

Method of Recovery from Visual Strain Caused by Video Data Terminal Operations

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Abstract

Recovery from the visual strain has been recognized based on the evaluation of the visual strain caused by continuous VDT operations. Relation between the visual strain and the VDT operations was investigated. The recovery from the visual strain using a new recovery method was confirmed to be satisfactory. Based on the above experimental results, a new method of recovery from the visual strain caused by VDT operations has been proposed.

Introduction

Fatigue of an operator during the video data terminal (VDT) operations, of which causes are very complicated, is recognized as a function of visual accommodation in eyes, brain, and other body positions. Fatigue of the VDT operator can be grouped into two types: i.e., physical and mental stresses. Because the mechanism of fatigue generation is too complicated to be evaluated, it is grouped into these 2 types. The physical stress has to be investigated from the viewpoint of the functional degradation in body positions due to visual strain. So, the function of degradation due to visual strain is measured using the measuring instruments for both the visual sensation (visual acuity, strabismus, and flicker) and eye movement (accommodation and convergence in the near point). At that time, biological changes of the subject are measured using the sphygmomanometer and heart rate meter. Although these were measured, no parameters affected by visual strain during the VDT operations were found when the measurement was carried out. Even if found, visual strain cannot be recovered by itself and medical treatment will be required. The mental stress has to be investigated based on the results of the evaluation in accordance with 5 category steps. Then, the relation between the visual strain and the efficiency of works during the VDT operations has to be investigated, and the relation between the time of VDT operations and the indexes for the recovery treatments of the visual strain is to be found from the experimental results of the fatigue.

Based on the above experimental results obtained from our study, the authors propose a new "Method of Recovery from Visual Strain caused by VDT Operations."

Loading and Recovery of Visual Strain

New recovery measurement instruments used to measure the visual strain have been developed, based on the evaluation results to the visual strain caused by continuous VDT operations. They include an achromatic color measurement instrument to estimate long wave-length warm colors using the complementary colors of short wavelength, and a recovery measurement instrument used to estimate the function of the visual accommodation using the virtual far point picture of a natural landscape. Relation between the visual strain and the efficiency of works during the VDT operations has been investigated.[1]

Where

1. Result obtained of the visual strain was loaded.
2. Result obtained when the recovery Treatments of the visual strain were carried out every 60 minutes.
3. Result obtained when the recovery treatments of the visual strain were carried out in 120 minutes after the start of the VDT operation.

Figure 1 shows the averages and 95% confidence intervals of the efficiency of works during the VDT operations in the loading and recovery of visual strain.[2] The efficiency of works during the VDT operations in the loading of visual strain was gradually decreased. Both the

complementary color stimuli and virtual far point picture were put on the frame of the VDT display. Two kinds of pictures used for the recovery of visual strain were sequentially displayed on the frame every 60 or 120 minutes. The color stimuli of long wave warm colors, which was accumulated on the operator's retina, can be eliminated by displaying the compensation color image consisting of short wavelengths of cool colors, and the ciliary muscles of the operator's eyes can be relaxed when the virtual far point picture of a natural landscape is displayed. The efficiency of works during the VDT operations when the recovery treatments of visual strain was carried out every 60 minutes was improved to be 1.14 to 1.15 times as compared with that obtained from the loading of visual strain. The efficiency of works during the VDT operations when the recovery treatments of visual strain was carried out every 120 minutes was decreased to 0.93 time. Accordingly, the recovery treatment of visual strain which was carried out every 60 minutes was most effective. However, the efficiency of works during the VDT operations when the recovery treatment was carried out in 120 minutes after the VDT operation was started a little smaller than that obtained from the loading of visual strain.

