A PRELIMINARY REPORT ON A CROSS-SECTIONAL SURVEY OF VDT USERS AT THE BALTIMORE SUN

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I. SUMMARY

In December 1979, the National Institute for Occupational Safety and Health, received a request from the Newspaper Guild, AFL-CIO, to evaluate the effects of video display terminals (VDTs) on employees at the Baltimore Sunpapers. The request reported several cases of cataracts among VDT users, a high rate of complaints about eye problems, such as irritation and blurred vision, headaches, and back and neck aches. Accordingly, NIOSH undertook a cross-sectional survey to define the type of eye an body complaints reported, and the prevalence of eye abnormalities, including cataracts and retinal abnormalities, and their relationship to VDT use.

We surveyed 379 employees of the Baltimore Sun, 283 of whom were members of the Newspaper Guild. Each participant answered a self-administered questionnaire on personal and job information, symptom complaints, and on a personal assessment of the pressure, pace, autonomy, security, and satisfaction associated with the job. Each survey participant underwent a complete eye examination.

We found that as participants increasingly reported that they were bothered by the brightness of the VDT screen or characters, by the glare off the screen, by the readability of the characters, or by flicker; they also increasingly reported (1) changes in their visual function, namely, seeing colored fringes around objects, difficulty reading and focusing on characters; (2) pain and stiffness in their neck, shoulders, and back; (3) headaches associated with work, in particular their usual job; and (4) headaches accompanied by itching, burning, watery eyes, blurry vision, nasal discharge and sweating. As participants tended to report that their VDT use typically involved shifting their eyes between the source document, VDT keyboard and screen; and as they tended to report that they found that they were bothered by the relative height, distance, and tilt of the VDT keyboard and screen; so too they tended to report that their headaches characteristically were superficial in location, dull and boring in sensation, beginning on one side of the head, but spreading to involve both sides. As participants reported a greater total number of years of VDT operating experience, they tended to report less than their headaches occurred during periods of stress, worry, and/or tension. As participants reported a greater number of hours per week of VDT operation, they also tended to report less that their headaches were preceded and accompanied by double and blurry vision.

We did not find any meaningful relationship between adequacy of the participants' refractions, including the wearing of glasses with bi- or multifocal lenses, and the reporting of work-associated symptoms. We did not find any significant association between VDT use, including hours per week of VDT operation and total years of VDT operating experience; and the prevalence of eye abnormalities, including cataracts.

Summary

The National Institute for Occupational Safety and Health, was asked by a representative of employees of the Newspaper Guild, AFL-CIO, representing a large segment of employees at the Baltimore Sunpapers, to undertake an evaluation of the effects of video display terminals (VDTs) "on the environment and health of employees who use them." Included in the request was the statement that there had occurred "several cases of cataracts among VDT users, a high rate of complaints about eye problems such as irritation and blurred vision and headaches, back and neck aches...[sic]" Accordingly, we undertook a cross-sectional survey, to define the type of eye and body complaints reported by VDT users, and to identify their relation to VDT use; the association between symptoms and the participants' abilities to see clearly (i.e., their refractive abilities) relative to the demands for clear vision required by their job; and the prevalence of eye abnormalities, including cataracts and retinal abnormalities, and their relationship to VDT use.

We surveyed 379 employees of the Baltimore Sun, 283 of whom were members of the Newspaper Guild. Each participant answered a self-administered questionnaire on personal and job information, symptom complaints, and on a personal assessment of the pressure, pace, autonomy, security, and satisfaction associated with the job. Each survey participant underwent a complete eye examination.

Using a statistical technique known as "factor analysis", we found that as participants increasingly reported that they were bothered by the brightness of the VDT screen or characters, by the glare off the screen, by

the readability of the characters, or by flicker; they also increasingly reported (1) changes in their visual function, namely, seeing colored fringes around objects, difficulty reading and focusing on characters; (2) pain and stiffness in their neck, shoulders, and back; (3) headaches associated with work, in particular their usual job; and (4) headaches accompained by itching, burning, watery eyes, blurry vision, nasal discharge and sweating. As participants tended to report that their VDT use typically involved shifting their eyes between the source document, VDT keyboard and screen; and as they tended to report that they found that they were bothered by the relative height, distance, and tilt of the VDT keyboard and screen; so too they tended to report that their headaches characteristically were superficial in location, dull and boring in sensation, beginning on one side to the head, but spreading to involve both sides. As participants reported a greater total number of years of VDT operating experience, they tended to report less that their headaches occurred during periods of stress, worry, and/or tension. As participants reported a greater number of hours per week of VDT operation, they also tended to report less that their headaches were preceded and accompanied by double and blurry vision. Controlling in the analyses for other characteristics of the participants, which might affect the symptoms being reported, did not change these observed associations in any meaningful way.

We did not find any meaningful relationship between adequacy of the participants' refractions, including the wearing of glasses with bi- or multifocal lenses, and the reporting of work-associated symptoms. We did not find any significant association between VDT use, including hours per

week of VDT operation and total years of VDT operating experience; and the prevalence of eye abnormalities, including cataracts.

We note that among VDT users, the average number of years of VDT operating experience was 3.8 years, with a maximum of 9.2 years. If a minimum duration of VDT usage is postulated to be required prior to eye abnormalities being detectable, then the group of participants in this survey may well be judged to have had an insufficient amout of VDT usage for us to have found any such postulated associations. Therefore, our survey may well have been inadequate in terms of amount of exposure to resolve such issues as the putative associations of cataracts and VDT usage.

This survey has been primarily of value in delineating the relationship between VDT-users' symptoms and various ergonomic aspects of VDT use. The bothersome visual aspects of the VDT itself, as usually adjusted, explained the plurality of work-associated symptoms, even when other participant and workplace characteristics were taken into account. We suggest that future emphasis be placed on research in regard to VDT viewing characteristics, and other aspects of the VDT viewing environment. We feel that these problems are best addressed experimentally.

Introduction

There has been a growing apprehension over environmental and workplace exposures to electromagnetic radiation. It has been recognized for many years that cathode ray tubes, in particular color television sets, can emit x-radiation under certain circumstances[1,2]. Similar concerns have arisen with respect to video display terminals (VDTs) in the workplace. Although initial emphases related primarily to x-radiation, more recent attention has shifted toward non-ionizing radiation putatively emitted by VDTs, particularly in the radio-frequency and microwave portions of the electromagnetic spectrum[1]. If such putative emissions actually were present, they would be especially worrisome since VDT users are generally situated close to the units for prolonged periods of time.

A review of newspaper and magazine articles describing employee reactions to increasing VDT use in the workplace reveals three broad areas of concern.[3,4] First, there is the lingering fear that VDTs may be sources of radiation that may cause specific and/or unknown biological damage. There are reports, for instance, of VDT-associated ocular cataracts[5], and of birth defects among offspring of women who worked with VDTs[6]. Second, there is the recognition that a wide variety of somatic complaints are prevalent among VDT users. These relate primarily to eyestrain, transient visual impairment, and musculo-skeletal complaints. There appears to be widespread agreement that ergonomic problems may be the likeliest cause of these complaints. These problems include postural relationships between the VDT and user, background illumination levels which affect contrast and glare of VDT screens, and the match of the user's visual

refraction and the job demands placed on his or her visual capabilities. Third, there is the fear of automation, and the tendency for some operators to regard their jobs as equivalent to assembly-line workers in demanding, paced, repetitive jobs. Job insecurity and uncertainity about the future contribute to job dissatisfaction, alienation, and stress. This may be manifested as somatic symptoms or illness. Concerns are expressed by employee representatives that research is not currently available or sufficiently disseminated upon which to base appropriate recommendations regarding adjustment of ergonomic factors, the need for work-rest breaks, and the need for medical and ophthalmological examinations. Those recommendations that have been made may be disputed or controversial. Furthermore, despite what is already known or may be extrapolated from other areas of knowledge, some unknown effect or factor still may have been overlooked.

Radiation emissions from VDTs have been measured. It has repeatedly been demonstrated not only that X-ray, radiofrequency, ultrasound, visible, and infrared emissions are all within existing federal guidelines[7-12], but that such emissions are generally indistinguishable from background levels. Even under intentional worst-case operating conditions, emissions fall within the standards and guidelines for each type of radiation[12].

Much has been written about the non-radiation health problems associated with VDT use. Although the complaints expressed by operators may be no different from those of other office workers,[13] the origin of the complaints is multifactorial, with many of the underlying factors interacting with each other. We touch upon what we believe to be some of

the more important factors as follows. Reviews of the subject may be found in references 14 through 19.

First, two basic modes of operation typify VDT use. These are the VDT as a "data-entry terminal", and the VDT as a "conversational terminal".[19] The former mode is characterized by the entry of large amounts of data into a computer. The user's gaze is fixed primarily on the source document, so that visual accomodation is fixed. There is, generally, a high key-stroke rate. The latter mode is primarily as an interactive system. The user's gaze alternates between the source document, keyboard, and screen, so that visual accomodation usually is changing. There is, generally, a lower key-stroke rate. Characteristic of the "conversational terminal" is that it may be used but occasionally, as a technical aid in an otherwise varied office routine, and not as a primary element around which the user's work is centered.

Second, decreasing freedom may characterize some VDT work.[21,22] Traditional office work can be carried out in a variety of ways, and the office worker generally is free to choose the preferred way of accomplishing a task. Computerizing the job may reduce this freedom. Regimentation of repetitive tasks may result in earlier fatigue and discomfort, with little opportunity for relief, than if the worker had the option to modify the way the task is performed. When the user does not have the option to modify the task, work/rest schedules become increasingly important.

Third, workplace lighting conditions may become a problem for VDT users. There may be large contrasts of surface luminances between the screen and source documents, as well as between the screen and its

surrounding elements, such as windows, light sources, and walls. It has been recommended that ambient lighting should be somewhat lower than in general office work, but supplementary adjustable lighting should be available.[21] The user's field of vision should not include windows or other sources of glaring luminence, which result in "discomfort glare". Sensitivity to discomfort glare increases with age.[14] On the other hand, visual acuity increases with increasing luminance, in part due to the decreased pupillary diameter and decreased spherical aberration. These changes also result in an increased ocular depth of focus, which is advantageous for older employees, who may compensate for decreased accomodation by increased depth of focus if illumination levels are high.[22]

Fourth, postural relationships between the VDT and the user must be considered as possibly explaining some of the operators' musculoskeletal complaints. The position of the head, for instance, is dictated by the visual angle and viewing distance, while the position of the hands is dictated by the keyboard and source document.[23] Different postures correspond to different modes of VDT use. There is a greater homogenity of postures, i.e., postural immobilization, among operators of data-entry terminals than among operators of conversational terminals. Variability of eye to screen and eye to document distances is less for operators of data-entry terminals than for operators of conversational terminals.[24] Since the position of the head is determined by the visual angle and viewing distance, traditional bifocal glasses may be unsuitable for some operators, and result in strenuous work postures, an over-stressed axial musculature, and discomfort.[21]

Fifth, problems with visual function must be considered as potential sources of the VDT user's reported discomfort. Visual refraction, accomodation, and convergence, all act to bring the visual image into sharp focus on the retina. Since the range of accomodation decreases with age, viewing distances must be adhered to more or less strictly with increasing age. However, equal viewing distances for the screen, keyboard, and source document may have the effect of requiring the amount of accomodation to be maintained at a constant level. This might be responsible for some of the reported symptoms.[22] Compensation for decreased accomodative power by bi- or multifocal glasses may, as noted previously, lead to a forced, strenuous viewing posture.[21,22] With continuous close work, temporary "myopization" may result, in which the eye exhibits too much refractive power for the viewing distance. Very close work may, however, have the reverse effect, with the near point of accomodation moving outward.[21]

A number of observational studies have documented the presence of symptoms of eyestrain, musculoskeletal complaints, and psychological dysfunction, among VDT users. In general, the studies suffer from the problems intrinsic to observational research. For instance, the relationships between exposure (VDT use) and outcome (somatic symptoms, psychological dysfunction) are generally confounded by important covariates (such as age). No attempt was made in any of the studies to control for relevant covariates in analyzing relationships between VDT use and outcomes. As well, it frequently is not altogether clear whether the exposure (VDT use) is even relevant, since it may merely be a surrogate for or correlate of some underlying factor, such as workplace lighting

characteristics, constrained postures, paced-work, alienation from work, etc. Other problems that characterize the literature include inadequate definition of the target populations of the surveys, and lack of attention to participant bias. Many studies clearly were performed on conveniently available worker groups; some had no control group; others compared different groups of VDT users, apparently chosen so as to have some variation in amount of VDT usage.

The studies without comparison groups[25-29] are useful in identifying problem areas to be considered in regard to assessing work with VDTs. VDT users have been miscellaneously reported to complain of visual discomfort, e.g., burning eyes and lachrymation, frontal and occipital headaches, difficulty in fixation, blurred vision, and changes in color perception. Discomfort glare and reflections on the screen seemed to be the source of complaints at one site.[30]

The studies with comparison groups typically provide little or no information on response rates and participant biases. In general, confounding is ignored, and multivariable causes are disregarded.

Johannson and Aronsson[31] studied 95 subjects with a varying proportion of VDT work per week. Data-entry operators, with work-pace controlled more directly by the technology than by the operator him (or her) self, had greater mental strain. They suggested that autonomy, threats to job security, and machine-pacing were job stressors in some VDT jobs. Complaints of stress were primarily among individuals who did monotonous coding work. Individuals with varied tasks tended to regard the VDT as a useful technical aid.

Elias et. al.[32] studied two groups of female VDT operators. Those with fragmented job tasks expressed greater job dissatisfaction and more complaints about vision-related symptoms.

Rey and Meyer[33] studied 312 subjects at 3 workplaces, comparing VDT operators with persons in jobs with high visual demands (engraving, watch making, etc.) They found symptom complaints to be functions of age, task (VDT vs. non-VDT use), and duration of work. They concluded that the increase in symptom complaints among VDT operators were not due to excess eye defects. They also concluded that VDT operators had increasing complaints in parallel with the increase in eye defects in the older age group. Age confounded their results and was not controlled in their analysis.

Binaschi et. al.[34] compared a group of 54 VDT users (with unknown volunteer biases) to two non-user groups. They concluded that sociopsychological factors due to work organization were more important in assessing self-reported fatigue, than VDT use.

Ghiringelli[35] compared 62 VDT operators from 2 companies to 237 controls from one of the companies. Confounders such as age were compared by group, and then ignored. He reported eye discomfort, headache, back and neck aches, and psychological troubles as being "significant factor(s)" among VDT operators. The greatest discomfort was reported by the younger and better educated respondents. Fault was found with the office lighting, air-conditioning, and open space. He concluded that "VDUs seem to add their own troubles and emphasize the usual problems of employees, and we suggest that they could become a symbolic focus of discomfort."

Laubli et. al.[36] studied 2 groups of VDT operators (at data-entry terminals and at conversational terminals) and compared them to two groups of non-VDT user office workers. A factor analysis of their symptom questionnaire revealed 2 underlying patterns of response, namely, with respect to eye fatigue or irritation, and with respect to impaired accomodation. A correlation was noted between measured intensities of light reflections and annoyance, but no relation between measured luminance of reflections and visual impairment was noted.

Dainoff[37,38] studied two heterogeneous groups with respect to VDT usage. He found a relative high prevalence of symptoms suggestive of eye fatigue, as well as compaints regarding glare and lighting. These complaints increased with the proportion of time spent looking at the VDT screen. The compaints appeared to be independent of job pressure and hostility toward offoce computerization.

Smith et. al.[39,40] reported the results of a job stress survey at three sites. They concluded that job content factors and VDT-use interact to contribute to VDT operator problems. Although there may be a relationship between job activities and VDT-use that brings about job stress and health complaints, the authors concluded that the problems did not lie solely with VDT use.

Stammerjohn et. al.[41,42] reported on the ergonomics of the Smith et. al. study sites. VDT users reported more difficulties with their background lighting (glare, shadows) than non-users. A significant correlation was noted between visual function complaints and employee rating of glare, screen angle, VDT noise, and screen flicker. Among professional employees,

musculoskeletal complaints correlated with screen angle, height, glare, and flicker.

For completeness sake, we report a newly observed phenomenon (since our investigation, described below, was initiated) of facial dermatitis and itching, among VDT users in Norway,[43] hypothesized to be due to a static electric field generated by the VDT under conditions of low ambient humidity.

Survey of VDT users at the Baltimore Sun

The Division of Surveillance, Hazard Evaluations, and Field Studies of the National Institute for Occupational Safety and Health, was asked by an authorized representative of employees of the Baltimore-Washington chapter of the Newspaper Guild, AFL-CIO, representing a large segment of employees at the Baltimore Sunpapers, to undertake an evaluation of the effects of VDTs "on the environment and health of employees who use them". Included in the request was the statement that there had occurred "several cases of cataracts among VDT users, a high rate of complaints about eye problems such as irritation and blurred vision and headaches, back and neck aches...". Accordingly, we undertook a field survey of employees of the Baltimore Sunpapers, to attempt to address some of the issues previously discussed. This study attempted to define:

the type of ocular and somatic complaints reported by VDT users and non-users, and their relationship to VDT use,

the association, if any, between ocular and somatic complaints, and refractive abilities specific to the job tasks for VDT users and non-users, and

the prevalence of lenticular opacities and retinal abnormalities among VDT users and non-users, and their relationship to VDT use.

Study Design

There are approximately 1675 employees at the Baltimore Sunpaper. We were able to contract for approximately 500 eye examinations, to be performed by ophthalmologists at the University of Maryland Hospital. Thus, some selective process had to be implemented, to define a narrower potential participant universe, that would include both VDT users and non-users. We initially decided to limit the survey to members of the Newspaper Guild. A membership roster as of December 31, 1980, (referred to hereafter as the "Guild roster") listed 629 persons. This figure did not represent an exact count of current (as of December 31, 1980) Guild members employed in Baltimore at the Sunpapers, since it included persons who had left employment but had not yet been removed from the roster, and employees on assignment outside the Baltimore area; and did not include newly employed Guild members who had not at that time been added to the roster. Because data were not available to identify VDT users and non-users, a short questionnaire (Appendix 1) to obtain demographic and VDT-use information, was distributed to as many Guild members from the roster, as could be contacted. It was our intention to rank respondents according to VDT use, and to choose 250 participants from either end of the ranked scale, until all examination slots were filled. It soon became apparent that selective recruitment of participants was not feasible. Accordingly, an effort was made to obtain the short questionnaire information from all Guild members on the roster, and to offer participation in the ophthalmological examination to as many as would participate. Participation was also offered to members of the Typographers' Union at the Sunpapers, who likewise used VDTs in their

work. No similar effort was made, however, to define a universe of potential typographer participants, to canvas as completely as possible that universe with the short, demographic and work exposure questionnaire, or to enroll as many as possible of that potential participant universe into the examination.

Clinical Methods

The ophthalmological examinations were performed on 10 Saturdays, from February to May, 1981, at the Department of Ophthalmology of the University of Maryland. At the time of the examinations, a lengthier self-administered questionnaire was answered (Appendix 2) to obtain personal and job information, symptom complaints, and the participant's opnions on the pressure, pace, autonomy, security, and satisfaction associated with his or her job. Additional information was obtained on the use of eyeglasses, history of refraction, major illnesses, allergies, and medication use. The questionnaires were checked for completeness prior to discharging the participants at the end of the examinations.

The ophthalmological examination consisted of measurement of visual acuity, manifest and cycloplegic refractions, muscle balance, and intraocular pressure; and examinations of the anterior segment, lens, vitreous, and fundus of each eye (see Appendix 3). The examiners were blinded as to the participants' VDT use.

Statistical analyses:

The data were reduced to a computer file, and analyzed using standard, packaged statistical programs[44]. All tabulations and tests of statistical significance were performed using non-missing responses to each question. Deficits in any tabulation from the total number of specified participants are attributable to non-response to the particular question.

Factor analyses were used to reduce questionnaire responses to scores on underlying, latent factors (or traits), the characters of which were inferred from the question/factor correlations (or factor loadings). The derived underlying factors, which we inferred we measured with the administered long questionnaire, are summarized in appendix 4. Each score has approximately a unit normal distribution, with a mean of 0 and standard deviation of 1.

Since the statistical analyses were exploratory, few of the hypotheses tested were specified a priori. Because multiple comparisons have been performed on the data, a nominal p-level of 0.05 for "statistical significance" is too high. It is estimated that between 5 and 30 comparisons have been made in each section that follows. This would suggest that a nominal p-level between 0.01 and 0.001 would be appropriate.*

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* If "n" comparisons are made under the null hypothesis at a nominal p-level of "x" per cent, then the probability of finding at least one statistically significant comparison 5 per cent of the time is given by

$$1 - (1-x)^n = 0.05 \quad .$$

Given "n" comparisons, the nominal p-level "x" is determined from $(1-x)^n = 0.95$, or $(1-x) = 0.95^{1/n}$, or $x = 1 - 0.95^{1/n}$. If $n = 5$, then $x = 0.01021$. If $n = 30$, then $x = 0.00170$.

