic radiation emitted by a VDT is strongest at the back and sides of the unit, and drops off rapidly with distance. Try to sit 24 to 28 inches away from the front of your own monitor, and at least 40 inches away from the sides or back of any other monitors, including those behind walls or partitions.

Short term exposure to VDTs is generally not considered a problem. Even if you use a computer several times each day, you may be able to turn it off or move away from it when not actually using it.

Some computers, laptop models in particular, do not use cathode ray tubes. These models emit little if any VLF and ELF radiation.

The Untold Story

This, then, is the kind of information that UCS has distributed to users, in much the same form as it appears here. It was first published as a cover article in the University Computing Newsletter, with a short reading list and the summary of "Quick Tips" at the end.

The story behind the article may also be of interest. The impetus for writing it came from concern that users might see scare stories in the local and national press, panic, and wonder why the computing center wasn't addressing the issue. Thus, there were really two reasons for tackling the question: concern that stories in the popular press would spread misinformation, and a sense of our own responsibility to keep readers informed.

An early step in the process was to contact the local Risk Management Department. The University of Vermont is fortunate to have a department known as Risk Management, whose role is to advise University members on health and safety issues in the workplace. They were aware of the issue, had received a few inquiries (perhaps half a dozen in a year's time), and had addressed some aspects in their own in-house newsletter several months before. They proved to be an invaluable source of information and encouragement. Most importantly, since

their stated mission is to deal with knotty issues,we discovered we could refer all the really tough questions (and users) to them.

In researching the article, locating primary sources became an absolute necessity. Several hours spent in the medical library were rewarded by relevant research reports from medical and occupational health journals, including the original chick studies by Delgado et al. (1982) and the widely-reported Kaiser Permanente epidemiological study (Goldhaber, et al., 1988). These reports were essential in helping to determine which claims to accept in the popular press. They also provided a welcome change from the rhetoric found in more emotional sources.

Thus, the article is a summary of the situation as it is currently understood, backed up by a plump folder of reprints from both popular and scientific sources. The explicit goals of the article were to acquaint the reader with the issues, to explain why some aspects are controversial, and to provide ideas for specific action wherever possible. The tone of the article was intended to be informative but not inflammatory; the target audience was that ubiquitous phantom, the intelligent lay reader.

Despite a determined effort to avoid sensationalism, the article led a difficult life. Deemed too controversial, it was held for several weeks before being published. The primary stated objections were that it would make people nervous and that the computing center staff was not qualified to discuss the topic or answer questions from concerned readers. Only after rave reviews from Risk Management, earnest promises from them to handle any inquiries generated by the article, and certification of accuracy by the author was the article released for publication.

We are now awaiting any reaction to the article. Risk Management is prepared to handle questions or concerns from inquiring readers. (They have to be, since we included their phone number at the end of the article.) An abbreviated version of the article was published simultaneously in the Risk Management newsletter. Together, the two newsletters reached every faculty member and graduate student, as well as most laboratory personnel on campus.

Tips From The War-Weary

If you decide to publicly address the issue of computer and health on your own campus, the following tips — although rather obvious — may be useful.

1. **Consult local experts.** If your campus has the equivalent of a Risk Management or Campus Safety office, initiate contact with them. Other possible sources include Radiation Safety departments or local health officials. Although we were unsuccessful in locating anyone locally who could accurate measure low-frequency fields near a VDT, other sites may be able to accomplish this.

2. **Consult many sources, and read them critically.** Don't rely on just one source of information (including this paper!). Because the topic is so controversial, many sources (including some of those in the reading list) favor one point of view very strongly. Also, sources printed more than a year or two ago will not include recent research. Especially on the topi of low-frequency radiation, be wary of sources that claim to have all the answers: the full facts are simply not known at this time.

3. **Rely on primary sources whenever possible.** If you read an assertion or summary based on specific research, try to find the original research report.

4. **Determine which aspects of the issue to focus on.** For example, we decided to include quire a bit of information on ergonomics in addition to addressing the radiation question. The ergonomics aspects are fairly straightforward (at least in comparison), so we were able to provide some definite recommendations in that area. They also served as a less controversial lead-in to the radiation information. On the other hand, some aspects (such as the details of carpal tunnel syndrome or the allegations of a media cover-up) were clearly outside our scope.

5. **Avoid presenting only one side of the picture.** No matter which way you slant the article you are bound to upset someone, so you might as well be fair. To do otherwise will leave you open to charges of either sensationalism or cover-up. Someday when more facts are known, it may be possible to state conclusively which aspects of computer use (if any) pose risks, and what can be done to avoid them. For now, informed intelligence is a more realistic goal.

For More Information

A short reading list follows. Copies of the newsletter article mentioned in this paper, along with a much more complete list of sources, are available from the author.

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