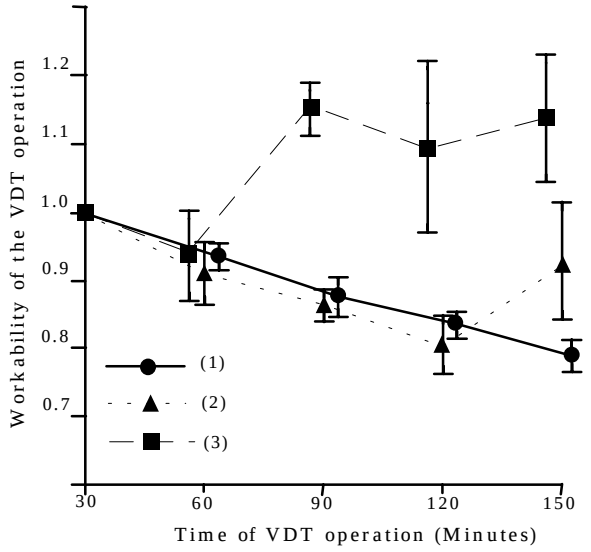

Figure 1. Averages and 95% confidence intervals of the workability of the VDT operation during the loading and recovery of the visual strain.

After the VDT operator felt visual strain during the VDT operations which were carried out every 60 minutes, complementary colors of short wavelengths were added to the original warm colors of long wavelengths and the virtual far point picture used for recovering the visual strain were displayed on the CRT. The effect•of these treatments on the recovery of fatigue are classified in accordance with the following category steps.

1. No visual strain was recovered, and the fatigue was felt too much to continue the VDT operation.
2. Visual strain was recovered a little, and the fatigue was decreased a little.
3. Visual strain was recovered compara-tively, and the fatigue was decreased considerably.
4. Visual strain was recovered remarkably, And the fatigue was felt a little.
5. Visual strain was recovered, and the Fatigue was not felt.

The recovery of visual strain was made clear from the result of the recovery treatments to eliminate the visual strain caused by the VDT operations which were carried out every 60 minutes. Fig. 2 shows the result of the subjective evaluation at the recovery treatments to eliminate the visual strain caused by the VDT operations in accordance with 5 category steps¨. By the recovery treatments of the visual strain using both complementary colors and a virtual far point picture, category (1) occupied 20% to the total number of events in 60 minutes after the start of the VDT operation, and category (2) occupied 80%. Then, category (1) occupied 20% to the total number of events in 120 minutes after the start of the VDT operation, and category (2) occupied 70%. Category (3) occupied 10%.

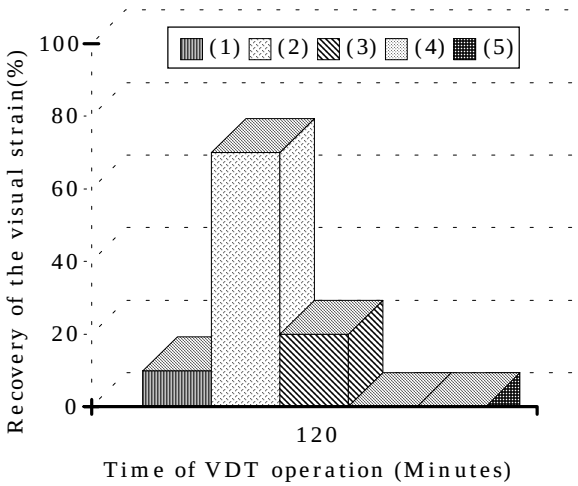

Figure 2. Recovery of the visual strain caused by the VDT operations, which was carried out every 60 minutes.

The recovery of the visual strain in 120 minutes after the start of the VDT operation became more remarkable than that in 60 minutes after the start of the VDT operation. Category (3) was observed when the visual strain was recovered in 120 minutes after the start of the VDT operation, and it was not observed when the visual strain was recovered in 60 minutes after the start of the VDT operation.

The recovery of the visual strain was made clear from the result of the recovery treatments to eliminate the visual strain caused by the VDT operations which were carried out every 120 minutes. Fig. 3 shows the result of the subjective evaluation when the recovery treatments of the visual strain caused by the VDT operation were carried out in accordance with the above 5 category steps.[2] By the recovery treatments of the visual strain using both complementary colors and a virtual far point picture, category (1) occupied 10% to the total number of events in 120 minutes after the start of the VDT operation, and category (2) occupied 70%.