Because the analyses are exploratory, the less stringent nominal p-level 0.01 is chosen to suggest "statistical significance". The true probability of finding at least one "statistically significant" comparison in each section, when a nominal p-level of 0.01 has been chosen, is likely to be greater than 5 per cent. The choice of a more stringent p-level would result in fewer of the associations to be designated as "statistically significant".

Exploratory Data Analyses

Target Population : Of the 629 persons on the Guild roster, 41 were found to have left employment. Of the remaining 588 persons, 456 completed the short, demographic and VDT-use questionnaire. Of these 456 respondents, 294 participated in the examinations. Of these 294 examination participants, 283 completed both the long questionnaire and underwent the eye examination, while 11 underwent the eye examination but failed to complete and return the long questionnaire. Of the 132 non-respondents to the short questionnaire, 40 refused all cooperation, while 92 simply failed to respond despite our best efforts to contact them both at home and at work.

	Number	Per cent of total available population
Answered demographic and VDT-use questionnaire	456	77.6
Participant in examinations	294	50.0
Fully participated	283	48.1
Partially participated	11	1.9
Did not answer demographic and VDT-use questionnaire	132	22.4
Refused cooperation	40	6.8
Could not contact	92	15.6
Available total target population (excludes 41 who had left employment	588	

Participants in Survey: 394 Sunpapers employees participated in the survey. Of these participants, 294 were Guild members on the December, 1980 roster. Of the 294 Guild participants, 11 failed to complete the long questionnaire. There were therefore 283 Guild members who provided complete survey information. Of the remaining 100 survey participants, 4 failed to complete the long questionnaire. There were therefore 96 non-Guild participants. Of the 96 non-Guild participants, 87 were members of the Typographers' union, and 9 were not members of either union. The analyses that follow are limited to the 283 Guild members, on the December 31, 1980 roster, who completed the long questionnaire and underwent ophthalmological examination. These persons represented 48.1 per cent of the available target population, and are hereafter referred to as "Guild participants".

Persons who participated fully in the examinations, were compared with

with non-participants who answered the demographic and VDT-use questionnaire. Partial participants in the examinations are excluded:

	Full Participants	Non-participants
Mean age (years)	38.1	37.4
Mean length of employment (years)	9.7	9.8
Use VDT in current job (proportion answering yes)	0.714	0.537
Hours per week of VDT use among VDT users	21.7	19.6
Total years of VDT use among VDT users	3.37	2.92
Use of home computer (proportion answering yes)	0.072	0.327
Education:		
Proportion LE 12 years	0.392	0.522
Proportion GE 12 years and LE 16 years	0.421	0.382
Proportion GT 16 years	0.186	0.095

We note that although participants did not differ in mean age or length of employment at the Sunpapers, they did differ on VDT use characteristics. Thus, a greater proportion of participants than non-participants currently used a VDT in their work. Among VDT users, participants reported a greater mean number of hours per week of VDT operation, and years of VDT operating experience, than non-participants. As a group, participants reported a greater number of years of education, than non-participants.

Based upon the above, it would appear that extrapolation of the results

of this survey beyond the group actually studied (i.e., participants in the survey) should be done with great caution.

Note: Since the analyses that follow are numerous, we will at this point describe, section by section, the sequence of investigations. Our intent is to determine, among the Guild participants:

> the inter-relationships between demographic, VDT-use, and workplace lighting variables;
>
> the relationships between VDT-use variables, and symptoms and job attitudes, controlling where appropriate for confounding by demographics and workplace lighting;
>
> the relationships between refraction and the use of corrective lenses, and symptoms and job attitudes, controlling where appropriate for confounding; and
>
> the relationship between VDT-use variables and ophthalmologic examination findings.

As well, we would like to fit a reasonable predictive equation to explain selected symptom outcomes. Having identified as "significant" various inter-relationships between demographic, VDT-use, workplace lighting, and job attitude variables; and symptoms variables; we then examine the remaining data, obtained on the non-Guild participants, to determine if the inter-relationships identified through our exploratory analyses on the Guild participants are extrapolatable beyond that group.

The exploratory analyses may be regarded as being organized into the following sections:

Section	Description
1	Demographic characteristics of the Guild participants, and their inter-relationships. These include age, sex, race, educational level, and years of employment at the Sun.
2	VDT-use characteristics of the Guild participants. These include use of a VDT in their "current" jobs; and among "current users", hours per week of VDT operation, total years of VDT operating experience, typical modes of VDT operation, and how bothersome were various aspects of the VDT as usually set-up.
3	Inter-relationships, among current VDT users, of hours per week of VDT operation and total years of VDT operating experience, and typical modes of VDT operation and bothersome aspects of VDT set-up.
4	Relationships between VDT use and demographic variables.
5	Relationships between workplace lighting characteristics, and VDT-use variables.
6	Relationships between VDT-use variables and symptoms. Where appropriate we control for confounding with respect to demographic variables and workplace lighting. The VDT-use variables investigated are current VDT use; and among current VDT users, hours per week of VDT operation, total years of VDT operating experience, typical mode of VDT operation, and bothersome aspects of the VDT set-up.
7	Relationships between VDT-use variables and job attitudes.
8	Relationships between job attitudes and symptoms.
9	Relationships between VDT use, and visual characteristics such as stereopsis, muscle balance, accomodation, and convergence.
10	Relationships between the visual characteristics muscle balance and accomodation, and symptoms.
11	Relationships between adequacy of refraction and the use of bi- or multifocal lenses, and symptoms and job attitudes.
12	Relationships between selected symptoms; and demographic variables, VDT-use, workplace lighting, use of multifocal lenses, and job attitudes, i.e., "model fitting".
13	Relationships between VDT-use variables and ophthalmologic findings.
14	Investigation of relationships specified a priori among non-Guild participants.

Section 1

Demographics: Among the 283 Guild participants, there were 155 (54.8 percent) males and 128 (45.2 percent) females. 244 (86.2 per cent) were white, and 33 (13.8 per cent) were non-white. The mean and median ages of Guild participants were 39.1 and 35.5 years, respectively, ranging from 18.8 to 64.4 years. The mean and median years of employment at the Sunpapers were 9.3 and 7.7, respectively, ranging from 0.2 to 40.3 years. 86 (30.4 per cent) of Guild participants had at most a high school education, while 146 (51.6 per cent) had completed college, and 51 (18.0 per cent) had some post-graduate education.

Inter-relationships among demographic variables: Age was significantly associated with race, educational level, and years of employment, but not with sex:

Race	Mean age	Test statistic Probability
White	40.0	$t_{281}=3.2548$
Non-White	33.8	0.0013

Education	Mean age	Test statistic Probability
High School	43.0	$F_{2,280}=11.52$
College	36.9	0.0001
Post-Graduate	37.6	

Correlation between age and years of employment

$r = 0.7000$
$Pr = 0.0001$

Sex was significantly associated with educational level and years of employment, but not with age (as above) or race:

Education	Proportion of females	Test statistic Probability
High school	0.651	$X^2(2)=27.691$
College	0.424	0.0001
Post-graduate	0.196	

Sex	Mean number of years of employment	Test statistic Probability
Males	10.8	$t_{281}=3.585$
Females	7.5	0.0005

Race was significantly associated with age (as above) and years of employment, but not with sex or educational level:

Race	Mean number of years of employment	Test statistic Probability
White	9.94	$t_{75}=4.9716$**
Non-white	5.27	0.0001

** The variances of the two groups were deemed unequal. An approximate t-test with degrees fo freedom less than 281 was computed

Education was significantly associated with age (as above), sex (as above), and years of employment, but not with race (as above):

Education	Mean number of years of employment	Test statistic Probability
High school	12.16	$F_{2,280}=8.88$
College	8.25	0.0002
Post-graduate	7.48	

Years of employment was associated with age, sex, race and education (all as above.

Summary and comment:

	Age	Sex	Race	Educational Level	Years of Employment
Age	-	.	Whites older than non-whites p = 0.0013	Decreases with increasing education p = 0.0001	Positive Correlation p = 0.0001
Sex	-	-	.	Proportion of females decreases with increasing education p = 0.0001	Males have longer employment than females p = 0.0004
Race	-	-	-	.	Whites have longer employment than non-whites p = 0.0001
Educational level	-	-	-	-	Years of employment decreases with increasing education p = 0.0002
Years of employment	-	-	-	-	-

. = not statistically significant (p GT 0.01)
- = redundant

As educational level increases, the proportion of males increases, while the average age and years of employment decrease. This suggests that with increasing education there is a predominance of male professionals with a higher rate of turnover. Increasing age with increasing years of employment and decreasing educational level suggests a somewhat more stable (than the professional group) blue-collar work-force. The proportion of females increasing with decreasing educational level suggests a non-professional, presumably clerical/secretarial work-force. The association of race and sex with years of employment suggests a historical white and male predominance in the newspaper job force.

Section 2

VDT usage : 204 (72.1 per cent) of Guild participants used VDTs in their current job. Among current VDT users, the mean and median number of hours per week of VDT usage were 21.7 and 20, respectively, ranging from 1 to 64 hours per week. Among current VDT users, the mean and median total number of years of VDT operating experience were 3.8 and 4.0, respectively, ranging from 0.1 to 9.2 years. 11 (5.4 per cent) of current VDT users followed a special work/rest schedule. Factor analyses (appendix 4) of examples of how VDTs are operated revealed two basic modes of VDT operation, namely, with the eyes fixed on the VDT screen; and with the eyes shifting between the VDT screen and keyboard, and the source document. Among current VDT non-users, 17 (22.4 per cent) worked in a room where VDTs were used. The mean and median approximate distances from the VDT non-users' work stations were 17.6 and 27.5 feet, respectively, ranging from 2 to 30 feet. Among Guild participants, 88 (32.6 per cent) of responders had used a VDT in their past work, either at the Sunpapers or at another company. The percentage previous work with VDTs among non-users was 16.0 per cent, and among users was 39.0 per cent. Among Guild participants, only 2 (0.7 per

cent) used a VDT in the home. Factor analyses (appendix 4) of how bothersome were various aspects of the current set-up of the VDT revealed two basic patterns of response, namely, with respect to the physical relationship between the VDT apparatus and the user, and with respect to the characteristics of the VDT screen and readability of the characters.

Comment:

All the VDT-use variables described were intended for use as possible predictors for symptom and examination outcomes. It became apparent during the analysis, however, that not all questions were useful toward that end. Because of the inadvertent branching of the questionnaire, for instance, total years of VDT operating experience was asked only of current VDT users. Therefore, hours per week of VDT operation and total years of VDT operating experience were defined only for the 201 current VDT users.

Section 3

Association of hours per week and total years of VDT operation, and modes and bothersome aspects of VDT operation: Hours per week of VDT operation was not associated with "eyes shifting" mode of operation, or with the two bothersome aspects of VDT adjustment. Hours per week of VDT operation was positively associated with the "eyes fixed" mode of VDT operation:

$$r = 0.4026$$
$$Pr = 0.0001$$

Number of years of VDT operating experience similarly was not associated with the "eyes shifting" mode of operation, or with the two bothersome aspects of VDT adjustment. Number of years of VDT operating experience was negatively associated with the "eyes fixed" mode of VDT operation:

r = -0.1922

Pr = 0.0059

The "eyes shifting" mode of VDT operation was positively associated with bothersome positional relationships between the VDT and the user, but not with the bothersome visual aspects of the VDT:

r = 0.1841
Pr = 0.0084

The "eyes fixed" mode of VDT operation was not associated with either bothersome aspect of VDT adjustment.

Summary and comments:

	Eyes Shift	Eyes Fixed	Bothersome positional relationship between the VDT and user	Bothersome Visual Aspect of VDT
Hours per week of VDT operation	.	Positive Association 0.0001	.	.
Total years of VDT operating experience	.	Negative Association 0.0059	.	.
Eyes shift	-	.	Positive Association 0.0084	.
Eyes fixed	.	-	.	.

. = not significant (p GT 0.01)
- = redundant

The "eyes fixed" mode of VDT operation increased with hours per week of VDT use, and decreased with total years of VDT operating experience. It was previously shown tha the "eyes fixed" mode was associated with sex (females GT males), and decreased with increasing education. It is presumed that this pattern of association is characteristic of clerical job responsibilities, with relatively higher turnover in employment.

The positive association between the "eyes shifting" mode of VDT operation and bothersome positional relationship between the VDT and user probably reflects the obvious, namely, that as the user must shift his or her gaze among multiple positions to use an instrument, the more his or her positional relationship to the instrument is likely to become bothersome.

Section 4

Association of VDT-usage and demographic variables: Three variables describing aspects of VDT use were examined with respect to their associations with the five demographic variables age, sex, race, education, and length of employment. The three VDT-use variables were current VDT use among Guild participants, hours per week of VDT use among current VDT users (the question was not asked of VDT non-users), and total years of VDT operating experience among current VDT users (the question was not asked of VDT non-users).

Age was associated with total years of VDT operating experience, but with neither current VDT use, nor (among current VDT users) hours per week of VDT operation. As age increased, so did the total years of VDT operating experience:

Age	Mean Number of Years of VDT operating experience	Test Statistic Probability
LT 40 years	3.36	$t_{202} = 4.400$
GE 40 years	4.54	0.0001

Sex was associated with total years of VDT operating experience, but with neither current VDT use, nor (among current VDT users) hours per week of VDT operation. Total years of VDT operating experience was greater among males than among females:

Sex	Mean Number of Years of VDT operating experience	Test Statistic Probability
Males	4.17	$t_{202} = 3.407$
Females	3.27	0.0008

Race was not associated with VDT usage, hours per week of VDT operation, or total years of VDT operating experience.

Educational level was associated with current VDT use, but not with hours per week of VDT operation, or total years of VDT operating experience. The proportion of current VDT users increased with educational level:

Educational level	Proportion of Current VDT users	Test Statistic Probability
High School	0.419	$X^2(2) = 57.703$
College	0.829	0.0001
Post-Graduate	0.922	

Years of employment was associated with current VDT use and with total years of VDT operating experience, but not with hours per week of VDT use. The proportion of current VDT users decreased with increasing years of employment:

Years of employment	Proportion of Current VDT users	Test Statistic Probability
LT 5 years	0.853	$X^2(2) = 25.279$
GE 5 years and LT 10 years	0.768	0.0001
GE 10 years	0.559	

The total years of VDT operating experience increased with years of employment.

Years of employment	Mean number of Years of VDT operating experience	Test Statistic Probability
LT 5 years	2.75	$F_{2,201} = 37.367$
GE 5 years and LT 10 years	4.61	0.0001
GE 10 years	4.83	

Summary and comment:

	Current VDT use	Hours per week of VDT operation	Total years of VDT operating experience
Age	.	.	Positive association p = 0.0001
Sex	.	.	Males GT Females p = 0.0008
Race	.	.	.
Education	Positive Association p = 0.0001	.	.
Years of Employment	Negative Association p = 0.0001	.	Positive association p = 0.0001

. = no significant association (p GT 0.01)

It is not surprising that total years of VDT operating experience would increase with both age and years of employment. The increasing proportion of VDT users with increasing educational level, and decreasing proportion with increasing years of employment, suggests that VDT use increases with professional qualifications and job mobility. The observation that current VDT usage does not differ significantly between sexes, but that total years of VDT operating experience is greater among male than female users, may reflect a historical male dominance in the job force, that has since lessened.

In any further analyses where current VDT use is a predictor of symptoms or examination outcomes, educational level and years of employment should be considered as potential confounders. In any further analyses where total years of VDT operating experience is a predictor of symptoms or examination outcomes, age, sex, and years of employment should be considered as potential confounders. Hours per week of VDT operation is, however, unconfounded by any of the above demographic variables.

Association of mode of VDT operation and demographic variables: Among VDT users, two modes of VDT operation were identified, namely, with the eyes fixed on the VDT screen (as for example, the user receives information via telephone, and inputs it directly into the VDT); and with the eyes shifting between the screen, the terminal, and the source of information. There were no associations between the five demographic variables and the "eyes shifting" mode of operation. However, the "eyes fixed" mode was associated with sex and educational level. Females more than males tended to report an "eyes fixed" mode of operation:

Sex	Mean Value of Factor Score for Typical Mode of VDT Operation: Eyes Fixed on VDT Screen	Test Statistic Probability
Males	- 0.1827	$t_{170} = -2.962$**
Females	0.2360	0.0036

** The variances of the two groups were deemed unequal. An approximate t-test with degrees of freedom less than 204 was computed.

Persons with less education tended to report the "eyes fixed" mode, more than persons with greater education:

Educational level	Mean Value of Factor Score for Typical Mode of VDT Operation: Eyes Fixed on VDT Screen	Test Statistic Probability
High School	0.5114	$F_{2,201} = 6.84$
College	- 0.0508	0.0013
Post-Graduate	- 0.2611	

Summary and comment:

	Mode of VDT operation: eyes fixed	Mode of VDT operation: eyes shift
Age	.	.
Sex	Females GT Males p = 0.0036	.
Race	.	.
Education	Decreases with Increasing Education p = 0.0013	.
Years of Employment	.	.

. = No significant association (p GT 0.01)

The increased association of the "eyes fixed" mode of VDT operation with being female and with decreasing education is consistent with the presumption that in the job market there are discernable sex and educational trends, with females, and persons with less education, being more likely to be employed in clerical positions.

In any further analyses where the "eyes fixed" mode of VDT operation is considered as a predictor of symptoms or of examination outcomes, sex and educational level should be considered as potential confounders.

Association of bothersome aspects of VDT operation, and demographic variables: Among VDT users, two bothersome aspects of the VDT, as it was usually adjusted, were identified. These were the positional relation of the user to the VDT itself (i.e., the height, distance, and tilt of the VDT screen relative to the user), and the visual aspects of the VDT screen (glare, brightness, readability, resolution). Neither of these bothersome aspects of the VDT as normally adjusted were significantly associated with age, sex, race, educational level, or years of employment.

Section 5

VDT-usage and lighting characteristics: VDT users and non-users were compared on their opinion of 12 aspects of workplace lighting, as it impacted on their work. It was noted that VDT users and non-users differed significantly in the availability of supplemental lighting at their work stations, brightness of main and background lighting at their work stations, and glare caused by the main lighting. Specifically, a greater proportion of VDT users than non-users reported their source of main lighting to be natural light, although the source of main lighting for both groups was predominantly fluorescent light; and VDT users less often had available supplemental lighting, less often reported their supplemental lighting to be adjustable, more often found the main lighting to be too bright and to cause glare, and more often found the background light to be too bright.

	VDT users (per cent) (N=204)	VDT non-users (per cent) (N=79)	Test of Statistical Significance
Sources of Main Lighting:			
Number of responses	202	76	
Natural light	7.9	1.3	$X^2(3)=11.666$
Fluorescent light	84.7	88.2	Pr=0.0086
Incandescent light	2.4	9.2	
Natural plus fluorescent or incandescent light	5.0	1.3	
Supplemental lighting available			
Number of responses	202	77	
Yes	3.0	14.3	$X^2(1)=12.475$
No	97.0	85.7	Pr=0.0004
Supplemental lighting adjustable			
Number of responses	172	67	
Yes	4.1	13.4	$X^2(1)=6.767$
No	95.9	86.6	Pr=0.0093
Lighting at work station:			
Number of responses	199	75	
Too bright	28.6	10.7	$X^2(3)=30.711$
[In between]	0.5	1.3	Pr=0.0001
Just right	67.8	66.7	
Too dark	3.0	21.3	
Number of responses	202	76	
Causes a great deal of glare	20.3	5.3	$X^2(2)=18.194$
Causes some glare	50.5	40.8	Pr=0.0001
Does not cause glare	29.2	54.0	
Lighting of background areas around work station:			
Number of responses	199	75	
Too bright	21.0	10.7	$X^2(3)=23.989$
[In between]	0.5	0.0	Pr=0.0001
Just right	76.0	70.7	
Too dark	2.5	18.7	

Among VDT users, the hours per week of VDT operation and total years of VDT operating experience were compared with respect to lighting characteristics. The only significant association was for adjustability of main lighting and hours per week of VDT operation. As a group, VDT operators whose main lighting was adjustable tended to use the VDT fewer hours per week than those whose main lighting was not adjustable. No other significant associations (p LE 0.01) were noted.

Main Lighting Adjustable?	Mean Hours per Week of VDT operation	Test Statistic Probability
Yes	12.4	t_{14} =-5.1205**
No	22.2	0.0002

** The variances of the two groups were deemed unequal. An approximate t-test with degrees of freedom less than 204 was computed.

Comment: In any subsequent analyses in which current VDT use is a predictor of symptoms or examination outcomes, participants' opinions on workplace lighting should be considered as potential confounders.

