

Evaluation of Safety Considerations in Workstation Design for Computer Operator.

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Abstract

A structured questionnaire was designed for administration on the subjects at the end of the workday. Subjects were asked to describe their feelings or how intense their feelings like vision problems and any muscle, back, or joint pain. Questionnaire responses were scored on four scales: eye irritation, eye fatigue, back pain, and neck-shoulder pains. Measures of workstation features were correlated with the feelings or complaints reported by the subjects. The result of the analysis showed that the only variable that consistently correlated with reported complaints was time spent on the computer. These correlation ranged from $r = .22$ ($p < 0.05$), between time on the computer and neck shoulder pain, while between time and back pain was $r = 0.32$ ($p < 0.05$). The sum of the complaints correlated with time at $r = 0.36$ ($p < 0.01$). Forty two subjects who reported no complaints spent an average of 42% of day working with the computer, while fifty one subjects who reported symptoms spent 60% of time working on the computer, $t_{92} = 3.22$, ($p < 0.01$). The result further showed that the operators with few complaints used preferred workstations with less than half of the day's work with breaks in work schedule. It can also be inferred that workstation design features would predict specific complaints among operators who spend most of their workday at the computer. The result, however, suggest that work break schedule may be a better predictor of operator feelings than workstation design.

Keyword: Workstation, Computer, Design, Operator safety.

Introduction

In recent years, computer operation has become a major work activity of people who are not computer professionals. Along with this increase in computer use, there have been many complaints from the operators. Office work activities, generally considered clean and safe, may have hidden danger. Some of these danger may include eyestrain and fatigue that may result from close repetitive work-especially on computer screen terminals. Other activities like word processing have already complained of backache, eyestrain, and stress Nelson (2007).

Many surveys of computer related Operators have revealed similar problems. The panel on impact of video viewing on vision of workers (2009) reviewed a large number of survey and Laboratory studies and concluded that the comfort, performance, level of stress and job

satisfaction of who regularly use computers have in many cases been adversely affected by failure to apply jobs and equipment with well-established principle of good design and practice.

According to the panel, poor workstation design and inappropriate lighting are primarily responsible for computer operators' complaints.

Cakir, Hart and Stewart (2006) proposed an extensive set of guideline for Video terminal display workstation which primarily involve lighting and work posture. Dainoff Fraser and Taylor (2010) used guideline similar to Cakir et al.'s in order to study operator response to an optimal workstation and to a poorly designed one. Subjects worked for three hours at a simulated data entry task without breaks. Dainoff et al. report that operators showed better task performance and lower level of discomfort when using the optimal workstation. Other authors however have questioned the generality of Cakir et al.'s guideline. Miller and Suther (2009) found that when operators were invited to adjust their workstations, height and angle of the keyboard and screen were often at variance with recommended positions. Grand Jean, Hunting, and Piderman (2009) report that preferred work posture in a sample of 68 operators were distinctly different from those recommended in textbooks". Grandjean et al. suggest that "feelings of postural relaxation" may be more important than postural support. Operators in the Grandjean et al. survey did not report the sort of discomfort that would be expected based on the recommendations of Cakir et al. and the results of the Dainoff et al. study.

In order to reconcile some of these apparent contradictions and to determine specific workstation feature correlated with operator complaints, a field survey of Computer operators was undertaken. It was expected that lighting problem such as high contrast between the screen and copy work would be associated with reports of eye fatigue or irritation; likewise, it was expected that poor work postures would be correlated with complaints of back or neck discomfort.

Methodology.

The subjects covered 99 Computer operators who were contacted at work with the cooperation of their employers. All operators who used Computers for at least 100% of that day were asked to volunteer. Two sets of data were collected for each subject: workstation and report of unusual feelings.

Workstation Features

For each subject's workstation, measures were taken of lighting, furniture dimensions, and workstation-operators fit. The lighting measures were: illumination on the keyboard and the luminance of the screen, near and, far positions of operator, and copy work. Measurement of the furniture includes desk height, keyboard thickness, seat pan height, thigh clearance, and the distance from desk to screen center. Finally, with the operators assuming a comfortable and safe work posture, measures were taken from the viewing angle from horizontal to the screen center and the distance from the eye to the screen; rotation of the trunk when viewing the screen was

also recorded. Similar measures, viewing angle, viewing distance, and rotation angle, were also recorded while the operator looked at copy work.

Questionnaire Response

Subjects were given a questionnaire to be completed at the end of the working day. Questionnaires were either collected by assistance or mailed directly to the experimenter using envelopes provided. Open ended questions asked subject to describe any overall unsafe feelings, eye irritation or vision problems, and any muscle, back, or joint pain. Subject were asked to describe how intense or annoying were any of these feelings. Finally, subject estimates, "what percent of today's time was spent at the Computer.

Findings

Questionnaire responses were scored on four scales: eye irritation, eye fatigue, back pains, and neck-shoulder pains or unusual feelings. Each response was scored from zero, no unusual feelings, to four, intense pains. Measures of workstation features were then correlated with the unusual feelings scales. In addition to the measured features, the predictors included contrast ratios from screen to near and, far positions, and screen to copy work. Estimated time spent at the Computer was also included as a predictor. Data from six subjects were unusable due to incomplete records.

The only variable which was consistently correlated with unusual feelings was time spent at the Computer. These correlations ranged from $r = .22$ ($p < .05$) between time and neck- shoulder pain to $r = .32$ ($p < .01$). Between time and back pain. Overall discomfort correlated with time at $r = .36$ ($p < .01$). Furthermore, subjects who reported no complaints ($N = 42$) spent an average 42% of the day working with a Computer while subjects who did report symptoms ($N = 51$) spent 60%, $t(92) = 3.22$, $p < .01$.

Discussion and Conclusions

Most of the workstation observed in this study consisted of a terminal place on conventional office desk. Few had any provision for holding copy work and most were placed haphazardly with respect to windows and lighting fixtures. None of the workstations utilized furniture which is marketed as "ergonomically designed" office furniture. It would be expected from the result of Dainoff et al. (2010) that workstations like these should produce vigorous complaints. Nonetheless, workstation features were not correlated with any of the measures of the operators' complaints. The difference between the tasks of subjects in the present study, and the Dainoff et al. study should be noted. In the Dainoff et al. study, subjects performed data entry work at the Computer for three hours without breaks; report of bad feelings were recorded immediately after completing the task. In the present study, many subjects report that they worked intermittently at Computers. Only four subjects described themselves as word processing operators who spent 90+% of their time at Computer. Most of the other subjects described their jobs as general office, librarian reporter or other work that did not require continuous Computer operation.

Grandjean et al. (2009) also concluded that preferred work postures could be very different from recommended standards without producing operators' complaint. The operator in the present study who reported the fewest unpleasant feelings used their preferred workstations for less than half the work day with a self - paced work rest schedule. It is possible that workstation design features would predict specific complaint among operators who spend most of their work at Computer. Too few subjects in the present study fulfill this criterion to test this hypothesis. The data suggest, however, that work-break schedule may be a better predictor of operator safety than workstation design. Optimal Computer workstations may be most useful for operators who spend most of their day at the Computer.

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