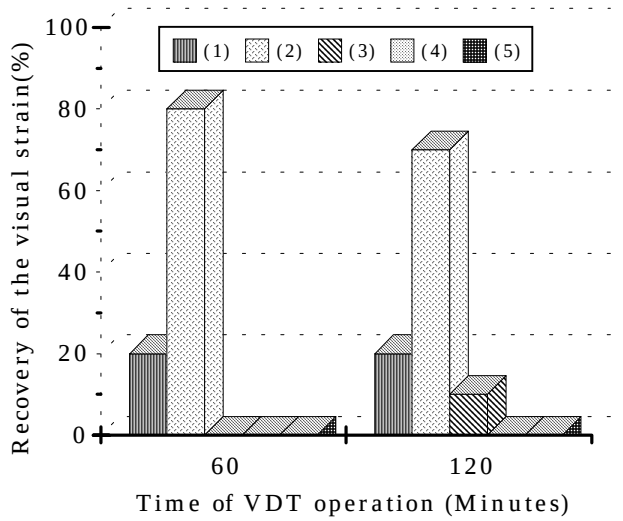

Figure 3. Recovery of the visual strain caused by the VDT operation, which was carried out every 120 minutes.

Table 1 Indexes for effective recovery of fatigue.

Eye accommodation or body positions where fatigue has been recognized	Index of recovery on fatigue	Rates of occurrence of specific index (%)
Recovery of eye accommodation	Far point is seen	10 (Min.) 30 (Max.)
Recovery of strain in eyes	Eyes feel clear	40 (Min.) 50 (Max.)
Recovery of strain in brain	Forehead feels clear.	30 (Min.) 40 (Max.)
Body positions other than brain and eyes	Neck and shoulder feel clear.	0 (Min.) 20 (Max.)

Based on the above results, when the visual strain was recovered a little by the recovery treatments as adding complementary colors of short wavelengths to the warm colors of long wavelengths on the retina, and as displaying a virtual far point picture on the CRT, the fatigue was decreased a little.

Table 1 summarizes the experimental results obtained when the recovery treatments were carried out in a time ranging from 60 to 120 minutes after the start of the VDT operation. The indexes shown on Table 1 summarize the feeling after the recovery treatments. These indexes mean the recovery of the fatigue caused by VDT operation.

Method of Recovery from Visual Strain caused by VDT Operations

Loading and Recovery of Visual Strain

On the basis of the experimental results of the study, the authors propose a new method of evaluating recovery from visual strain hereafter:

First, alphabetic characters are to be displayed on a flame of the CRT display. Second, the time of a VDT operation between two successive recovery treatments to eliminate the visual strain is to be obtained, and an index for recovery treatment of the visual strain is to be obtained. These are obtained on the basis of the results of the evaluation in accordance with the above 5 category steps. Variables needed to the measurement of loading and recovery of the visual strain include brightness, luminance contrast, visual distance, visual angle, and time of a VDT operation. The subject is selected among the personnel with a normal visual acuity of at least 1.0 (the difference between two eyes to be a 0.3 or less) and should be not 30 years old or younger.

Recovery Method of Visual Strain caused by VDT Operation

The recovery method of the visual strain caused by the VDT operation is as follows:

1. Degradation of the functional activity due to the visual strain is to be measured using the measurement instruments for both the visual sensation (visual acuity, strabismus, and flicker) and eye movement (accommodation and convergence in the near point). At that time, biological changes of the subject are to be measured using both the sphygmomanometer and heart rate meter. No parameters affected by the visual strain during the VDT operation can be found during the measurement, and the VDT operations keeping the body healthy can be carried out everyday.
2. The VDT operator has to watch complementary colors of short wavelengths and the three dimensional virtual far point picture used for the recovery of the visual strain caused by the VDT operations which are carried out every 60 minutes, and the VDT operator has to carry out the recovery treatments of the visual strain caused by the VDT operations which are carried out every 120 minutes.
3. The indexes of the fatigue in a certain time ranging from 1 to 120 minutes after the start of the VDT operation are to be arranged in the order of “Eyesight flickers”, ”Whole head feels dull”, and “Eyes feel the dry”. The effective indexes at the time of recovery treatments to eliminate the fatigue in a certain time ranging from 1 to 120 minutes after the start of the VDT operation are to be arranged in the order of “Eyes feel clear”, ”Forehead feels clear”, “Far point is clear”, and “Neck and shoulder feel clear”.