Association of mode of VDT operation and lighting characteristics:

Among VDT users, the "eyes fixed" on the VDT screen mode of VDT operation was significantly associated only with the source of main lighting:

Source of Main lighting	Mean Value of Factor Score for Typical Mode of VDT Operation: Eyes Fixed on VDT Screen	Test Statistic Probability
Natural light	1.0828	$F_{2,189}$ = 4.80
Fluorescent	- 0.0622	0.0093
Incandescent	- 0.4438	

The "eyes shifting" mode of VDT operation was unassociated with lighting characteristics.

Association of bothersome aspects of VDT operation and lighting characteristics: Among VDT users, the bothersome positional relationship of the VDT to the user was not associated with workplace lighting characteristics. However, bothersome visual aspects of the VDT screen were significantly associated with various aspects of workplace lighting:

Lighting Characteristics	Mean Value of Factor Score for Bothersome Visual Aspects of VDT operation	Test Statistic Probability
Lighting at work station:		
Too bright	0.4734	$F_{2,195} = 9.66$
Too dark	- 0.0591	0.0001
Just right	- 0.2010	
Lighting at work station causes:		
A great deal of glare	0.5518	$F_{2,199} = 20.29$
Some glare	0.1238	0.0001
No glare	- 0.5865	
Lighting at work station causes:		
A lot of shadows	0.4794	$F_{2,195} = 7.99$
Some shadows	0.3776	0.0005
No shadows	- 0.1916	
Lighting at work station:		
Helps to do work	- 0.1884	$t_{188} = - 4.3463$
Makes it harder to do work	0.4844	0.0001
Lighting of background areas:		
Too bright	0.5029	$F_{2,198} = 7.00$
Too dark	- 0.3103	0.0012
Just right	- 0.1256	
Lighting of background areas causes:		
A great deal of glare	0.5666	$F_{2,198} = 9.52$
Some glare	- 0.1563	0.0001
No glare	- 0.2796	
Background lighting at work station:		
Helps to do work	- 0.1201	$t_{187} = - 3.2479$
Makes it harder to do work	0.4260	0.0014

We note an increasing gradient in mean scores for bothersome visual aspects of VDT adjustment, as the main and/or supplemental lighting are reported to be too bright, to cause glare, to cause shadows, and to make it harder for the respondents to do their work.

Comment: In any analyses where bothersome visual aspect of VDT adjustment is considered as a predictor of symptom or examination outcomes, various aspects of workplace main and/or background lighting should similarly be considered. Here, it is not merely a problem of confounding of one predictor (bothersome visual aspect of VDT) by another (workplace lighting). The two are inextricably intertwined, since the VDT may be visually bothersome because of workplace lighting characteristics, and vice versa. We shall see in a subsequent section that, indeed, the bothersome aspect of VDT adjustment explains most of the participants' symptoms. When workplace lighting characteristics are considered jointly with bothersome visual aspects, the bothersome visual aspects still explain a statistically significant amount of the symptom complaints, in addition to that explained by workplace lighting alone.

Section 6

Association between current VDT use, and headache and somatic symptom factor scores: There were no significant associations between current VDT usage and the seventeen headache factor scores. The only significant association between current VDT usage and somatic symptoms was in relation to pain and stiffness in the axial (neck, shoulders, back) musculature [appendix 4, table 6, factor 4], with VDT users reporting a greater amount of such discomfort than non-users:

	Mean score for pain and stiffness in the axial musculature	Test statistic Probability
Users	0.0996	$t_{281} = 2.6822$
Non-users	-0.2571	0.0077

It was previously noted that educational level and years of employment were associated with current VDT use. Both educational level and years of employment were, as well, significantly associated with the above factor scores, and were thus confounders of current VDT usage, with respect to pain and stiffness in the axial musculature. When the effects of education and years of employment were included in assessing the relationship of current VDT use and reported pain and stiffness in the axial musculature, there no longer was a significant association with current VDT usage.

Comment: In the five sections that follow, we examine the association between headache and somatic symptoms; and amount of VDT usage, typical mode of VDT operation, and the user's perception of how bothersome were various aspects of VDT adjustment. These latter variables are, of course, defined only for VDT users. We shall see that, among current VDT users, the symptoms that correlated with VDT use characteristics were in relation to the user's perception of how bothersome were the visual aspects of VDT use, in regard to brightness of the characters and screen, glare off the screen, readability, and flicker of the screen display. The question will then be addressed, whether, these bothersome visual aspects of VDT adjustment are related to workplace lighting characteristics and/or the user's visual refraction, relative to job demands.

Association between hours per week of VDT operation, and headache and somatic symptom factor scores: Hours per week of VDT operation was significantly negatively associated with headaches preceded and accompanied by double and blurry vision [appendix 4, table 12, factor14]:

$$r = -0.2348$$
$$Pr = 0.0015$$

Hours per week of VDT operation was not significantly associated with any of the demographic variables, so that control for confounding in the analysis was unnecessary.

Association between total years of VDT operating experience, and headache and somatic symptom factor scores: Total years of VDT operating experience was negatively associated with headaches that occur during periods of worry, tension, and emotional stress [appendix 4, table 10, factor 1]:

$$r = -0.2180$$
$$Pr = 0.0032$$

Although total years of VDT operating experience was associated with age, sex, and years of employment, only age was associated with headaches occurring during periods of stress. Age was thus the only confounder, with regard to the association between years of VDT operating experience and headaches during stress. When age was controlled in the analyses, the relationship between total years of VDT operating experience and headaches during stress remained significant.

Association between eyes shifting mode of VDT operation, and headache and somatic symptom factor scores: The "eyes shifting" mode of VDT operation was significantly positively associated with headaches located superficially, boring or dull in quality, that general began unilaterally but spread bilaterally [appendix 4, table 12, factor 12]:

$$r = 0.2338$$
$$Pr = 0.0016$$

The "eyes shifting" mode of VDT operation was not significantly associated with any of the demographic variables, so that control for confounding in the analysis was unnecessary.

Association between "eyes fixed" mode of VDT operation, and headache and somatic symptom factor scores: The "eyes fixed" mode of VDT operation was not associated with any of the headache or somatic symptom factors scores.

Association between bothersome positional relationship between the VDT and user, and headache and somatic symptom factor scores: Bothersome positional relationship between the VDT and user, was positively correlated with headaches located superficially, boring or dull in quality, that generally begin unilaterally but spread bilaterally [appendix 4, table 12, factor 12]:

$$r = 0.2581$$
$$Pr = 0.0005$$

Bothersome positional relationship between the VDT and user was not associated with the demographic variables or workplace lighting characteristics, so that control for confounding in the analyses was unnecessary.

Association between bothersome visual aspects of the VDT, and headache and somatic symptom factor scores: Bothersome visual aspects of VDT adjustment, was positively correlated with headaches associated with work [appendix 4, table 10, factor 2], headaches with accompanying itching, burning, water eyes, nasal discharge, blurry vision, and sweating [appendix 4, table 12, factor 8], changes in visual function [appendix 4, table 6, factor 3], and pain and stiffness in the axial musculature [appendix 4, table 6, factor 4]:

Headaches associated with work

r = 0.2387
Pr = 0.0012

Headaches with accompanying eye symptoms

r = 0.2304
Pr = 0.0018

Somatic symptoms: changes in visual function

r = 0.2257
Pr = 0.0012

Somatic symptoms: Pain and stiffness in the axial musculature

r = 0.2516
Pr = 0.0003

Bothersome visual aspects of VDT adjustment was not associated with the demographic variables, so that control for confounding with respect to demographics was unnecessary. However, bothersome visual aspects of VDT adjustment was associated with various lighting characteristics of the work station. Therefore the above relationships were examined by multiple linear regressions, in which the effects of the pertinent work station lighting characteristics and bothersome visual aspects of VDT adjustment jointly (R^2), and the additional amount of variation explained by bothersome visual aspects of VDT adjustment (partial R^2) after work station lighting had been accounted for, were examined.

Headaches occur on the job

Work station Lighting Characteristic	Overall amount of variation explained R^2	p	Additional amount of variation explained partial R^2	p
Brightness of main lighting	0.0669	0.0075	0.0489	0.0033
Glare of main lighting	0.0688	0.0056	0.0361	0.0108
Shadows caused by main lighting	0.0663	0.0076	0.0428	0.0059
Helpfulness of lighting in doing work	0.0891	0.0004	0.0626	0.0010
Brightness of background lighting	0.0700	0.0056	0.0459	0.0043
Glare of background lighting	0.0965	0.0005	0.0429	0.0055
Helpfulness of lighting in doing work	0.0892	0.0004	0.0676	0.0007

Headaches with accompanying eye symptoms

Work station Lighting Characteristic	Overall amount of variation explained R^2	p	Additional amount of variation explained partial R^2	p
Brightness of main lighting	0.0655	0.0084	0.0610	0.0060
Glare of main lighting	0.0533	0.0209	0.0432	0.0257
Shadows caused by main lighting	0.0652	0.0084	0.0506	0.0139
Helpfulness of lighting in doing work	0.0589	0.0061	0.0462	0.0201
Brightness of background lighting	0.0564	0.0173	0.0446	0.0230
Glare of background lighting	0.0591	0.0132	0.0385	0.0380
Helpfulness of lighting in doing work	0.0593	0.0062	0.0535	0.0110

Somatic symptoms: changes in visual function

Work station Lighting Characteristic	Overall amount of variation explained R^2	p	Additional amount of variation explained partial R^2	p
Brightness of main lighting	0.1011	0.0002	0.0491	0.0018
Glare of main lighting	0.0522	0.0139	0.0491	0.0016
Shadows caused by main lighting	0.0656	0.0044	0.0357	0.0080
Helpfulness of lighting in doing work	0.0557	0.0047	0.0520	0.0016
Brightness of background lighting	0.0576	0.0090	0.0479	0.0020
Glare of background lighting	0.0583	0.0080	0.0384	0.0055
Helpfulness of lighting in doing work	0.0612	0.0040	0.0574	0.0009

Somatic symptoms: Pain and stiffness in the axial musculature

Work station Lighting Characteristic	Overall amount of variation explained R^2	p	Additional amount of variation explained partial R^2	p
Brightness of main lighting	0.1062	0.0001	0.0378	0.0063
Glare of main lighting	0.1419	0.0001	0.0319	0.0114
Shadows caused by main lighting	0.0747	0.0019	0.0505	0.0114
Helpfulness of lighting in doing work	0.1388	0.0001	0.0364	0.0086
Brightness of background lighting	0.1132	0.0001	0.0488	0.0018
Glare of background lighting	0.1088	0.0001	0.0363	0.0070
Helpfulness of lighting in doing work	0.1322	0.0001	0.0420	0.0048

We note that (as expected) workstation lighting characteristics and bothersome visual aspects of the VDT jointly explain a significant amount of variation in the above headache and somatic symptoms. When workplace lighting characteristics are accounted for, bothersome visual aspects of the VDT still explained a significant (p LE 0.01) amount of variation of all the above headache and somatic symptoms, except for headaches with accompanying eye symptoms.

Section 7

Association between current VDT use and job attitude factor scores: Current VDT users tended more than non-users to report that their work pace was intermittent, with lulls between heavy workloads, such that the job did not require their full attention, and there was time to daydream on the job [appendix 4, table 8, factor 5]:

	Mean score for job attitude: work is intermittent and does not require full attention	Test statistic Probability
User	0.1716	$t_{281} = 4.8168$
Non-user	-0.4431	0.0001

It was previously noted that educational level and years of employment were associated with current VDT use. Both educational level and years of employment were, as well, significantly associated with the above factor score, and were thus confounders of current VDT usage with respect to job intermittency. When the effects of education and years of employment were included, the positive significant association remained between VDT use and work intermittency.

Association between hours per week of VDT operation and job attitude factor scores: Hours per week of VDT operation was negatively associated with job attitude scores for back-logged quantity of work and work pressure [appendix 4, table 8, factor 4], and with job autonomy [appendix 4, table 8, factor 7].

Job attitude: Back-logged quantity of work and work pressure

r = -0.2813
Pr = 0.0001

Job attitude: Job autonomy

r = -0.3480
Pr = 0.0001

None of the demographic variables were associated with hours per week of VDT operation, so that control of confounding in these relationships was not necessary.

Association between total years of VDT operating experience and job attitude factor scores: Total years of VDT operating experience was not significantly associated with any of the job attitude factor scores.

Association between eyes shifting mode of VDT operation and job attitude factor scores: The "eyes shifting" mode of VDT operation was positively associated with the job attitude that work was demanding, with little time available to do it [appendix 4, table 8, factor 1]:

r = 0.1933
Pr = 0.0056

The "eyes shifting" mode of VDT operation was not associated with any of the demographic variables, so that control for confounding by demographics was not necessary in the analyses.

Association between "eyes fixed" mode of VDT operation and job attitude factor scores: The "eyes fixed" mode of VDT operation was positively associated with the clarity of work responsibilities and expectations [appendix 4, table 8, factor 3], and negatively associated with back-logged quantity of work and work pressure [appendix 4, table 8, factor 4], and job autonomy [appendix 4, table 8, factor 7]:

Job attitude: clarity of work responsibilities and expectations

r = 0.1913
Pr = 0.0061

Job attitude: quantity of work

r = -0.3053
Pr = 0.0001

Job attitude: job autonomy

r = -0.3517
Pr = 0.0001

Sex, educational level, and hours per week of VDT operation, were confounders of the above relationships. When confounding was controlled in the analysis, all three job attitudes remained significantly correlated with "eyes fixed" mode of VDT operation

Association between bothersome positional relationship between the VDT and user and job attitude factor scores: No significant correlations were noted between bothersome positional relationship between the VDT and user, and job attitude scores.

Association between bothersome visual aspects of the VDT and job attitude factor scores: Bothersome visual aspects of the VDT, as it is usually adjusted, was positively correlated with the job attitude that work is demanding, with little time to do it [table 8, factor 1]:

Job attitude: work is demanding, with little time to do it

r = 0.2523
Pr = 0.0003

None of the demographic variables were associated with bothersome visual aspects of the VDT, so that control for confounding was not necessary.

Section 8

Association between job attitude factor scores, and headache and somatic symptom factor scores: Job attitude factor 1, that work was demanding, with little time available to do it, was significantly correlated with headaches occurring on the job:

r = 0.1802
Pr = 0.0047,

with aches and pains in the appendicular musculature:

r = 0.1533
Pr = 0.0098,

and with aches and pains in the axial musculature:

r = 0.1661
Pr = 0.0051.

No other job attitude was significantly associated with headache or somatic symptoms. Job attitude factor 1 was noted above to be significantly and positively correlated with the eyes shifting mode of VDT operation and with

bothersome visual aspects of the VDT as usually adjusted, and therefore ought to be considered as a possible confounder for headaches occurring on the job, and aches and pains in the axial musculature.

Section 9

Association of VDT use and stereopsis, muscle balance, and accomodation: No association was observed between current VDT use or hours per week of VDT operation, and stereopsis, muscle balance (orthophoria and heterotropia), adequacy of accomodation (near point of accomodation less than usual working distance), and approximate equality of accomodation (near point of accomodation approximately equal in both eyes). When age was included in the analyses, no association was noted between total years of VDT operating experience, and any of these ocular measurements. Only 2 participants had abnormalities of convergence, so that any relation between symptoms and convergence could not be investigated.

Section 10

Association of muscle balance and accomodation, and headache, somatic symptoms, and job attitudes: When confounding by age was controlled in the analyses, no association was noted between muscle balance and adequacy of accomodation, and any headache, somatic symptom, or job attitude factor score.

Association of adequacy of refraction, and headache, somatic symptom, and job attitude factor scores: The question of a correlation between ocular and somatic complaints, and refractive abilities of the participants relative to their job tasks, was a major question to be addressed in this study. Prescription measurements of the reading addition on 16 per cent of the participants, all of them wearers of bifocals, were not obtained. Therefore, the data are incomplete with respect to this information on a per centage of persons critical to this study. We are in the process of obtaining this information on as many of the participants as possible from whom the information is missing. Preliminary analyses on the data available fail to reveal any relationship between refractive adequacy, and headache, somatic symptoms, or job attitude factor scores.

Section 11

Association of wearing bi- or multifocal lenses and of wearing glasses to do office work; and headache, somatic symptom, and job attitude factor scores: Wearing of bi- or multifocal lenses was significantly negatively correlated with headaches made worse by light and use of the eyes to do close work [appendix 4, table 12, factor 6], with aches and pains in the axial musculature [appendix 4, table 6, factor 4], and with the job attitude that work was intermittent, with lulls between heavy workloads, such that the job did not require the respondent's full attention, and with time to daydream on the job [appendix 4, table 8, factor 5]:

	Mean value of factor score for factor score: headaches made worse by light, etc.	Test Statistic Probability
Does not wear bi- or multifocal lenses	0.1177	$t_{111.5}$=-3.2677** 0.0014
Wears bi- or multifocal lenses	-0.2684	

	Mean value of factor score for factor score: aches and pains in the axial musculature	Test Statistic Probability
Does not wear bi- or multifocal lenses	0.0845	t_{83}=-3.7349** 0.0003
Wears bi- or multifocal lenses	-0.4136	

	Mean value of factor score for job attitude: work is intermittent with lulls between work loads	Test Statistic Probability
Does not wear bi- or multifocal lenses	0.0928	t_{281}=-3.5241 0.0005
Wears bi- or multifocal lenses	-0.4544	

** The variances of the two groups were deemed unequal. An approximate t-test with degrees of freedom less than 204 was computed.

The association with aches and pains in the axial musculature was in a direction opposite to that which might have been expected, based upon the published literature.

Wearing of glasses to do office work was associated with aches and pains in the axial musculature:

	Mean value of factor score for somatic symtpom: aches and pains in the axial musculature	Test Statistic Probability
Does not wear glasses	-0.0137	$F_{2,276}=5.11$
Wears single lense glasses	0.1689	0.0066
Wears bi- or multifocal lense glasses	-0.3993	

The lowest score for aches and pains in the axial musculature was among wearers of bi- or multifocal lenses, which was in a direction opposite to that which might have been expected, based upon the published literature.

Section 12

Model fitting for selected headache and somatic symptoms: Having demonstrated significant (nominal p-level LE 0.01) associations between selected demographic variables, VDT adjustment characteristics, workplace lighting characteristics, job attitude factor scores, and use of multifocal lenses; and specific headache and somatic symptom factor scores; we felt it appropriate to determine the overall amount of variation of the headache and somatic symptom factor scores reasonably explainable by all such predictor variables, regardless of the strength of the bivariate associations. Therefore, the following factor scores:

Headache factor 1: Headaches occur during periods of stress, tension, and worry
Headache factor 2: Headaches associated with work,
Headache factor 6: Headaches made worse by light and the use of eyes to do close work,
Headache factor 8: Headaches with itching, burning, watery eyes, blurry vision, nasal discharge, and sweating,

Headache factor 12: Headaches located superficially, boring or dull in quality, that generally began unilaterally but spread bilaterally,
Headache factor 14: Headaches preced and accompanied by double and blurry vision,
Symptom factor 3: Changes in visual function,
Symptom factor 4: Pain and stiffness in the axial musculature,

were modeled as linear functions of demographic (age, sex, employment, years of employment), workplace lighting, use of multifocal lenses, job attitudes (all seven factors), and VDT-use variables (hours per week of VDT operation, total years of VDT operating experience, typical mode of VDT operation, and bothersome aspects of VDT adjustment). Predictive models were fitted, first by backward stepwise elimination, and then by forward selection. All variables were retained whose F-statistics to stay were significant at the 0.01 level. Where both variable selection algorithms yielded the same model, the results are listed below as "backward elimination and forward selection". When different models were obtained by either selection algorithm, both are given below, with an attempt to reconcile the differences.

Headache factor 1: Headaches that occur during periods of stress, tension, and worry. The backward and forward selection algorithms yielded different models. The backward elimination model retained total years of VDT operating experience as the sole predictor, while the forward selection model retained years of employment as the sole predictor:

Headache factor 1

Predictor	Coefficient	P-value	Model R^2
Backward elimination			
Intercept	0.4029		
Years of VDT operating experience	-0.1106	0.0037	0.0487
Forward selection			
Intercept	0.2205		
Years of employment	-0.0302	0.0025	0.0526

In section 2, we had analyzed this headache factor in the presence of age as the only demographic confounding variable. We had declared that although years of employment were associated with years of VDT operating experience, years of employment were not associated with this headache factor (at the p LT 0.01 level of significance), and therefore was not included as a confounder in the analysis. Now we note that we have, in the forward selection algorithm, retained years of employment as the sole predictor of this headache factor and declared it to be statistically significant, in contradiction to the earlier analysis. This apparent discrepancy is explained as follows.

The finding in section 6 that years of employment and years of VDT operating experience were not significantly associated was based upon 244 ovservations, i.e., 244 Guild participants who had headaches, regardless of VDT use. The finding that years of employment is the best predictor in the forward selection model at a significant p-level (LT 0.01) is based upon 170 observations, i.e., 74 fewer than in section 6. The difference between 244

and 170 observations is due to the facts that (1) the stepwise analyses is defined only for VDT users (numbering 204), and (2) a missing value for any of the 18 predictor variables included in the stepwise analysis would cause an observation to be deleted from the calculations.

The analysis in regard to headaches that occur during periods of stress, tension, and worry, is thus unstable, depending as it does on the number of observations available for the analysis, and the selection algorithm (backward vs. forward) by which the data are analyzed. Years of VDT operating experience and years of employment are sufficiently correlated that we are witnessing the problem of correlated predictors in the same data analysis. The contribution of years of VDT operating experience and years of employment, in explaining headaches that occur during periods of stress, tension, and worry, are mutually and inextricably intertwined.

Headache factor 2: Headaches that are associated with work. In regard to the VDT use predictors, the backward and forward selection algorithms yielded similar models. However, the non-VDT-use predictors retained by either model were different:

Headache factor 2

Backward elimination

Predictor	Coefficient	P-value	Model R^2
Intercept	-0.4894		
Bothersome visual aspects of VDT adjustment	0.2563	0.0003	0.1879
Sex	0.3600	0.0097	
Job requires hard work (factor 1)	0.1854	0.0094	
Worry about job loss or reprimand (factor 6)	0.2155	0.0045	

Forward selection

Intercept	0.2561		
Bothersome visual aspects of VDT adjustment	0.2960	0.0001	0.1651
Years of employment	-0.0289	0.0025	
Worry about job loss or reprimand (factor 6)	0.2082	0.0065	

Thus, bothersome visual aspects of the VDT as usually adjusted explained a statistically significant amount of variation, in the presence of other predictors, of headaches associated with work, regardless of the predictor selection algorithm.

Headache factor 6: Headaches made worse by light and use of the eyes to do close work. Neither the backward nor forward stepping algorithms retained any of the predictor variables, including the use of glasses with bi- or multifocal lenses, with which they had been found to be significantly correlated in section 11. The difference between the analyses in section 11 and in this section are essentially the same as noted above, namely, the analyses in section 11 were based upon 244 observations (Guild participants

with headaches, regardless of VDT use), while the analyses in this section were based upon 170 observations (the subset of 204 Guild VDT users for whom there were no missing values among the 18 predictor variables). We can only note the instability of the analytical results obtained in section 11, compared to this section. Conclusions based upon unstable associations (dependent upon the number of observations in the analysis) are best avoided.

Headache factor 8: Headaches accompanied by itching, burning, watery eyes, blurry vision, nasal discharge, and sweating. Both the backward and forward selection algorithms yielded identical results:

Headache factor 8

Backward and forward selection

Predictor	Coefficient	P-value	Model R^2
Intercept	-0.0992		
Bothersome visual aspects of VDT adjustment	0.2169	0.0017	0.0566

None of the additional predictors were retained. The results are consistent with those of section 6.

Headache factor 12: Headaches located superficially, generally with unilateral onset but spreading bilaterally, boring and dull in sensation. Both the backward and forward selection algorithms yielded identical results:

Headache factor 12

Backward and forward selection

Predictor	Coefficient	P-value	Model R^2
Intercept	-0.0847		
"Eyes shifting" mode of VDT operation	0.2568	0.0012	0.0602

Only the "eyes shifting" mode of VDT operation was retained as a predictor, in contrast to the results of section 6, where bothersome positional aspects of the VDT as usually adjusted were likewise correlated with these headaches. It was noted in section 3 that both the "eyes shifting" mode of VDT operation and bothersome positional aspects of VDT adjustment were significantly correlated with each other. Thus, inclusion of "eyes shifting" as a predictor caused bothersome positional aspects of VDT adjustment consistently to fall out of the model. Although we do not show the data here, bothersome positional aspects of VDT adjustment does get included in the predictive model during the forward selection routine at a borderline ($p=0.0166$) significance level, in the presence of "eyes shifting" already entered in the model.

Headache factor 14: Headaches preceded and accompanied by double and blurry vision. Both the backward and forward selection algorithms yielded identical models:

Headache factor 14

Backward and forward selection

Predictor	Coefficient	P-value	Model R^2
Intercept	0.4083		
Hours per week of VDT operation	-0.0199	0.0010	0.0626

These results are consistent with section 6, where the identical association was noted.

Symptom factor 3: Changes in visual function. Both the backward and forward selection algorithms yielded identical results:

Symptom factor 3

Backward and forward selection

Predictor	Coefficient	P-value	Model R^2
Intercept	0.0483		
Bothersome visual aspects of VDT adjustment	0.1144	0.0059	0.0933
Job is dull, dislikes work (factor 2)	0.1143	0.0035	

Bothersome visual aspects of VDT adjustment explained a significant amount of variation of changes in visual function, in the presence of other predictors entered in the predictive model.

Symptom factor 4: Pain and stiffness in the axial musculature. The backward and forward selection algorithms yielded different models:

Symptom factor 4

Backward elimination

Predictor	Coefficient	P-value	Model R^2
Intercept	-0.4137		
Years of employment	-0.0325	0.0002	0.2007
Workstation lighting	0.5949	0.0001	
Bothersome visual aspects of VDT adjustment	0.1802	0.0090	

Forward selection

Predictor	Coefficient	P-value	Model R^2
Intercept	0.0468		
Age	-0.0245	0.0001	0.1792
Workstation lighting	0.7582	0.0001	

The backward elimination model retained both bothersome visual aspects of VDT adjustment and workplace lighting characteristics as significant predictors, as well as years of employment. The forward selection algorithm retained workplace lighting and age. Clearly the differences are explainable by the correlatedness of years of employment and age; and of workplace lighting and bothersome visual aspects of VDT adjustment.

Section 13

Association of current VDT use and ophthalmologic examinations: The relationship of the ophthalmologic examination findings and current VDT use are summarized in the accompanying table. None of the ophthalmologic examination findings were significantly associated with current VDT use at a nominal p-level of 0.05, let alone 0.01. For the ophthalmologic examination findings for which there were greater than 5 abnormalities among VDT users, the associations with hours per week and total years of VDT operating experience were examined. No associations were noted with either variable, at a nominal p-level of 0.05.

ASSOCIATION OF VDT USE AND OPHTHALMOLOGIC FINDINGS

	VDT users number/total (per cent)	VDT non-users number/total (per cent)	Test Statistic	Probability
Intraocular pressure GE 21 in either eye	8/204 (3.9)	4/79 (5.1)	$X^2(1)=$ 0.183	0.669
Pupillary reflexes intact to light	199/199 (100.0)	78/78 (100.0)	*	
Pupillary reflexes intact to accomodation	204/204 (100.0)	79/79 (100.0)	*	
Marcus-Gunn pupil present	0/204 (0.0)	1/79 (1.3)	**	
Extra-ocular motions "full"	203/204 (99.5)	78/79 (98.7)	Fisher's exact	0.0772
Exophthalmos	2/204 (1.0)	0/78 (0.0)	Fisher's exact	0.4774
Lids abnormal	7/204 (3.4)	1/79 (1.3)	Fisher's exact	0.2950
Conjunctivae:				
Injection	16/204 (7.8)	7/79 (8.8)	$X^2(1)=$ 0.079	0.779
Chemosis	1/204 (0.4)	0/79 (0.0)	**	
Visible Tumor	1/204 (0.4)	1/79 (1.3)	Fisher's exact	0.0772
Vessel Enlargement	3/204 (1.4)	0/79 (0.0)	Fisher's exact	
Lacrymal Function excessive	2/204 (1.0)	0/78 (0.0	Fisher's exact	0.4774
Lacrymal Duct Patent	194/198 (97.9)	72/74 (97.3)	Fisher's exact	0.2038

(continued)

TABLE (continued)

	VDT users number/total (per cent)	VDT non-users number/total (per cent)	Test Statistic	Probability
Inflammation of Iris	0/203 (0.0)	0/78 (0.0)	*	
Lenticular Opacity				
Segmental	5/203 (2.4)	2/79 (2.5)	Fisher's exact	0.3464
Nuclear	10/203 (4.9)	5/79 (6.3)	Fisher's exact	0.2170
Cortical	25/203 (12.3)	8/79 (10.1)	Fisher's exact	0.3878
Anterior subcapsular	8/203 (3.9)	2/79 (2.5)	Fisher's exact	0.4348
Posterior subcapsular	8/203 (3.9)	5/79 (6.3)	Fisher's exact	0.1220
Vacuoles	30/203 (14.8)	15/79 (19.0)	$X^2(1)=$ 0.751	0.3861
Cataract Classification:				
0	147/202 (72.8)	52/79 (65.8)		
1	52/202 (25.7)	25/79 (31.7)	$X^2(2)=$ 1.543	0.462
GE 2	3/202 (1.4)	2/79 (1.5)		
Vitreous abnormality	12/203 (5.9)	8/79 (10.1)	$X^2(1)=$ 1.534	0.216
Fundoscopic Examination:				
Glaucomatous cupping of disc	2/202 (1.0)	0/79 (0.0)	Fisher's exact	0.484
Papilledema	0/203 (0.0)	0/79 (0.0)	*	
Diminished foveal reflex	2/203 (1.0)	0/79 (0.0)	Fisher's exact	0.482

(continued)

TABLE (continued)

	VDT users number/total (per cent)	VDT non-users number/total (per cent)	Test Statistic	Probability
Chorioretinal scars	3/203 (1.5)	1/79 (1.3)	Fisher's exact	0.313
Disciform degeneration	0/203 (0.0)	0/79 (0.0)	*	
Optic atrophy	0/203 (0.0)	0/79 (0.0)	*	
Lattice dystrophy	1/203 (0.5)	1/79 (1.3)	Fisher's exact	0.0778
Peripheral chorio-retinal scars	3/203 (1.5)	1/79 (1.3)	Fisher's exact	0.313
Exudates	0/203 (0.0)	0/79 (0.0)	*	
Intraretinal hemorrhages	0/203 (0.0)	0/79 (0.0)	*	
Vitreous hemorrhages	0/203 (0.0)	0/79 (0.0)	*	
Microaneurysms	0/203 (0.0)	1/79 (1.3)	**	
Arteriolar narrowing	2/203 (1.0)	1/79 (1.3)	Fisher's exact	0.191
Macular scars	0/203 (0.0)	0/79 (0.0)	*	
Hypertensive retinopathy	1/203 (0.5)	1/79 (1.3)	Fisher's exact	0.0778
Malignant hypertension	0/203 (0.0)	0/79 (0.0)	*	

(continued)

TABLE (continued)

	VDT users number/total (per cent)	VDT non-users number/total (per cent)	Test Statistic	Probability
Background diabetic retinopathy	0/203 (0.0)	1/79 (1.3)	**	
Proliferative diabetic retinopathy	0/203 (0.0)	0/79 (0.0)	*	
Rhegmatous retinal detachment	0/203 (0.0)	0/79 (0.0)	*	
Non-rhegmatous retinal detachment	0/203 (0.0)	0/79 (0.0)	*	
Drusen (peripheral)	2/203 (1.0)	0/79 (0.0)	Fisher's exact	0.482
Drusen (macular)	2/203 (1.0)	3/79 (3.8)	Fisher's exact	0.0228
Pigmentary disturbance (peripheral)	4/203 (2.0)	2/79 (2.5)	Fisher's exact	0.218
Pigmentary disturbance (macular)	5/203 (2.4)	1/79 (1.3)	Fisher's exact	0.462
Retinitis pigmentosa	0/203 (0.0)	0/79 (0.0)	*	
Choroidal nevi	0/169 (0.0)	1/74 (1.4)	**	
Choroidal/ciliary body melanoma	1/203 (0.5)	0/79 (0.0)	**	

* = None observed.
** = Only one observed. No test of statistical significance performed.

Section 14

We summarize our findings, as a prelude to specifying our hypotheses to be tested on the non-Guild participants. It should be kept in mind that we are interested primarily in the association of VDT-related variables with symptom outcomes, controlling for confounders. Thus, the associations between symptoms and demographic variables are not our primary concern, except as they may alter the relationship between VDT variables and symptoms.

[Headache factor 1] Headaches that occur during periods of tension, worry, and/or stress: This factor was negatively correlated with total years of VDT operating experience, and remained so when confounders were controlled for. The predictive model revealed the association to be unstable in the presence of years of employment. The result depended on the variable selection algorithm. We conclude that some length of time variable is significantly negatively correlated with headaches that occur during periods of stress, tension, and worry. This may be either years of employment or total years of VDT operating experience. The two are otherwise inseparable within this study.

[Headache factor 2] Headaches associated with work: This factor was positively associated with bothersome visual aspects of the VDT as usually adjusted, with workplace lighting, and with the job attitude [factor 1] that work was hard, fast, with little time to get things done. The predictive models obtained by both variable selection algorithms were similar with respect to retained VDT-use variables, and consistent with prior results. Thus, bothersome visual aspects of the VDT as usually adjusted was

significantly correlated with headaches associated with work, in the presence of addition predictors in the model.

[Headache factor 3] Headaches that occur with changes in the weather, etc.: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 4] Headaches not associated with work: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 5] Headaches preceded and accompanied by flashing bright lights and spots in the field of vision, and to a lesser extent double and blurry vision: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 6] Headaches made worse by light, use of the eyes to do close work, and noise, generally deep-seated and throbbing, preceded and accompanied by blurry vision, generally unilateral in onset but progressing to involve both sides of the head: This factor was negatively correlated with the use of bi- or multifocal lenses. However, when the predictive model was fit, the association was no longer significant, for reasons noted previously. It is therefore unwarranted to conclude that an association (negative or otherwise) exists between this headache factor, and the use of glasses with bi- or multifocal lenses.

[Headache factor 7] Headaches preceded and accompanied by nausea and vomiting, double vision, accompanied by loss of appetite, and weakness of one or both arms or legs: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 8] Headaches accompanied by itching, burning, watery

eyes, accomanied by blurry vision, nasal discharge, and sweating, located around the eyes: This factor was positively correlated with bothersome visual aspects of the VDT as usually adjusted. It became borderline significant (0.05 GT p GT 0.01) in the presence of workstation lighting characteristics. The predictive model obtained by both variable selection algorithms yielded identical results, and verified the positive correlation with bothersome visual aspects of the VDT as usually adjusted.

[Headache factor 9] Headaches accompanied by weakness of one or both arms or legs, accompanied by disturbances of sensation in arms or legs: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 10] Headaches that are generally unilateral, located around the eyes or lower face, deep-seated and pressure-like in sensation: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 11] Headaches made worse primarily by coughing or sneezing: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 12] Headaches located superficially, dull or boring in sensation, generally one-sided in onset but progressing to involve both sides: This factor was positively associated with the "eyes shifting" mode of VDT operation, and with bothersome positional relationship as usually adjusted between the VDT and user. Predictive modeling by both variable selection algorithms yielded identical results. However, the "eyes shifting" mode of VDT operation was the only retained predictor. In the

presence of "eyes shifting", bothersome positional relationship was not statistically significantly associated with this headache variable.

[Headache factor 13] Headaches that radiate into the shoulders, accompanied by muscle tenseness: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 14] Headaches preceded and accompanied by double and blurry vision: This factor was negatively associated with the hours per week of VDT operation. Predictive modeling by both variable selection algorithms produced identical results, and verified the negative association between this headache variable and hours per week of VDT operation.

[Headache factor 15] Headaches described as feeling like a tight-band, constriction, pressure, boring, or shooting sensation: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 16] Headaches located around the top of the head or temples, shooting or throbbing in sensation: This factor was not significantly associated with VDT-related or job attitude variables.

[Headache factor 17] Headaches accompanied by sweating, flushing, and loss of appetite: This factor was not significantly associated with VDT-related or job attitude variables.

[Symptom factor 1] Visual symptoms: This factor was not significantly associated with VDT-related or job attitude variables.

[Symptom factor 2] Pain and stiffness in the extremities: This factor was not significantly associated with VDT-related or job attitude variables.

[Symptom factor 3] Changes in visual function: This factor was positively associated with bothersome visual aspects of the VDT as usually

adjusted, with workplace lighting, and with the job attitude [factor 1] that work was hard, fast, with little time to get things done. When the predictive model was fit, bothersome visual aspects remained significantly associated with this symptom factor.

[Symptom factor 4] Pain and stiffness in the axial musculature: This factor was significantly associated with bothersome visual aspects of the VDT as usually adjusted, with workplace lighting, and with the job attitude [factor 1] that work was hard, fast, with little time to get things done. It was negatively associated with the use of glasses with bi- or multifocal lenses, and of glasses at work. When the predictive model was fit, depending on the variable selection algorithm, bothersome visual aspects of VDT operation and/or workplace lighting remained as significant predictors. These two predictor variables were themselves correlated. The association between this symptom factor, and the use of glasses with bi- or multifocal lenses, was no longer evident in the predictive model.

We therefore conclude that the meaningful relationships among Guild participants are as follows:

Predictor	Outcome	Direction of Association
Years of VDT operating experience and/or Years of employment	Headaches that occur during of stress, tension, worry	Negative
Bothersome visual aspects of the VDT as usually adjusted	Headaches associated with work	Positive
	Headaches accompanied by itching, burning, watery eyes, blurry vision, nasal discharge, sweating	Positive
	Changes in eye function	Positive
Bothersome visual aspects of the VDT as usually adjusted and/or Workplace lighting characteristics	Pain and stiffness in the axial musculature	Positive
Eyes shifting mode of VDT operation	Headaches located superficially, dull or boring in sensation, with unilateral onset but spreading bilaterally	Positive
Hours per week of VDT operation	Headaches preceded and accompanied by double and blurry vision	Negative

We examined these relationships among the non-Guild participants. The predictor variables are VDT-use variables, and therefore are defined only for 73 of the non-Guild participants (the balance were VDT non-users). Because of missing values for some data, the number of observations ranged from 65 to 73. A nominal p-level of 0.05 is reasonable for "statistical significance", since the hypotheses are specified a priori.

Among non-Guild VDT-user participants, only bothersome visual aspects of

the VDT as usually adjusted was significantly associated with headaches associated with work (r=0.3809, Pr=0.0016), and changes in visual function (r=0.2702, Pr=0.0208). None of the other hypothesized associations were found at a p-level of 0.05.

Thus, although we have demonstrated significant relationships between specific VDT characteristics and use patterns within the Guild participant group, only two of the demonstrated associations were extrapolatable to non-Guild VDT-users. We note, however, that the associations extrapolatable beyond the Guild participant group are in regard to two of the major complaints which provided the motivating force for this survey, namely, headaches associated with work, and changes in visual function.

Discussion

Observational research is subject to selection and response biases that frequently are of unknown magnitude and importance. Extrapolation of the results from a cross-sectional survey, such as the one we report here, is best avoided, unless some independent assessment can show that the persons available for study were similar to the persons with the same exposures but who were unavailable for the study, and that among the persons available for the study, those actually studied were similar to those not studied. Stated differently, VDT-users who remained at the Sunpapers must have been similar to VDT-users who have left; and among the VDT users who remained, those who participated must have been similar to those who did not participate. We have no information on the persons, VDT-users or not, who left the Sunpapers prior to our conducting the survey. We noted in the "Study Design" section

that we offered participation to as many Guild members "as would participate", i.e., we were dealing with a volunteer study population. Since we demonstrated that active Sunpapers employees who participated differed from non-participants in terms of VDT use in their current job, we concluded that extrapolation of the survey beyond the group actually studied should be done with great caution. We analyzed the survey for Guild participants alone, and then examined the data on the non-Guild participants, to determine if relationships observed among Guild participants likewise could be identified among non-Guild participants. Whether or not the relationships that are demonstrable among both Guild and non-Guild participants, analyzed separately, ought reasonably to be extrapolated beyond those two groups, is arguable. Certainly, the results of this survey may be compared to other VDT research performed on groups of participants that were similarly flawed in terms of the possible presence of unknown biases; and areas of agreement and disagreement may be noted.

Prior to undertaking this survey, we reviewed the published literature, and designed our questionnaire to obtain the information we believed necessary to identify possible workplace-symptom associations. We do not believe it to be pre-judgmental of our results to admit that based upon the published literature, we had anticipated finding a number of possible workplace-symptom associations. We had anticipated finding that VDT use would lead to job regimentation, with a resulting increase in the user's mental strain, decreased autonomy, threats to job security, and a generally negative attitude toward work.[21,22,31] We had anticipated that sociopsychological factors might play an important role in explaining

self-reported symptoms.[21,22,25,26,32,34] As well, we thought it likely that workplace lighting characteristics, positional or postural relationships between the VDT and user, and mismatch of the user's visual refraction to the job, might also be significant explainers of symptoms.[23,24,30] In particular, musculoskeletal complaints might be expected to be greater among operators whose type of VDT-use frequently involves the "eyes-fixed" mode of VDT operation[19]; and musculoskeletal complaints might also be expected to be greater among wearers of bi- or multifocal lenses, the use of which might result in strenuous work postures, an overstressed axial musculature, and discomfort).[23,24,27,28,33,36]

We found an association between visual and musculoskeletal symptoms, and workplace lighting characteristics and the bothersome visual characteristics of the VDT itself. However, we found no consistent relationship between visual refraction relative to visual job demands, and symptoms or job attitude factors. In regard to job attitudes, there appeared to be two patterns of response, based upon typical mode of VDT operation. Those operators who reported an "eyes fixed" mode of VDT operation, suggestive of the VDT as data-entry terminal with primarily clerical responsibilities, tended to report greater job clarity (with respect to work responsibilities and expectations), and lesser job autonomy. Such operators also reported a lesser amount back-logged quantity of work and work pressure. As hours per week of VDT operation increased, as we had expected the feeling of job autonomy decreased. Again, however, the amount of back-logged work and feelings of work pressure also decreased. Those operators who reported an "eyes shifting" mode of VDT operation, suggestive of the VDT as

conversational terminal with primarily professional job responsibilities, tended to report a greater quantity of back-logged of work and work pressure, i.e., just the opposite of the "eyes fixed" or data-entry mode. None of the VDT related variables were associated with worry about job loss or reprimand. It appears that the most revealing contrast here is between back-logged quantity of work and work pressure, and the two modes of VDT operation. We suspect that the job attitudes associated with VDT work are characteristic of the jobs rather than the VDT itself. VDT use and associated job attitudes reflect the job, and not the fact of VDT use within the job.