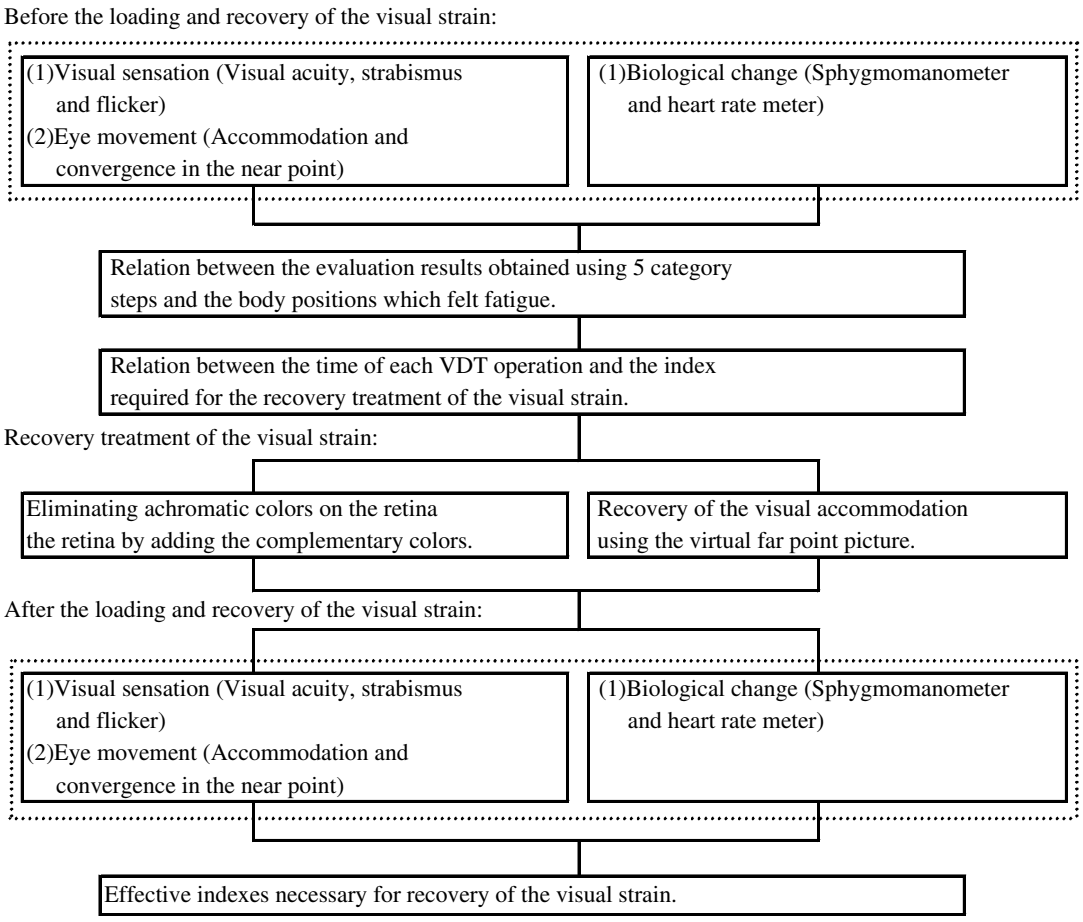

Figure 4. Recovery method of visual strain caused by VDT operations

The ideas contained in the above method are summarized in Fig. 4.

Conclusion

The visual strain caused by the VDT operations should be recovered using the visual strain recovery system in which both the complementary colors and three dimensional virtual far point picture are incorporated into the personal computer. The VDT operator, even if feels fatigue, can keep the body healthy after the recovery treatment of the visual strain. Then, the new mode of VDT operations has been established by eliminating the visual strain during the VDT operations which are contiguously carried out everyday.

References

1. T. Muraoka, N. Nakashima, H. Ikeda, and Y. Ishizaki, “Subjective Evaluation for Recovery from Visual Strain in Video Data Terminal Operation”, Proceedings of the 14th Korea Automatic Control Conference, International Session Papers, pp.189-193, (October) Yong-In, Korea, 1999.
2. T. Muraoka, N. Nakashima, H. Ikeda, and H. Sumiyoshi, “New Instrument of Recovery from Visual Strain Caused by Video Data Terminal Operations”, Contributing the IEEE-IECON 2000