In regard to job-associated symptoms among Guild participants, it was the bothersome visual aspects of the VDT as usually adjusted, and workplace lighting, that consistently explained the plurality of symptoms, even in the presence of other covariates (demographic variables, other VDT use variables, refraction, and job attitudes). Other additional associations observed were a negative correlation between headaches associated with periods of stress and worry or years of employment, and years of VDT operating experience; a negative association between hours per week of VDT operation, and headaches preceded and accompanied by double and blurry vision; and a positive association between the "eyes shifting" mode of VDT operation, and headaches located superficially, dull or boring in sensation, with unilateral onset but spreading bilaterally.

These results suggest that future emphasis should be placed on characteristics of workplace lighting and VDT visual characteristics. The problems appear to require adjustment in workplace and terminal design, to

alter those aspects of the VDT viewing environment (including the VDT itself) that adversely impact on the viewing process. We feel that these problems are best addressed experimentally. Epidemiologic studies suggest from what area the problems arise. However, the solutions are technological, and not capable of resolution through observational research.

Two final points need to be made, with respect to the power of this survey to detect relationships worth detecting. It is to be noted that most of our analyses in regard to ergonomic factors and work-associated symptoms were based upon product-moment correlations. Most such analyses were based upon approximately 200 observations. Cohen[45] provides tables of the power of a study to detect alternative "r" values. With nominal two-sided p-level of 0.01 and 200 observations, the power to detect r = 0.20 is approximately 0.61, while the power to detect r=0.30 is approximately 0.96. Our survey was powerful enough to detect correlations on the order of r=0.3, and we may feel confident that within our participant group, a significant correlation among those examined was not missed due to insufficient power of the study to detect the correlation. Our analyses in regard to the ophthalmological examination outcomes (such as cataracts) are based upon chi-square statistics. In general we compared approximately 79 VDT non-users with approximately 203 VDT users. Hayman et. al. [46] provide tables of the non-central chi-square distribution suitable to determine the power of this study to detect alternative prevalences of selected abnormalities among the "exposed" vs. the "non-exposed". Assuming a background prevalence of posterior subcapsular cataracts to be, for instance, 4.6 per cent, the power of this study to detect a doubling in the prevalence among the "exposed" is

approximately 0.68. (The choice of a background prevalence of 4.6 per cent is based upon the results given in section 13 of the "results" section.) This assumes, of course, that an exposure has occurred sufficient to cause the outcome. However, among VDT users the average number of years of VDT operating experience was 3.8 years, with a maximum of 9.2 years. If a minimum duration of VDT usage is postulated to be required prior to eye abnormalities being detectable, then the group of participants in this survey may well be judged to have had an insufficient amout of VDT usage for use to have found any such postulated associations. Therefore, our survey may well have been inadequate in terms of the amount of exposure to VDTs, to resolve such issues as the putative association of cataracts and VDT usage. Thus, the issue of VDT-associated cataracts is <u>not</u> resolved by our study. If such an issue were to be addressed epidemiologically, the study population would have to be chosen to have relatively lengthy, well-defined, and homogeneous types of VDT operating experience.

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APPENDIX 1

QUESTIONNAIRE ON VDT USE...EMPLOYEES OF THE BALTIMORE SUN PAPERS

1. > > > > > > > > > > > > > > > >
Last name (1-15)

> > > > > > > > > > > > > > > >
First name

> >
Middle initial

2. >
Street address

> > > > > > > > > > >
City

> > >
State

> > > > > >
Zipcode

3. Phone number: Office (301)-332-> > > > >

Home > > > > - > > > > - > > > > >
Area code

4. Employee number (this number is on your paycheck or stub.) (16-20) > > > > > >

5. Date of hire at the Sunpapers: > > > Month (21-22) 19 > > > Year (23-24)

6. Age > > > Years

7. >
Department name (current job at Sunpapers)

> >
Job title (current job at Sunpapers)

8. Do you now use a VDT in your work at the Sunpaper?: (Check one)

YES > > (1)
NO > > (2)
(25)

If NO, go to question 12.

9. If YES to question 8, what machine do you use most? (Check only one)

Harris 1500 > > (1)
Harris 1900 > > (2)
Harris 2200 > > (3)
Hewlett-Packard > > (4)
Other > > (5)
(26)

10. On the average, how many hours a week do you operate the terminal? (Example: If 8 hours/week, enter 08.)

> > >
Hours/week
(27-28)

(continued)

11. How long have you operated the VDT? (Example: If 3 years and 8 months, enter 03 and 08.)
    Years (29-30) > > >
    Months (31-32) > > >

12. Do you work in a room where VDTs are used? (Check one)
    YES > > (1)
    NO > > (2)
    (33)

13. If YES to question 12, what is the approximate distance from your regular work location to the nearest VDT? (Example: if the distance is 25 feet, enter 025.)
    > > > >
    Feet
    (34-36)

14. Have you used a VDT in the past in your work at the Sunpaper or at another company? (Check one)
    YES > > (1)
    NO > > (2)
    (37)

15. If YES to question 14, for how long at the Sunpaper?
    Years (38-39) > > >
    Months (40-41) > > >

16. How many hours a week on the average?
    > > >
    Hours/week
    (42-43)

17. For how long at another company?
    Years (44-45) > > >
    Months (46-47) > > >

18. How many hours a week on the average?
    > > >
    Hours/week
    (48-49)

19. Do you use or have you ever used a VDT in your home (that is, a home computer with TV screen display, but not a desk-top calculator)?
    YES > > (1)
    NO > > (2)
    (50)

20. What is the highest grade of education you have finished? (Check one)
    Grade 6 > > (1)
    Grade 12 > > (2)
    College > > (3)
    Graduate School > > (4)
    (52)

If you have a question or if you are unsure about any part of this questionnaire, please check here. > >
A representative from NIOSH will contact you by phone.

Please mail this questionnaire to NIOSH using the post-paid, self-addressedenvelope as soon as possible. Thank you for your cooperation.

HHE 80-127

APPENDIX 2

HHE 80-127

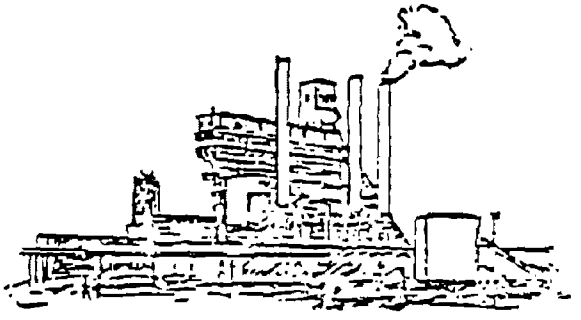
98.

NIOSH

WORK/HEALTH QUESTIONNAIRE

BALTIMORE SUN PAPER VDT STUDY

January 1981



U. S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service/Center for Disease Control
National Institute for Occupational Safety and Health

Today's date: > > > Month > > > Day > > > Year
(6-11)

Print your name: > > > > > > > > > > > > > > > >
Last name (12-26)

> > > > > > > > > > > > > > > > First name (27-41) > > Middle initial (42)

Address: >
Street (43-62)

>1>1>
(79-80)

> > > > > > > > > > > > > > > >
City (6-20)

> > > State (21-22) > > > > > > Zip code (23-27)

Telephone number: Home (28-37) > > > > - > > > > - > > > > >
Area code

Work (38-47) > > > > - > > > > - > > > > >
Area code

PERSONAL DATA:

Race (check one): (48)
White, not of Hispanic origin...................______(1)
Black, not of Hispanic origin...................______(2)
Hispanic..______(3)
American Indian or Alaskan Native...............______(4)
Asian or Pacific Islander.......................______(5)

Sex (check one): (49)
Male..______(1)
Female..______(2)

Date of birth: (50-55) > > > - > > > - > > >
Month Day Year

Circle the highest year
that you reached in school:
(56-57)

Grade School: 01 02 03 04 05 06 07 08 09 10 11 12

College:	13	14	15	16	17	18
	Freshman	Sophomore	Junior	Senior	Masters	Doctorate

>1>2>
(79-80)

1. Date of hire at the Sunpapers: > > > 19 > > >
   Month (6-7) Year (8-9)

2. In what department do you currently work? >
   (10-28)

3. What is your job title? >
   (29-47)

4. Do you now use a VDT in your current job at the Sunpaper? (Check one)
   (48)
   Yes ____ (1)
   No ____ (2)

   If NO, go to question 11 on page 4.

   If YES, continue with question 5.

5. How often do you use each of the following VDT machines?

   Rank the frequency with which you use each machine on a scale from 1 to 6. "1" means that you never use the machine. "6" means that you always use the machine. If the answer is somewhere between "never" and "always", you must judge where on the scale from "1" to "6" the appropriate answer lies. If you are not sure, guess.

		NEVER					ALWAYS
5a.	Harris 1500 (49)	1	2	3	4	5	6
5b.	Harris 1900 (50)	1	2	3	4	5	6
5c.	Harris 2200 (51)	1	2	3	4	5	6
5d.	Hewlett-Packard (52)	1	2	3	4	5	6
5e.	Some other machine (53)	1	2	3	4	5	6

6. On the average, how many hours a week do you operate a VDT?
(Example: If 8 hours/week, enter 08.)
(54-55) > > > Hours/week

7. How long have you operated a VDT?
(Example: If 3 years and 8 months, enter 03 and 08.)
> > > Years (56-57) > > > Months (58-59)

8. In your job at the Sunpapers, is there a special work-rest schedule you follow when you use the VDT? (60)
Yes ____ (1)
No ____ (2)

9. If YES, what is the schedule?

> > > > minutes of work (61-63) followed by > > > > minutes of rest. (64-66)

10. The following are some examples of how VDTs are operated.

Rank each method of operation on a scale from 1 to 6 according to your typical method of VDT operation in your daily work. "1" means than you NEVER operate the VDT in that way. "6" means you ALWAYS operate the VDT in that way. If the answer is somewhere between "never" and "always", you must judge where on the scale from "1" to "6" the correct answer lies.

Answer all questions. If you are not sure, guess.

	NEVER					ALWAYS
a. Your eyes are fixed on the VDT screen. For example, you receive information via telephone, and put it into the VDT. (67)	1	2	3	4	5	6
b. Your eyes shift between the VDT terminal and keyboard (because, for example, you are not familiar with the keyboard, or possibly that is the way you are accustomed to using a typewriter. (68)	1	2	3	4	5	6
c. Your eyes shift between the source document and the VDT screen for input and/or output. (69)	1	2	3	4	5	6
d. Your eyes shift among the source document, the VDT screen, and the keyboard. (70)	1	2	3	4	5	6

>1>3> (79-80)

11. Do you work in a room where VDTs are used? (6)
    Yes ____ (1)
    No ____ (2)

12. If YES, what is the approximate distance from your regular work location to the nearest VDT? (Example: if the distance is 25 feet, enter 025.) (7-9)
    > > > >
    feet

13. Have you used a VDT in the past in your work at the Sunpaper or at another company? (Check one) (10)
    Yes ____ (1)
    No ____ (2)

    If NO, go to question 18 below.

    If YES, continue with question 14.

14. For how long at the Sunpaper did you use a VDT (in your past work?)
    > > > Years (11-12)
    > > > Months (13-14)

15. For how many hours a week on the average? (15-16)
    > > >
    Hours/week

16. For how long at another company did you use a VDT (in your past work?)
    > > > Years (17-18)
    > > > Months (19-20)

17. For how many hours a week on the average? (21-22)
    > > >
    Hours/week

18. Do you use or have you ever used a VDT in your home (that is, a home computer with TV screen display, but not a desk-top calculator or TV-game)? (23)
    Yes ____ (1)
    No ____ (2)

DIRECTIONS: If you use a VDT in your current job at the Sunpapers, answer the questions in this section. If you do not use a VDT in your current job, go to the next page and continue with question 31.

Read each statement and circle a number to the right of the statement, to indicate how the statement applies to you.

"1" means that the statement does not apply, or you never feel that way. "6" means that the statement always applies, or you always feel that way.

If the answer is somewhere between "never" amd "always", you must judge where on the scale from "1" to "6" the appropriate answer lies. Answer all questions. If you are not sure, guess.

Considering the current set-up of your VDT, as it is normally adjusted, how bothersome are the following:

		NEVER					ALWAYS
19.	The brightness of the screen. (24)	1	2	3	4	5	6
20.	The brightness of the letters or numbers. (25)	1	2	3	4	5	6
21.	The readability (size or sharpness). (26)	1	2	3	4	5	6
22.	The tilt of the VDT screen toward you. (27)	1	2	3	4	5	6
23.	The tilt of the VDT keyboard. (28)	1	2	3	4	5	6
24.	The height of the screen. (29)	1	2	3	4	5	6
25.	The height of the keyboard. (30)	1	2	3	4	5	6
26.	The distance of the screen from you. (31)	1	2	3	4	5	6
27.	The distance of the keyboard from you. (32)	1	2	3	4	5	6
28.	Glare off the VDT screen. (33)	1	2	3	4	5	6
29.	Glare off the keyboard. (34)	1	2	3	4	5	6
30.	Flicker of the screen display. (35)	1	2	3	4	5	6

DIRECTIONS: The following questions relate to the lighting at your principal or usual work area.

Check one answer to each question.

31. Which of the following sources does the main lighting at your work area come from?
(36)
Natural light (windows)..... ____ (1)
Fluorescent light..... ____ (2)
Incandescent light (light bulbs)..... ____ (3)

32. Can you adjust the main lighting?
(37)
Yes ____ (1)
No ____ (2)

33. Do you have any supplemental lighting (such as a desk lamp) at your work area?
(38)
Yes ____ (1)
No ____ (2)

34. Can you adjust the supplemental lighting at your work area?
(39)
Yes ____ (1)
No ____ (2)

How would you rate the lighting at your work station?
(Check the approtriate answer for each of the items below.)

35.
Too bright..... ____ (1)
Just right..... ____ (2)
Too dark..... ____ (3)
(40)

36.
Causes a great deal of glare..... ____ (1)
Causes some glare..... ____ (2)
Does not cause glare..... ____ (3)
(41)

37.
Produces a lot of shadows..... ____ (1)
Produces some shadows..... ____ (2)
Does not produce shadows..... ____ (3)
(42)

38.
Helps me to do my job..... ____ (1)
Makes it harder for me to do my job..... ____ (2)
(43)

How would you rate the lighting of the background areas around your workstation? (Check the appropriate answer for each of the items below.)

39.

Too bright.....____ (1)
Just right.....____ (2)
Too dark.....____ (3)
(44)

40.

Causes a great deal of glare.....____ (1)
Causes some glare.....____ (2)
Does not cause glare.....____ (3)
(45)

41.

Produces a lot of shadows.....____ (1)
Produces some shadows.....____ (2)
Does not produce shadows.....____ (3)
(46)

42.

Helps me to do my job.....____ (1)
Makes it harder for me to do my job.....____ (2)
(47)

DIRECTIONS: Check one answer to each question. If you are not sure, guess.

43. Do you wear glasses for reading? (48)
YES ____ (1)
NO ____ (2)

44. Do you wear glasses for distance vision? (49)
YES ____ (1)
NO ____ (2)

45. If you wear glasses for both reading and distance vision, are they the same pair of glasses? (50)
YES ____ (1)
NO ____ (2)

46. IF YES, are they bifocals? (51)
YES ____ (1)
NO ____ (2)

47. trifocals? (52)
YES ____ (1)
NO ____ (2)

48. Do you wear glasses for office work such as typing, using a calculator, using a video display terminal? (53)
YES ____ (1)
NO ____ (2)

49. IF YES, are they your reading pair of glasses? (54)
YES ____ (1)
NO ____ (2)

50. your distance pair of glasses? (55)
YES ____ (1)
NO ____ (2)

51. Do you wear contact lenses? (56)
YES ____ (1)
NO ____ (2)

52. During the past 2 years, how many times have you had your glasses prescription changed? (Enter 0, 1, 2, 3, etc.) (57)
>____> times

53. How long ago did you last have your vision checked by an eye doctor?
>_>_> months (58-59) and >_>_> years (60-61) ago

54. When was your present glasses/contact lens prescription last changed?
>_>_> Month (62-63) 19>_>_> Year (64-65) >1>4> (79-80)

Have you ever had any of the following? IF YES, check whether it involved the right eye, the left eye, or both eyes, and enter the year as best you can remember.

CONDITION		Right or left eye (check one)	Year
55. Eye injury	Yes ____ (1) No ____ (2) (6)	Right eye ____ (1) Left eye ____ (2) Both eyes ____ (3) (7)	19 > > > (8-9)
56. Eye tumor	Yes ____ (1) No ____ (2) (10)	Right eye ____ (1) Left eye ____ (2) Both eyes ____ (3) (11)	19 > > > (12-13)
57. Glaucoma	Yes ____ (1) No ____ (2) (14)	Right eye ____ (1) Left eye ____ (2) Both eyes ____ (3) (15)	19 > > > (16-17)
58. Cataract	Yes ____ (1) No ____ (2) (18)	Right eye ____ (1) Left eye ____ (2) Both eyes ____ (3) (19)	19 > > > (20-21)
59. Eye surgery	Yes ____ (1) No ____ (2) (22)	Right eye ____ (1) Left eye ____ (2) Both eyes ____ (3) (23)	19 > > > (24-25)
60. Crossed or lazy eye	Yes ____ (1) No ____ (2) (26)	Right eye ____ (1) Left eye ____ (2) Both eyes ____ (3) (27)	19 > > > (28-29)
61. Detached retina	Yes ____ (1) No ____ (2) (30)	Right eye ____ (1) Left eye ____ (2) Both eyes ____ (3) (31)	19 > > > (32-33)

Has any member of your blood family (parents, brothers or sisters, or children) ever had any of the following?

62. Blindness (34) Yes ____ (1) No ____ (2)

63. Eye tumor (35) Yes ____ (1) No ____ (2)

64. Glaucoma (36) Yes ____ (1) No ____ (2)

65. Cataract (37) Yes ____ (1) No ____ (2)

66. Eye surgery (38) Yes ____ (1) No ____ (2)

67. Detached retina (39) Yes ____ (1) No ____ (2)

68. Myopia or near sightedness (40) Yes ____ (1) No ____ (2)

>1>5> (79-80)

DIRECTIONS: In this section, a number of illnesses and medical conditions are listed.

Check "YES" or "NO" in answer to each question.

If you are not sure, guess.

If you answer "YES", enter the year in which you first had the illness or condition.

Have you ever had any of the following?	YES	NO	If YES, enter year
69. Sinus problem..... (6)	____(1)	____(2)	19 > > > (7-8)
70. High blood pressure..... (9)	____(1)	____(2)	19 > > > (10-11)
71. Heart attack..... (12)	____(1)	____(2)	19 > > > (13-14)
72. Stroke..... (15)	____(1)	____(2)	19 > > > (16-17)
73. Diabetes or sugar in the urine..... (18)	____(1)	____(2)	19 > > > (19-20)
74. Head injury..... (21)	____(1)	____(2)	19 > > > (22-23)
75. Convulsions or seizures..... (24)	____(1)	____(2)	19 > > > (25-26)
76. Emphysema..... (27)	____(1)	____(2)	19 > > > (28-29)
77. Chronic bronchitis..... (30)	____(1)	____(2)	19 > > > (31-32)
78. Other chronic lung disease..... (33)	____(1)	____(2)	19 > > > (34-35)

If YES, specify: _____

		YES	NO	If YES, enter year
79.	Kidney problem..... (36)	____(1)	____(2)	19 >__>__> (37-38)
	If YES, specify: _____			
80.	Thyroid problem..... (39)	____(1)	____(2)	19 >__>__> (40-41)
	If YES, specify: _____			
81.	Any other serious illness..... (42)	____(1)	____(2)	19 >__>__> (43-44)
	If YES, specify: _____			

82. In general, would you describe yourself as an anxious person? Rate yourself on a scale from 1 to 6, on which "1" means you are not at all anxious, and "6" means that you are very anxious. Circle the appropriate answer.
(45)

Not at all anxious					Very anxious
1	2	3	4	5	6

83. In general, would you describe yourself as a depressed person? Rate yourself on a scale from 1 to 6, on which "1" means you are not at all depressed, and "6" means that you are very depressed. Circle the appropriate answer.
(46)

Not at all depressed					Very depressed
1	2	3	4	5	6

>1>6>
(79-80)

DIRECTIONS: In this section, a number of allergies are listed.
Check "YES" or "NO" in answer to each question.
Answer all questions. If you are not sure, guess.
If you answer "YES", check off the symptoms which you have when you usually experience the allergy.

Are you allergic to any of the following?	YES	NO	If YES, what symptoms do you have? (Check all that apply.)
84. Pollen..... (6)	____ (1)	____(2)	Itchy eyes ____ (1) (7) Watery eyes ____ (1) (8) Stuffy nose ____ (1) (9) Headaches ____ (1) (10) Skin rash ____ (1) (11)
85. Hay/grasses..... (12)	____(1)	____(2)	Itchy eyes ____ (1) (13) Watery eyes ____ (1) (14) Stuffy nose ____ (1) (15) Headaches ____ (1) (16) Skin rash ____ (1) (17)
86. Dust..... (18)	____(1)	____(2)	Itchy eyes ____ (1) (19) Watery eyes ____ (1) (20) Stuffy nose ____ (1) (21) Headaches ____ (1) (22) Skin rash ____ (1) (23)
87. Animal hair/feathers..... (24)	____(1)	____(2)	Itchy eyes ____ (1) (25) Watery eyes ____ (1) (26) Stuffy nose ____ (1) (27) Headaches ____ (1) (28) Skin rash ____ (1) (29)
88. Cosmetics..... (30)	____(1)	____(2)	Itchy eyes ____ (1) (31) Watery eyes ____ (1) (32) Stuffy nose ____ (1) (33) Headaches ____ (1) (34) Skin rash ____ (1) (35)
89. Drugs or Medications..... (36)	____(1)	____(2)	Itchy eyes ____ (1) (37) Watery eyes ____ (1) (38) Stuffy nose ____ (1) (39) Headaches ____ (1) (40) Skin rash ____ (1) (41)
90. Other..... (42) If Yes, specify: _____	____(1)	____(2)	Itchy eyes ____ (1) (43) Watery eyes ____ (1) (44) Stuffy nose ____ (1) (45) Headaches ____ (1) (46) Skin rash ____ (1) (47)

>1>7>
(79-80)

DIRECTIONS: Next, check YES or NO for the following medications.
Answer all questions. If you are not sure, guess.
If you answer YES, enter the name of the medication as best you can remember.

Are you now taking any of the following medications?	YES	NO	If YES, enter name of medication
91. Medication to reduce spasm of your stomach? (6)	___(1)	___(2)	_____
92. Antihistamine? (7)	___(1)	___(2)	_____
93. Medication to control high blood pressure? (8)	___(1)	___(2)	_____
94. Tranquilizer? (9)	___(1)	___(2)	_____
95. Pain reliever? (10)	___(1)	___(2)	_____
96. Cold or headache tablet? (11)	___(1)	___(2)	_____
97. Any other medication?	___(1)	___(2)	_____
			_____
			_____
			_____

> > >	> > >	> > >	> > >	> > >	> > >	> > >	> > >
(12-13)	(14-15)	(16-17)	(18-19)	(20-21)	(22-23)	(24-25)	(26-27)

>1>8>
(79-80)

DIRECTIONS: Check the most appropriate or closest response to each of the following questions.

Answer all questions. If you are not sure, guess.

98. Do you have a headache more than once a year?.....YES ____ (1) NO ____ (2) (6)

If NO, go to question 168 on page 21.

99. When you have a headache or headaches, do they occur in packs, with long intervals free of headaches between packs?.....YES ____ (1) NO ____ (2) (7)

100. How often do you usually have a headache? (Check one) (8)

- Less than once every 3 months.____ (1)
- Once every 2 or 3 months.....____ (2)
- Once a month.....____ (3)
- Once a week.....____ (4)
- 2 to 4 times a week.....____ (5)
- Once a day.....____ (6)
- More than once a day.....____ (7)

101. How long do your headaches usually last? (Check one) (9)

- Less than one hour.....____ (1)
- 1 to 3 hours.....____ (2)
- 3 to 6 hours.....____ (3)
- 6 to 12 hours.....____ (4)
- 12 to 24 hours.....____ (5)
- More than 24 hours.....____ (6)

102. How severe are your usual headaches? (Check one) (10)

- Slightly painful.....____ (1)
- Mildly painful.....____ (2)
- Moderately painful.....____ (3)
- Very painful.....____ (4)
- Extremely painful.....____ (5)

103. Which description best fits your typical headache? (Check one)
(11)

It has no effect on your
regular activities.....____ (1)
It affects your regular activities,
but you are able nonetheless to
carry out your regular activities.....____ (2)
It forces you to take it easy.....____ (3)
It forces you to lie down.....____ (4)

104. Were your headaches present before you came to work at the Sunpapers? (Check one.)
(12) Yes.....____ (1)
No.....____ (2)

105. Were your headaches present before you began your present job at the Sunpapers?
(Check one.)
(13) Yes.....____ (1)
No.....____ (2)

106. Have your headaches intensified since you began your present job at the Sunpapers? (Check one.)
(14) Yes.....____ (1)
No.....____ (2)

107. Are your headaches usually relieved by over-the-counter medications, such as aspirin, anacin, bufferin, etc.?
(Check one.)
(15) Yes.....____ (1)
No.....____ (2)

>1>9>
(79-80)

DIRECTIONS: In this section, statements are made that may describe your headaches.

Read each statement below and circle a number to the right of the statement, to indicate how the statement applies to you.

"1" means that the statement does not apply, or that you never feel that way. "6" means that the statement always applies, or you always feel that way.

If the answer is somewhere between "never" and "always", you must judge where on the scale from "1" to "6" the appropriate answer lies.

Answer all statements. If you are not sure, guess.

Your headaches:		NEVER					ALWAYS
109.	awaken you from sleep. (6)	1	2	3	4	5	6
110.	occur upon awakening, but do not actually awaken you from sleep. (7)	1	2	3	4	5	6
111.	are associated with your usual job at work. (8)	1	2	3	4	5	6
112.	first occur within the first four hours of work. (9)	1	2	3	4	5	6
113.	first occur within the second four hours of work. (10)	1	2	3	4	5	6
114.	occur off the job. (11)	1	2	3	4	5	6
115.	occur soon after work. (12)	1	2	3	4	5	6
116.	occur hours after work. (13)	1	2	3	4	5	6
117.	are due to an allergy. (14)	1	2	3	4	5	6

Your headaches:		NEVER					ALWAYS
118.	occur during periods of emotional stress. (15)	1	2	3	4	5	6
119.	occur during periods of tension. (16)	1	2	3	4	5	6
120.	occur during periods of worry. (17)	1	2	3	4	5	6
121.	occur with changes in the weather. (18)	1	2	3	4	5	6
122.	are located around your eyes. (19)	1	2	3	4	5	6
123.	are located around your forehead. (20)	1	2	3	4	5	6
124.	are located around your temples. (21)	1	2	3	4	5	6
125.	are located around the top of your head. (22)	1	2	3	4	5	6
126.	are located around your lower face. (23)	1	2	3	4	5	6
127.	radiate into your shoulders. (24)	1	2	3	4	5	6
128.	are generally on one side of your head. (25)	1	2	3	4	5	6
129.	generally begin on one side of your head, but progress to involve both sides. (26)	1	2	3	4	5	6
130.	are located superficially. (27)	1	2	3	4	5	6

Your headaches:		NEVER					ALWAYS
131.	are deep-seated. (28)	1	2	3	4	5	6
132.	feel like a pressure sensation. (29)	1	2	3	4	5	6
133.	feel like a tight band. (30)	1	2	3	4	5	6
134.	feel like a constriction. (31)	1	2	3	4	5	6
135.	are a dull feeling. (32)	1	2	3	4	5	6
136.	are a boring sensation. (33)	1	2	3	4	5	6
137.	are a throbbing sensation. (34)	1	2	3	4	5	6
138.	are a shooting pain. (35)	1	2	3	4	5	6
139.	are made worse by coughing. (36)	1	2	3	4	5	6
140.	are made worse by sneezing. (37)	1	2	3	4	5	6
141.	are made worse by noise. (38)	1	2	3	4	5	6
142.	are made worse by bright light. (39)	1	2	3	4	5	6
143.	are made worse by poor light. (40)	1	2	3	4	5	6
144.	are made worse by use of your eyes to do close work. (41)	1	2	3	4	5	6
145.	are preceded by nausea. (42)	1	2	3	4	5	6

Your headaches:		NEVER					ALWAYS
146.	are <u>preceded</u> by vomiting. (43)	1	2	3	4	5	6
147.	are <u>preceded</u> by blurry vision. (44)	1	2	3	4	5	6
148.	are <u>preceded</u> by double vision. (45)	1	2	3	4	5	6
149.	are <u>preceded</u> by spots in your field of vision. (46)	1	2	3	4	5	6
150.	are <u>preceded</u> by flashing bright lights in your field of vision. (47)	1	2	3	4	5	6
151.	are <u>accompanied</u> by nausea. (48)	1	2	3	4	5	6
152.	are <u>accompanied</u> by vomiting. (49)	1	2	3	4	5	6
153.	are <u>accompanied</u> by blurry vision. (50)	1	2	3	4	5	6
154.	are <u>accompanied</u> by double vision. (51)	1	2	3	4	5	6
155.	are <u>accompanied</u> by spots in your field of vision. (52)	1	2	3	4	5	6
156.	are <u>accompanied</u> by flashihg bright lights in your field of vision. (53)	1	2	3	4	5	6
157.	are <u>accompanied</u> by muscle tenseness. (54)	1	2	3	4	5	6
158.	are <u>accompanied</u> by nasal discharge. (55)	1	2	3	4	5	6
159.	are <u>accompanied</u> by watery eyes. (56)	1	2	3	4	5	6

Your headaches:		NEVER					ALWAYS
160.	are accompanied by flushing of your skin. (57)	1	2	3	4	5	6
161.	are accompanied by sweating. (58)	1	2	3	4	5	6
162.	are accompanied by itching eyes. (59)	1	2	3	4	5	6
163.	are accompanied by burning eyes. (60)	1	2	3	4	5	6
164.	are accompanied by loss of appetite. (61)	1	2	3	4	5	6
165.	are accompanied by disturbances of sensation in your arms or legs. (62)	1	2	3	4	5	6
166.	are accompanied by weakness of one or both arms. (63)	1	2	3	4	5	6
167.	are accompanied by weakness of one or both legs. (64)	1	2	3	4	5	6

>2>0>
(79-80)

DIRECTIONS: In this section, a number of statements are made concerning your body and the way it functions.

Read each statement and circle a number to the right of the statement, to indicate how the statement applies to you during your usual job, that is, the job you are currently doing at the Sunpapers.

"1" means the statement does not apply, or that the condition never occurs. "6" means that the statement always applies, or the condition always occurs.

If the answer is somewhere between "never" and "always", you must judge where on the scale from 1 to 6 the appropriate answer lies.

Answer all statements. If you are not sure, guess.

	NEVER					ALWAYS
During your usual work activities:						
168. your eyes feel tired. (6)	1	2	3	4	5	6
169. your eyes feel hot. (7)	1	2	3	4	5	6
170. your eyes feel dry. (8)	1	2	3	4	5	6
171. your eyes ache. (9)	1	2	3	4	5	6
172. your eyes feel uncomfortable. (10)	1	2	3	4	5	6
173. your eyes feel irritated. (11)	1	2	3	4	5	6
174. your eyes burn. (12)	1	2	3	4	5	6
175. your eyes feel itchy. (13)	1	2	3	4	5	6
176. you have double vision. (14)	1	2	3	4	5	6

During your usual work activities:	NEVER					ALWAYS
177. you have blurry vision. (15)	1	2	3	4	5	6
178. you have difficulty reading. (16)	1	2	3	4	5	6
179. you have difficulty focusing on characters. (17)	1	2	3	4	5	6
180. you have pain or stiffness in your neck. (18)	1	2	3	4	5	6
181. you have pain or stiffness in your shoulders. (19)	1	2	3	4	5	6
182. you have pain or stiffness in your back. (20)	1	2	3	4	5	6
183. you have pain or stiffness in your arms. (21)	1	2	3	4	5	6
184. you have pain or stiffness in your legs. (22)	1	2	3	4	5	6
185. you have pain or stiffness in your hands. (23)	1	2	3	4	5	6
186. your ability to see colors changes. (24)	1	2	3	4	5	6
187. you have eyestrain. (25)	1	2	3	4	5	6
188. you see colored fringes around objects. (26)	1	2	3	4	5	6
189. you have difficulty maintaining your attention. (27)	1	2	3	4	5	6
190. lights bother you. (28)	1	2	3	4	5	6

DIRECTIONS: In this section, a number of statements are made concerning your job and your feelings about it.

Read each statement and circle a number to the right of the statement, to indicate how the statement applies to you.

"1" means that the statement does not apply, or you never feel that way. "6" means that the statement always applies, or you always feel that way.

If the answer is somewhere between "never" and "always", you must judge where on the scale from "1" to "6" the appropriate answer lies.

Answer all statements. If you are not sure, guess.

	NEVER					ALWAYS
191. Your work is interesting to do. (29)	1	2	3	4	5	6
192. You dislike the amount of work that you are expected to do. (30)	1	2	3	4	5	6
193. You feel bored with the work you have to do. (31)	1	2	3	4	5	6
194. You are dissatisfied with the pace of your work. (32)	1	2	3	4	5	6
195. The work on your job is dull. (33)	1	2	3	4	5	6
196. You are unhappy about your current work load. (34)	1	2	3	4	5	6
197. You are clear about what your job responsibilities are. (35)	1	2	3	4	5	6
198. You can predict what others will expect of you on the job. (36)	1	2	3	4	5	6

	NEVER					ALWAYS
199. Your work objectives are well defined. (37)	1	2	3	4	5	6
200. Your job requires you to work very fast. (38)	1	2	3	4	5	6
201. Your job requires you to work very hard. (39)	1	2	3	4	5	6
202. Your job leaves you with little time to get things done. (40)	1	2	3	4	5	6
203. There is a great deal to be done. (41)	1	2	3	4	5	6
204. You can set the pace at which you work. (42)	1	2	3	4	5	6
205. You have more than one week's work piled up to do. (43)	1	2	3	4	5	6
206. You can choose the kind of work you do. (44)	1	2	3	4	5	6
207. Your job requires your full attention. (45)	1	2	3	4	5	6
208. You are concerned about losing your job or being laid off. (46)	1	2	3	4	5	6
209. You have time to think and contemplate. (47)	1	2	3	4	5	6
210. You have time to do all your work. (48)	1	2	3	4	5	6
211. There are lulls between heavy workload periods. (49)	1	2	3	4	5	6
212. You daydream on the job. (50)	1	2	3	4	5	6
213. You worry about being reprimanded by your supervisor. (51)	1	2	3	4	5	6

>2>1>
(79-80)

APPENDIX 3

OPHTHALMOLOGICAL EXAMINATION

1. PERSONAL IDENTIFICATION

ASE NUMBER: [ ][ ][ ][ ] (1-5) DATE OF EXAMINATION: [ ][ ] (Mo) - [ ][ ] (Day) - [ ][ ] (Yr) (6-11)

UBJECT IDENTIFICATION

AST NAME: [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] (12-30)

IRST NAME: [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] (31-43)

IDDLE INITIAL: [ ] (44)

DDRESS: [ ] (45-69)

ITY: [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] (6-20)

011 (78-80)

STATE: [ ][ ] (21-22) ZIP CODE: [ ][ ][ ][ ][ ] (23-27)

PERSONAL DATA

1. TELEPHONE: [ ][ ][ ] (area code) - [ ][ ][ ] - [ ][ ][ ][ ] (Work) (28-37)

[ ][ ][ ] (area code) - [ ][ ][ ] - [ ][ ][ ][ ] (Home) (38-47)

2. RACE/ETHNIC CODE:
   1 White, not of Hispanic origin
   2 Black, not of Hispanic origin
   3 Hispanic
   4 American Indian or Alaskan Native
   5 Asian or Pacific Islander
   [ ] (48)

3. SEX: 1 Male
   2 Female
   [ ] (49)

4. DATE OF BIRTH: [ ][ ] (Mo) - [ ][ ] (Day) - [ ][ ] (Yr) (50-55)

5. BLOOD PRESSURE: Systolic [ ][ ][ ] mmHg (56-58) Diastolic [ ][ ][ ] mmHg (59-61)

6. SOCIAL SECURITY NUMBER: [ ][ ][ ] - [ ][ ] - [ ][ ][ ][ ] (62-70)

02 (79-80)

(Under Federal law, people participating in our surveys DO NOT have to tell us their social security number. However it is very useful and helps us do follow-up studies.)

II. REFRACTION

1. STEREOPSIS (TITMUS STEREOSCOPIC TEST)

1 ☐ Present (6) ⟶ [| |] Seconds of Arc (7-9)

2 ☐ Absent (10) ⟶ Worth 4-Dot Test 1 ☐ Normal Fusion 2 ☐ No Fusion (11)

2. IF NO FUSION: 1 ☐ Alternate Suppression 2 ☐ Right Eye Suppression 3 ☐ Left Eye Suppression (12)

MUSCLE BALANCE (MADDOX ROD)

3. ORTHOPHORIA 1 ☐ Yes 2 ☐ No (13)

IF NO:

			PRISM DIOPTERS
4. ESOPHORIA	1 ☐ Yes	2 ☐ No (14)	Far ☐ (15) Near ☐ (16)
5. EXOPHORIA	1 ☐ Yes	2 ☐ No (17)	Far ☐ (18) Near ☐ (19)
6. HYPERPHORIA	1 ☐ Yes	2 ☐ No (20)	Far ☐ (21) Near ☐ (22)
7. CYCLOPHORIA	1 ☐ Yes	2 ☐ No (23)	Far ☐ (24) Near ☐ (25)

8. HETEROTROPIA 1 ☐ Absent 2 ☐ Present (26)

IF PRESENT:

			PRISM DIOPTERS
9. ESOTROPIA	1 ☐ Yes	2 ☐ No (27)	Base out ☐ (28)
10. EXOTROPIA	1 ☐ Yes	2 ☐ No (29)	Base in ☐ (30)
11. HYPERTROPIA	1 ☐ Yes	2 ☐ No (31)	Base up ☐ (32)

117.

CONVERGENCE

12. NEAR POINT OF CONVERGENCE ☐☐ cm (33-34)

13. AMOUNT OF ACCOMMODATION WITH DISTANCE CORRECTION Right ☐☐☐ cm (35-37) Left ☐☐☐ cm (38-40)

BEFORE CYCLOPLEGIC

			Right		Left	
14. VISUAL ACUITY:	Uncorrected Far	(41-45)	☐☐ - ☐☐☐	☐☐ - ☐☐☐	(46-50)	
	Uncorrected Near	(51-55)	☐☐ - ☐☐☐	☐☐ - ☐☐☐	(56-60)	
Present Glasses	Corrected Far	(61-65)	☐☐ - ☐☐☐	☐☐ - ☐☐☐	(66-70)	0 3 (79-80)
	Corrected Near	(6-10)	☐☐ - ☐☐☐	☐☐ - ☐☐☐	(11-15)	

15. IS THIS PERSON USING OR WEARING GLASSES? 1 ☐ Yes 2 ☐ No (16)

16. IS THIS PERSON USING OR WEARING CONTACT LENSES? 1 ☐ Yes 2 ☐ No (17)

17. ENTER THE PRESCRIPTION (IF MEASURED OR AVAILABLE)

	(18-21) ± Sphere	(22-25) ± Cylinder	(26-28) Axis	(29-30) Prism
O.D.	☐.☐☐	☐.☐☐	☐☐☐	☐ Base ___
O.S.	☐.☐☐	☐.☐☐	☐☐☐	☐ Base ___
	(31-34)	(35-38)	(39-41)	(42-43)

18. THIS PERSON'S TYPICAL VISUAL DISTANCE IN WORK IS:

1 ☐ Reading distance (14-16 inches; 35-40 cm)

2 ☐ Arm's length (26-32 inches; 65-80 cm) (44)

3 ☐ Other (Specify): _____

OCULAR PRESSURE

19. APPLANATION PRESSURE Right ☐☐ (45-46) Left ☐☐ (47-48)

20. MANIFEST REFRACTION

	Sphere	Cylinder	Axis	Prism	Visual Acuity	
	± (49-52) (6-9)	± (53-56) (10-13)	(57-59) (14-16)	(60-61) (17-18)	(62-66) (19-23)	0 4 (79-80)
Distance O.D.	☐.☐☐	☐.☐☐	☐☐☐	☐ Base ___	☐☐ / ☐☐☐	
Distance O.S.	☐.☐☐	☐.☐☐	☐☐☐	☐ Base ___	☐☐ / ☐☐☐	
Arm's Length Addition	☐ None	(24)				
Arm's Length Addition O.D.	☐.☐☐	(25-28)		☐ Base ___	(29-30)	
Arm's Length Addition O.S.	☐.☐☐	(31-34)		☐ Base ___	(35-36)	
Reading Addition	☐ None	(37)				
Reading Addition O.D.	☐.☐☐	(38-41)	(42-43)	☐ Base ___	☐☐ / ☐☐☐	(44-48)
Reading Addition O.S.	☐.☐☐	(49-52)	(53-54)	☐ Base ___	☐☐ / ☐☐☐	(55-59)

21. CYCLOPLEGIC REFRACTION

	Sphere	Cylinder	Axis	Prism	Visual Acuity	
	± (60-63)	± (64-67)	(68-70)	(71-72)	(73-77)	0 5 (79-80)
Distance O.D.	☐.☐☐	☐.☐☐	☐☐☐	☐ Base ___	☐☐ / ☐☐☐	
Distance O.S.	☐.☐☐	☐.☐☐	☐☐☐	☐ Base ___	☐☐ / ☐☐☐	
	(6-9)	(10-13)	(14-16)	(17-18)	(19-23)	

EXAMINER'S INITIALS (for refraction): ☐☐☐ (24-26)

III. OPHTHALMIC EXAMINATION

1. PUPIL SIZE — Right ☐☐ mm (27-28) Left ☐☐ mm (29-30)

2. PUPILLARY REFLEXES INTACT TO LIGHT — 1 ☐ Yes 2 ☐ No (31)

IF NO, DESCRIBE: _____

3. PUPILLARY REFLEXES INTACT TO ACCOMMODATION — 1 ☐ Yes 2 ☐ No (32)

IF NO, DESCRIBE: _____

4. MARCUS-GUNN — 1 ☐ Present 2 ☐ Absent (33)

IF PRESENT, DESCRIBE: _____

5. EOM'S FULL — 1 ☐ Yes 2 ☐ No (34)

IF NO, DESCRIBE: _____

6. EXOPHTHALMOS — 1 ☐ Yes 2 ☐ No (35)

7. IF YES, SPECIFY HERTEL EXOPHTHALMOMETER READING ☐☐ (36-37) Right ☐☐ (38-39) Left

8. LIDS NORMAL — 1 ☐ Yes 2 ☐ No (40)

IF NO, DESCRIBE: _____

ANTERIOR SEGMENT

CONJUNCTIVA

9. INJECTION (ENTER GRADE 0-4) Right ☐ Grade (41) Left ☐ Grade (42)

If Present

10. CHEMOSIS 1 ☐ Right(43) 2 ☐ Left(44) 3 ☐ Absent(45)

11. VISIBLE TUMOR 1 ☐ Right(46) 2 ☐ Left(47) 3 ☐ Absent(48)

12. VESSEL ENLARGEMENT 1 ☐ Right(49) 2 ☐ Left(50) 3 ☐ Absent(51)

13. LACRYMAL FUNCTION Right: 1 ☐ Adequate 2 ☐ Deficient 3 ☐ Excessive (52)
Left: 1 ☐ Adequate 2 ☐ Deficient 3 ☐ Excessive (53)

14. PATENTCY OF LACRYMAL DUCT Right: 1 ☐ Patent 2 ☐ Not Patent (54)
Left: 1 ☐ Patent 2 ☐ Not Patent (55)

15. INFLAMMATION OF IRIS Right: 1 ☐ Present 2 ☐ Absent (56)
Left: 1 ☐ Present 2 ☐ Absent (57)

IF PRESENT: (ENTER GRADE 1-4)

16. CELLS Right ☐ Grade (58) Left ☐ Grade (59)

17. FLARE Right ☐ Grade (60) Left ☐ Grade (61)

LENTICULAR OPACITY

If Present

18. SEGMENTAL 1 ☐ Right (62) 2 ☐ Left (63) 3 ☐ Absent (64)

19. NUCLEAR 1 ☐ Right (65) 2 ☐ Left (66) 3 ☐ Absent (67)

20. CORTICAL 1 ☐ Right (68) 2 ☐ Left (69) 3 ☐ Absent (70)

21. ANTERIOR SUBCAPSULAR 1 ☐ Right (71) 2 ☐ Left (72) 3 ☐ Absent (73)

22. POSTERIOR SUBCAPSULAR 1 ☐ Right (74) 2 ☐ Left (75) 3 ☐ Absent (76)

0 6 (79-80)

23. VACUOLES 1 ☐ Right (6) 2 ☐ Left (7) 3 ☐ Absent (8)

COMMENTS: _____

24. CATARACT CLASSIFICATION (USE THE FOLLOWING CATEGORIES) ☐ Right (9) ☐ Left (10)

0 No lens opacity.

1 Minimal nuclear, cortical spokes, posterior or anterior subcapsular, or cortical dot cataracts. Opacity not marked enough to cause any decrease in vision. Vision equals 20/20.

2 More opacification than in Grade 1. Opacification sufficient to reduce visual acuity to 20/25 - 20/30 range.

3 More opacification than in Grade 2. Sufficient to reduce visual acuity to 20/40 - 20/70 range.

4 More opacification than in Grade 3. Sufficient to reduce visual acuity to 20/80 - 20/200 range.

5 Dense cataract. Vision less than 20/200.

25. LENS PHOTOGRAPHED? 1 ☐ Yes 2 ☐ No (11)

26. GONIOSCOPY PERFORMED? 1 ☐ Yes 2 ☐ No (12)

IF YES: (ENTER GRADE 1-4)

27. DEPTH Right ☐ Grade (13) Left ☐ Grade (14)

28. PIGMENTATION Right ☐ Grade (15) Left ☐ Grade (16)

COMMENTS: _____

29. VITREOUS Right: 1 ☐ Normal 2 ☐ Cells 3 ☐ Hemmorhages 4 ☐ Detached (17)

Left: 1 ☐ Normal 2 ☐ Cells 3 ☐ Hemmorhages 4 ☐ Detached (18)

FUNDUS EXAMINATION (CHECK ALL THAT APPLY)

30. CUPPING OF DISC

Right: 1 ☐ Physiological 2 ☐ Glaucomatous (19) Disc/Cup Ratio (0.0-0.9) 0.☐ (20)

Left: 1 ☐ Physiological 2 ☐ Glaucomatous (21) Disc/Cup Ratio (0.0-0.9) 0.☐ (22)

FUNDUS EXAMINATION (continued)

		If Present			
31.	PAPILLEDEMA	1 ☐ Right (23)	2 ☐ Left (24)	3 ☐ Absent	(25)
32.	DIMINISHED FOVEAL REFLEX	1 ☐ Right (26)	2 ☐ Left (27)	3 ☐ Absent	(28)
33.	CHORIORETINAL SCARS	1 ☐ Right (29)	2 ☐ Left (30)	3 ☐ Absent	(31)
34.	DISCIFORM DEGENERATION	1 ☐ Right (32)	2 ☐ Left (33)	3 ☐ Absent	(34)
35.	OPTIC ATROPHY	1 ☐ Right (35)	2 ☐ Left (36)	3 ☐ Absent	(37)
36.	LATTICE DYSTROPHY	1 ☐ Right (38)	2 ☐ Left (39)	3 ☐ Absent	(40)
37.	PERIPHERAL CHORIORETINAL	1 ☐ Right (41)	2 ☐ Left (42)	3 ☐ Absent	(43)
38.	EXUDATES	1 ☐ Right (44)	2 ☐ Left (45)	3 ☐ Absent	(46)
39.	INTRARETINAL HEMMORHAGES	1 ☐ Right (47)	2 ☐ Left (48)	3 ☐ Absent	(49)
40.	VITREOUS HEMMORHAGES	1 ☐ Right (50)	2 ☐ Left (51)	3 ☐ Absent	(52)
41.	MICROANEURYSMS	1 ☐ Right (53)	2 ☐ Left (54)	3 ☐ Absent	(55)
42.	ARTERIOLAR NARROWING	1 ☐ Right (56)	2 ☐ Left (57)	3 ☐ Absent	(58)
43.	MACULAR SCARS	1 ☐ Right (59)	2 ☐ Left (60)	3 ☐ Absent	(61)
44.	CONSISTENT WITH HYPERTENSIVE RETINOPATHY	1 ☐ Right (62)	2 ☐ Left (63)	3 ☐ Absent	(64)
45.	CONSISTENT WITH MALIGNANT HYPERTENSION	1 ☐ Right (65)	2 ☐ Left (66)	3 ☐ Absent	(67)
46.	CONSISTENT WITH BACKGROUND DIABETIC RETINOPATHY	1 ☐ Right (68)	2 ☐ Left (69)	3 ☐ Absent	(70)
47.	LESION SUGGESTIVE OF PROLIFERATIVE DIABETIC RETINOPATHY	1 ☐ Right (71)	2 ☐ Left (72)	3 ☐ Absent	(73)
48.	PROLIFERATIVE DIABETIC RETINOPATHY	1 ☐ Right (74)	2 ☐ Left (75)	3 ☐ Absent	(76)
49.	RHEGMATOGENOUS RETINAL DETACHMENT	1 ☐ Right (6)	2 ☐ Left (7)	3 ☐ Absent	(8)
50.	NON-RHEGMATOGENOUS RETINAL DETACHMENT	1 ☐ Right (9)	2 ☐ Left (10)	3 ☐ Absent	(11)
51.	DRUSEN (PERIPHERAL)	1 ☐ Right (12)	2 ☐ Left (13)	3 ☐ Absent	(14)
52.	DRUSEN (MACULAR)	1 ☐ Right (15)	2 ☐ Left (16)	3 ☐ Absent	(17)
53.	PIGMENTARY DISTURBANCE (PERIPHERAL)	1 ☐ Right (18)	2 ☐ Left (19)	3 ☐ Absent	(20)
54.	PIGMENTARY DISTURBANCE (MACULAR)	1 ☐ Right (21)	2 ☐ Left (22)	3 ☐ Absent	(23)
55.	RETINITIS PIGMENTOSA	1 ☐ Right (24)	2 ☐ Left (25)	3 ☐ Absent	(26)
56	OTHER (SPECIFY BELOW)	1 ☐ Right (27)	2 ☐ Left (28)		

SPECIFY: _____ ☐☐ (29-30)

0 | 7 (79-80)

57. CHOROIDAL NEVI-NUMBER ☐☐ Right (31-32) ☐☐ Left (33-34)

DESCRIPTION: _____

_____

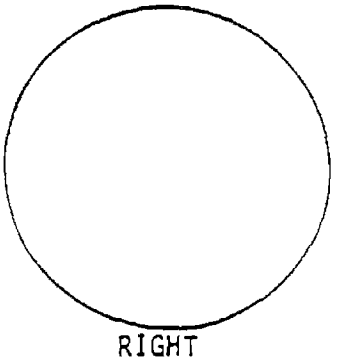
58. CHORODIAL/CILIARY BODY MELANOMA Right: 1 ☐ Present 2 ☐ Absent (35)

Left: 1 ☐ Present 2 ☐ Absent (36)

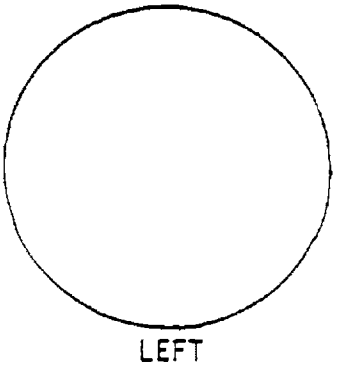
59. WAS THE RETINA PHOTOGRAPHED? 1 ☐ Yes 2 ☐ No (37)

60. DRAWING 1 ☐ Yes 2 ☐ No (38)

IF YES, USE SPACE BELOW FOR DRAWING OF PERIPHERAL LESIONS WHICH CANNOT BE PHOTOGRAPHED.



RIGHT



LEFT

DESCRIPTION: _____

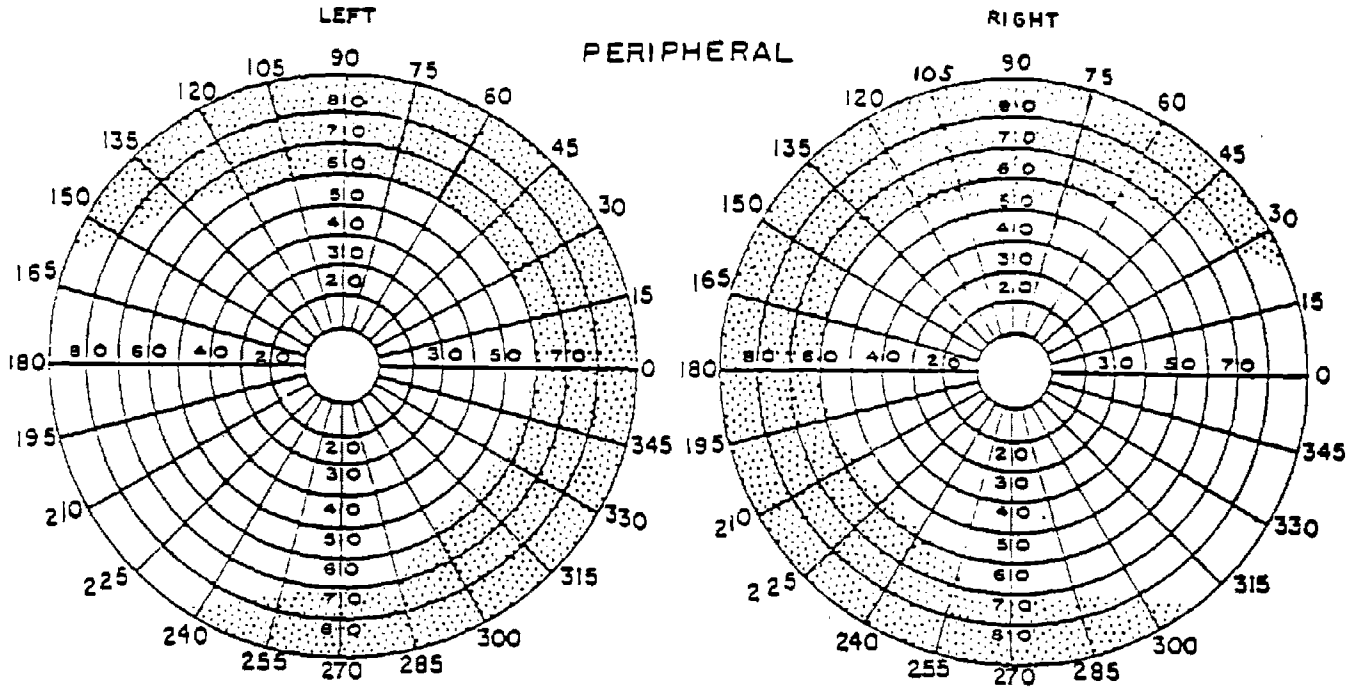
61. PERIMETRY 1 ☐ Performed 2 ☐ Not Performed (39)

IF PERFORMED: 62. Right: 1 ☐ Normal 2 ☐ Abnormal (40)

63. Left: 1 ☐ Normal 2 ☐ Abnormal (41)

IF ABNORMAL, DRAW IN SPACE PROVIDED ON FOLLOWING PAGE.

PERIPHERAL



TEST OBJECTS AND DISTANCE _____

NARRATIVE SUMMARY OF OPHTHALMOLOGICAL EXAMINATION: _____

Date

Signature of Examining Physician

APPENDIX 4

1.

In research in which information on a large number of variables is obtained, it would be unusual if all the individual measured variables were independent of each other. This is particularly true for health questionnaires, in which responses to inquiries about specific symptoms tend to covary in clusters. For example, someone who reports "nausea" is more likely to report "vomiting" as well. It is thus quite probable that the plethora of questions asked may represent different ways of measuring a few underlying traits or characteristics of the respondent. These traits are latent, in that they are not directly observed, but may be inferred from the associations in response patterns observed for a particular set of questions. Given a set of responses to "n" questions, then, we would like to derive a more limited description of the data. We would like to reduce the responses to the "n" questions, to scores on "r" latent traits which maximally differentiate the individuals when scored on those traits. The characters of of these latent traits might then be inferred by the correlation of the observed variables with those traits. We would furthermore like these traits to be independent of (or uncorrelated with) each other.

One technique to identify these latent traits is via principal components analysis, in which the latent traits are derived as linear combinations of the original variables. Although a number of components equal to the number of original variables can be derived, in practice only a "few" components are retained, which account for a "significant" proportion of the variation of the original data. The retained components are then rotated, such that the variation of the original data accounted-for by the

retained components is shifted or split-up differently across the factors. A more readily interpretable pattern of variable-factor correlations is thus obtained, and the characters of the underlying, latent (but not directly measured) traits are more readily identified.

Assume that we have a data matrix $\underline{X}$, where each of "m" rows contains observations from a single person, and each of "n" columns contains the observed values of a particular variable for each person. The particular variables might be measured characteristics, such as age, height, plasma cholesterol level; or they might be the responses to questions that are quantitated in some ranked fashion (i.e., graded on a scale that implies the responses are ordered in magnitude, such as from "none" to "a lot"). Let the data matrix be standardized by subtracting from each datum the mean of the particular variable, and dividing by its standard deviation, to yield the matrix $\underline{X}_s$:

	Col. 1	Col. 2	...	Col. n
Row 1	x_{11}	x_{12}	...	x_{1n}
Row 2	x_{21}	x_{22}	...	x_{2n}
.	.	.		.
.	.	.		.
.	.	.		.
Row m	x_{m1}	x_{m2}	...	x_{mn}

Since the matrix $\underline{X}_s$ is standardized, the covariance matrix $\underline{C}$, and the correlation matrix $\underline{R}$, are identical:

$$\underline{C} = \underline{R} = \frac{1}{m-1} \underline{X}_{sT}\underline{X}s \quad .$$

We want to construct a set of axes $\underline{Y}$ that are linear composites of the

original variables, such that the variance of the data is maximized when each observation is projected on the axes, and the axes are independent of (orthogonal to) each other, i.e.,

$$\begin{aligned} Y_1 &= a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n, \\ Y_2 &= a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n, \\ &\cdot \\ &\cdot \\ &\cdot \\ Y_n &= a_{n1}x_1 + a_{n2}x_2 + \ldots + a_{nn}x_n, \end{aligned}$$

or $$\underline{Y} = \underline{X}\ \underline{a}\ .$$

The orthogonality constraint requires that

$$\underline{a}_i\ \underline{a}_j = 0 \text{ if } i \neq j.$$

If a normality constraint is added, then

$$\underline{a}_i\ \underline{a}_j = 1 \text{ if } i = j.$$

Thus,

$$\underline{a}^T\ \underline{a} = \underline{I}.$$

Now, $Var(\underline{Y}) = Var\ (\underline{X}\ \underline{a}) = \underline{a}^T\ \underline{C}\ \underline{a} = \underline{a}^T\ \underline{R}\ \underline{a}$, since $\underline{C}$ and $\underline{R}$ are identical for standardized data. The principle components solution requires the maximization of $Var(\underline{Y})$ subject to the constraint $\underline{a}^T\ \underline{a} = I$. This suggests an eigenstructure problem, and indeed the solution is obtained by finding the eigenvalues and eigenvectors of $\underline{R}$, and decomposing $\underline{R}$ into "n" additive matrices. Thus,

$$R = \lambda_1 \underline{a}_1^T \underline{a}_1 + \lambda_2 \underline{a}_2 T \underline{a}_2 + \ldots + \lambda_n \underline{a}_n^T \underline{a}^n,$$

where $\lambda_1 \ldots \lambda_n$ are the eigenvalues of the correlation matrix $\underline{R}$, and $a_1 \ldots a_n$ are the corresponding eigenvectors. It can be shown that $a_1 \ldots a_n$ correspond to the "n" orthogonal axes $\underline{Y}$, and $\lambda_1 \ldots \lambda_n$ are the variances of the data projected on the axes $\underline{Y}_1 \ldots \underline{Y}_n$. Furthermore, the

correlations of the original standardized variables $\underline{X}_i$ with each principal component is given by $\lambda_i \underline{a}_i$. These correlations are referred to as the "component loadings", and are calculated as

$$F = \underline{a}\, \lambda^{1/2} ,$$

where $\lambda^{1/2}$ is a diagonal matrix of eigenvalues. If we retain all components and calculate the component loadings, the sum of the squared loadings in each column equals the respective eigenvalue (and thus the variance) of the component, and the sum of the squared loadings in each row equals the amount of variance of the original variable explained by the set of components retained (and hence equals 1, since all components were retained).

The eigenvalues may be ordered in magnitude from largest to smallest, and the cumulative amount of variance of $\underline{X}_s$ explained with the addition of each successive component may be tabulated:

Principal Component	Variance Explained	Cumulative Variance Explained	Cumulative Proportion of Variance Explained
1	λ_1	λ_1	λ_1/n
2	λ_2	$\lambda_1+\lambda_2$	$(\lambda_1+\lambda_2)/n$
.	.	.	.
.	.	.	.
.	.	.	.
n	λ_n	$\lambda_i=n$	$\lambda_1/n=1$

[Note: Since the data are standardized, $Var(X_i)=1$, $Var(X_i)= \quad 1=n$, or $Var(\underline{X})=n$. Thus, $\lambda_i=n$.]

Now, if we start with the correlation matrix $\underline{R}$, and extract "n" principal component axes, no reduction in data has been accomplished. Rather, the original axes have merely been rotated to a new set of axes.

Since, however, $\underline{R}$ can be decomposed into a set of additive matrices $\lambda_i \underline{a}_i \underline{a}_i^T$, i=1...n, we can approximate $\underline{R}$ by keeping "r"<"n" component matrices, thus reducing the dimensions of $\underline{R}$ from an "n" by "n" matrix to an "n" by "r" matrix. By keeping only "r" eigenvalues and their eigenvectors, we have extracted "r" principle components that collectively approximate the correlation matrix $\underline{R}$, and have reduced the data matrix $\underline{X}$ from "n" measured variables to "r" latent variables. The question is, how many axes (components) should be kept. One rule of thumb is to keep all axes (components) whose eigenvalue exceeds 1. Since the matrix $\underline{X}$ was standardized, the variance of each X_i equals 1. The rationale is as follows. If we argue that each variable by itself has a variance of 1, and we argue that a component with an eigenvalue (variance) less than 1 is a separate dimension, then we would have to argue that the derived component itself carries less variance than the individual variables. Therefore, one rule is to retain as a maximum, the eigenvalues greater than 1. Having retained "r"<"n" components, the component loadings may be computed. The sum of the squared loadings in each row as before represents the amount of variance of the original variable explained by the set of components retained, but now is less than 1, since some of the components were discarded. The sum of the squared loadings across rows is called the "communality" of the variable with the set of retained components.

It may further be asked whether the retained components are interpretable. In the procedure just described, there is a tendency for the first component to be a general factor or latent trait on which almost all directly measured variables are highly correlated. We would prefer a

solution in which the component axes produced dimensions with which only a few of the observed variables are correlated, i.e., only a few variables contribute significantly toward defining it. It can be demonstrated that the retained axes can be rotated further without destroying their ability to reconstruct and approximate R, such that a simpler and more interpretable structure is obtained. For the rotated axes, most of the manifest variables will be minimally associated with any specific trait (axis), but a few variables will have large associations with it; any given variable will display nonzero associations only with one, or at most a few latent traits; and any pair of traits will exhibit different correlation patterns with the original variables (otherwise one could not distinguish the two traits from each other). Such rotation is referred to as "factor analysis". The communalities and total variance accounted-for are unchanged from the original principal components solution. However, the variance accounted-for by each trait is split-up differently across traits. The traits obtained after rotation usually will be more interpretable than before, and scores can be computed for each individual on each retained trait.

Factor analysis of work/health questionnaire of VDT study:

The work/health questionnaire consisted of 213 questions, many of which clearly were not independent of each other. Factor analysis was used to identify underlying traits for 5 sections of the questionnaire, to attempt to reduce the responses th "n" correlated questions to scores on "r"<"n" uncorrelated factors. These 4 sections were:

(1) Questions 10a through 10d, relating to the VDT users typical pattern of VDT operation;

(2) Questions 19 through 30, relating to ergonomic aspects of VDT use, and "how bothersome" these aspects were when the respondent worked with the VDT;

(3) Questions 109 through 167, relating to symptoms which accompanied reported headaches;

(4) Questions 168 through 190, relating to symptoms which occurred during normal work activities; and

(5) Questions 191 through 213, relating to attitudes and feelings toward the respondent's job.

Factor analyses of questions 10a-10d, questions 19-30, questions 168-190, and questions 191-213 will be discussed sequentially. Factor analysis of questions 109-167 was more complicated, and will be discussed last.

Questions 10a-10d:

The respondents were asked to rank on an increasing scale from 1 to 6, how they typically operated a VDT in their daily work. Analysis was limited to 204 Guild members who answered "Yes" to question 4, "Do you now use a VDT in your current job at the Sunpapers." Principal components with eigenvalues greater than 1 were retained. Two factors were thus extracted, which jointly accounted for 74.3 per cent of the total variance of the correlation matrix. The rotated factor loadings are given in table 1. Loadings less than 0.25 have been replaced by "." for greater clarity of presentation. In table 2, the variables are ranked in decreasing order by

factor loadings on each retained factor. Those variables whose factor loadings were less than 0.25 are not listed.

The factor loadings (variable/factor correlations) suggest that the 4 variables measured 2 factors. Factor 1 described primarily a mode of VDT operation where the operator's eyes shift between the VDT screen and keyboard, and the source document. Factor 2 described primarily a mode of VDT operation where the operator's eyes are fixed on the VDT screen.

Questions 19-30:

The respondents were asked to rank on an increasing scale from 1 to 6, how bothersome was the "current" set-up of their VDT, as it was normally adjusted, with respect to each of 12 variables. Analysis was limited to 204 Guild members who answered "Yes" to question 4, "Do you now use a VDT in your current job at the Sunpapers". Principal components with eigenvalues greater than 1 were retained. Two factors were thus extracted, which jointly accounted-for 60.3 per cent of the total variance of the correlation matrix. The rotated factor loadings (variable-factor correlations) are given in table 3. Loadings less than 0.25 have been replaced by "." for greater clarity of presentation. In table 4, the variables are ranked in decreasing order by factor loadings on each retained factor. Those variables whose factor loadings were less than 0.25 are not listed.

The factor loadings (variable/factor correlations) suggest that the 12 variables measured 2 factors. Factor 1 related primarily to the physical relationship between the VDT and the user (the respondent). Factor 2 related primarily to readability of the VDT characters, with respect to brightness, resolution, glare, and flicker.

Questions 168-190:

The respondents were asked to rank on an increasing scale from 1 to 6, how each of 23 symptom descriptions applied to them during their normal work activities. Analysis was limited to 283 Guild members. Principal components with eigenvalues greater than 1 were retained. Four factors were thus extracted, which jointly accounted-for 60.6 per cent of the total variance of the correlation matrix. The rotated factor loadings (variable-factor correlations) are given in Table 5. Loadings less than 0.250 have been replaced by "." for greater clarity of presentation. In Table 6, the symptoms are ranked in decreasing order of factor loading on each retained factor. Those symptoms whose factor loadings were less than 0.25 are not listed.

The factor loadings (variable/factor correlations) suggest that the 23 questions measured 4 factors. Factor 1 related primarily to visual symptoms. Factor 2 related primarily to visual function. Factor 3 related primarily to musculo-skeletal symptoms in the neck, shoulders, and back. Factor 4 related primarily to musculo-skeletal symptoms in the extremities (arms, hands, legs).

Questions 191-213:

The respondents were asked to rank on an increasing scale from 1 to 6, how they felt about their job with respect to 23 possible descriptive phrases. Analysis was limited to 283 Guild members. Principal components with eigenvalues greater than 1 were retained. Seven factors were thus extracted, which jointly accounted-for 67.7 per cent of the total variance

of the correlation matrix. The rotated factor loadings (variable-factor correlations) are given in Table 7. Loadings less than 0.250 have been replaced by "." for greater clarity of presentation. In Table 8, the "job feelings" are ranked in decreasing order of factor loading on each retained factor. Those feelings whose factor loadings were less than 0.25 are not listed.

The factor loadings (variable/factor correlations) suggest that the 23 questions measured 7 factors. These seven factors seem, broadly, to fall into 3 categories: intrinsic characteristics of the job, organizational characteristics, and career-oriented characteristics. Factors 1, 2, 4, and 5 describe primarily intrinsic characteristics of the job. Factor 1 relates primarily to job pace and job pressure. Factor 2 relates primarily to (dullness of) job content and (dissatisfaction with) work lead and pace. Factor 4 relates primarily to time-pressure as well as work load. Factor 5 relates as well to time-pressure, with time to daydream. Factors 3 and 7 describe primarily organizational characteristics of the job. Factor 3 relates to clarity of job responsibilities and predictablity of others' expectations. Factor 7 relates to job autonomy. Factor 6 describes career-oriented characteristics, and refers to job insecurity.

Questions 109-167:

The respondents were asked to rank on an increasing scale from 1 to 6 how each of 59 descriptions applied to themselves when they had a headache. Analysis was limited to 244 Guild members who answered "Yes" to question 98, "Do you have a headache more than once a year." Principal components with

eigenvalues greater than 1 were retained. 17 factors were thus extracted, which jointly accounted for 69.9 per cent of the total variance of the correlation matrix. The 17 factors so identified seemed to be uninterpretable and contradictory. The following explanations were considered:

(1) Too many factor may have been retained. A solution with fewer retained factors might be more interpretable.

(2) Questions 109-121, which describe time relationships and precipitating circumstances of the headaches; and questions 122-167, which describe location of headaches and accompanying symptoms; might more appropriately be analyzed separately.

(3) All respondents with headache greater than once per year were included. However, persons with frequent headaches might be expected to respond differently from persons with infrequent headaches.

The following resolution was made:

(1) Questions 109-121 and questions 122-167 were analyzed separately. When this was done, retaining principal components with eigenvalues greater than 1, four factors were extracted for questions 109-121, which jointly accounted-for 61.6 percent of the total variance of the correlation matrix; and thirteen factors were extracted for questions 122-167, which jointly accounted-for 69.3 percent of the total variance of the correlation matrix. The factors so extracted seemed to by physiologically plausible.

(2) Questions 122-167 were analyzed separately, for respondents who had headaches less than once per week, and respondents who had headaches at least once per week. Fourteen and thirteen factor solutions were obtained, respectively, which were similar to each other and to the solution obtained when the data were analyzed as an aggregate (not divided according to frequency of headaches.) Accordingly, the data for questions 122-167 were analyzed without regard to frequency of headache.

Questions 109-121:

Respondents were asked to rank on an increasing scale from 1 to 6 how each of 13 time variables applied to them during their headaches. The four factor solution explained 61.6 per cent of the total variance of the correlation matrix. The rotated factor loadings are given in Table 9. Loadings less than 0.25 have been replaced by "." for greater clarity of presentation. In table 10, the descriptions about time circumstances with respect to headaches are ranked in decreasing order of factor loading on each retained factor. Those time circumstances whose factor loading was less than 0.25 are not listed.

The factor loadings (variable/factor correlations) suggest that the 13 questions measured 4 factors. Factor 1 related primarily to headaches that occurred during periods of tension, worry, and/or stress. Factor 2 related primarily to headaches associated with work, but did not differentiate between headaches with onset during the first and last four hours of work. Factor 3 related primarily to headaches that were associated with changes in

the weather or with an allergy. Factor 4 related primarily to headaches that occurred after work or off the job.

Questions 122-167:

Respondents were asked to rank on an increasing scale from 1 to 6, how each of 46 descriptive phrases applied to themselves during their headaches. The thirteen factor solution explained 69.3 per cent of the total variance of the correlation matrix. The rotated factor loadings are given in Table 11. To avoid confusion with the previous section, they are numbered as factors 5 through 17. Loadings less than 0.25 have been replaced by "." for greater clarity of presentation. In table 12, the descriptive phrases are ranked in decreasing order of factor loading on each retained factor. Those descriptive phrases whose factor loadings were less than 0.25 are not listed.

The factor loadings (variable/factor correlations) suggest that the 46 phrases measured 13 factors. Factor 5 is suggestive of headaches with visual prodrome and accompanying visual phenomena, reminiscent of migraine headache. Factor 6 relates primarily to headaches aggravated by light and noise. Factor 7 is suggestive of headaches with gastrointestinal prodrome and accompanying gastrointestinal symptoms, reminiscent of migraine headache. Factor 8 relates primarily to accompanying ocular (itching, burning, watery eyes) symptoms. Factor 9 relates primarily to headaches with motor and sensory disturbances, reminiscent of migraine headache. Factor 10 relates primarily to the location of headaches. Factor 11 relates primarily to headaches aggravated by coughing and sneezing. Factor 12

relates primarily to the location of headaches. Factor 13 relates primarily to headaches with accompanying muscle tenseness. Factor 14 relates primarily to headaches with double and blurry vision. Factor 15 primarily describes headaches like a tight band or constriction. Factor 16 relates primarily to location of headaches. Factor 17 relates primarily to headaches with accompanying vasomotor phenomena.

TABLE 1

FACTOR LOADINGS*, QUESTIONS 10a-10d

	Factor 1	Factor 2	Sum of communalities** obtained from 2 factors
Q10a	.	0.934	0.880
Q10b	0.876	.	0.783
Q10c	0.610	.	0.541
Q10d	0.786	.	0.768

* = Variable/Factor correlations
**= Amount of variation of questions explained jointly by the retained factors

TABLE 2

"The following are some examples of how VDTs are operated..."

Factor 1:	Factor loading
Q10b: Your eyes shift between the VDT terminal and keyboard.	0.876
Q10d: Your eyes shift among the source document, the VDT screen, and the keyboard.	0.786
Q10c: Your eyes shift between the source document, and the VDT screen for input and/or output	0.610
Factor 2:	
Q10a: Your eyes are fixed on the VDT screen	0.934

TABLE 3

FACTOR LOADINGS*, QUESTIONS 19-30

	Factor 1	Factor 2	Sum of communalities** obtained from 2 factors
Q19	.	0.795	0.692
Q20	.	0.853	0.760
Q21	.	0.718	0.568
Q22	0.571	0.427	0.509
Q23	0.799	.	0.688
Q24	0.714	.	0.522
Q25	0.583	.	0.738
Q26	0.606	0.379	0.511
Q27	0.808	.	0.710
Q28	.	0.777	0.637
Q29	0.724	.	0.583
Q30	.	0.596	0.378

* = Variable/factor correlation
** = Amount of variation of question explained jointly by the retained factors

TABLE 4

"Considering the current set-up of your VDT, as it is normally adjusted, how bothersome are the following..."

Factor 1:		Factor loading
Q25:	The height of the keyboard.	0.853
Q27:	The distance of the keyboard from you.	0.808
Q23:	The tilt of the VDT keyboard.	0.799
Q29:	Glare off the keyboard.	0.724
Q24:	The height of the screen.	0.714
Q26:	The distance of the screen from you.	0.606
Q22:	The tilt of the VDT screen toward you.	0.571
Factor 2:		**Factor loading**
Q20:	The brightness of the letters or numbers.	0.854
Q19:	The brightness of the screen.	0.795
Q28:	Glare off the VDT screen.	0.777
Q21:	The readability (size or sharpness).	0.718
Q30:	Flicker of the screen display.	0.596
Q22:	The tilt of the VDT screen toward you.	0.428
Q26:	The distance of the screen from you.	0.379

TABLE 5

FACTOR LOADINGS*, QUESTIONS 168-190

	Factor 1	Factor 2	Factor 3	Factor 4	Sum of communalities** obtained from 4 factors
Q168	0.729	.	.	.	0.617
Q169	0.732	.	.	.	0.534
Q170	0.657	.	.	.	0.491
Q171	0.712	.	.	.	0.574
Q172	0.794	.	.	.	0.745
Q173	0.833	.	.	.	0.743
Q174	0.801	.	.	.	0.681
Q175	0.629	.	.	.	0.458
Q176	.	.	0.564	.	0.384
Q177	0.274	.	0.629	.	0.527
Q178	0.359	.	0.633	.	0.576
Q179	0.412	.	0.588	0.398	0.687
Q180	.	.	.	0.867	0.838
Q181	.	0.270	.	0.855	0.833
Q182	0.280	0.380	.	0.697	0.711
Q183	.	0.776	.	0.340	0.756
Q184	.	0.787	.	.	0.681
Q185	.	0.778	.	.	0.657
Q186	.	.	0.597	.	0.412
Q187	0.704	.	.	0.287	0.628
Q188	.	.	0.694	.	0.529
Q189	0.268	.	0.504	0.353	0.458
Q190	0.414	.	0.322	0.322	0.398

* = Variable/factor correlation

** = Amount of variation of question explained jointly by the retained factors

TABLE 6

"During your usual work activities..."

Factor 1:	Factor Loading
Q173: Your eyes feel irritated.	0.833
Q174: Your eyes burn.	0.801
Q172: Your eyes feel uncomfortable	0.794
Q169: Your eyes feel hot.	0.732
Q168: Your eyes feel tired.	0.729
Q171: Your eyes ache.	0.712
Q187: You have eyestrain.	0.704
Q170: Your eyes feel dry.	0.657
Q175: Your eyes feel itchy.	0.629
Q190: Lights bother you.	0.414
Q179: You have difficulty focusing on characters.	0.412
Q178: You have difficulty reading.	0.359
Q182: You have pain or stiffness in your back.	0.280
Q177: You have blurry vision.	0.274
Q189: You have difficulty maintaining your attention.	0.268
Factor 2:	
Q184: You have pain or stiffness in your legs.	0.787
Q185: You have pain or stiffness in your hands.	0.778
Q183: You have pain or stiffness in your arms.	0.776
Q182: You have pain or stiffness in your back.	0.380
Q181: You have pain or stiffness in your shoulders.	0.270
Factor 3:	
Q188: You see colored fringes around objects.	0.694
Q178: You have difficulty reading.	0.633
Q177: You have blurry vision.	0.629
Q186: Your ability to see colors changes.	0.594
Q179: You have difficulty focusing on characters.	0.588
Q176: You have double vision.	0.564
Q189: You have difficulty maintaining your attention.	0.504
Q190: Lights bother you.	0.322

-Continued-

TABLE 6 (continued)

Factor 4:	
Q180: You have pain or stiffness in your neck.	0.867
Q181: You have pain or stiffness in your shoulders.	0.855
Q182: You have pain or stiffness in your back.	0.697
Q179: You have difficutly focusing on characters.	0.398
Q189: You have difficulty maintaining your attention.	0.353
Q183: You have pain or stiffness in your arms.	0.340
Q190: Lights bother you.	0.322
Q187: You have eyestrain.	0.287

TABLE 7

FACTOR LOADINGS*, QUESTIONS 191-213

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Sum of Communalities** from 7 factors
Q191	0.274	-0.721	0.266	.	.	.	.	0.744
Q192	0.373	0.400	.	0.397	.	.	-0.280	0.646
Q193	.	0.838	.	.	.	.	.	0.740
Q194	.	0.644		.	.	.	.	0.569
Q195	.	0.872		.	.	.	.	0.7926
Q196	0.292	0.649	.	0.308	.	.	.	0.654
Q197	.	.	0.813	.	.	.	.	0.686
Q198	.	.	0.801	.	.	.	.	0.651
Q199	.	.	0.759	.	.	.	.	0.613
Q200	0.819	.	.	.	.	.	.	0.737
Q201	0.848	.	.	.	.	.	.	0.759
Q202	0.546	.	.	0.438	-0.261	.	.	0.591
Q203	0.739	.	.	0.293	.	.	.	0.673
Q204	.	.	.	.	.	.	0.741	0.608
Q205	.	.	.	0.758	.	.	0.334	0.7126
Q206	.	.	.	0.331	.	.	0.650	0.639
Q207	0.440	.	.	.	-0.459	.	0.262	0.574
Q208	.	.	.	.	.	0.797	.	0.734
Q209	-0.262	.	.	-0.396	0.384	.	0.495	0.664
Q210	.	.	.	.	.	.	.	0.738
Q211	.	.	.	-0.414	0.655	.	.	0.641
Q212	.	.	.	.	0.767	.	.	0.664
Q213	.	.	.	.	.	0.730	-0.363	0.716

* = Variable/factor correlation

** = Amount of variation of question explained jointly by the retained factors

TABLE 8

Factor 1:	Factor loading
Q201: Your job requires you to work very hard.	0.848
Q200: Your job requires you to work very fast.	0.819
Q203: There is a great deal to be done.	0.739
Q202: Your job leaves you with little time to get things done.	0.546
Q207: Your job requires your full attention.	0.440
Q192: You dislike the amount of work that you are expected to do.	0.373
Q196: You are unhappy about your current work load.	0.292
Q191: Your work is interesting to do.	0.274
Q209: You have time to think and contemplate.	-0.262
Factor 2:	
Q195: The work on your job is dull.	0.872
Q193: You feel bored with the work you have to do.	0.838
Q196: You are unhappy about your current work load.	0.649
Q194: You are dissatisfied with the pace of your work.	0.644
Q192: You dislike the amount of work that your are expected to do.	0.400
Q191: Your work is interesting to do.	-0.721
Factor 3:	
Q197: You are clear about what your job responsibilities are.	0.813
Q198: You can predict what others will expect of you on the job.	0.801
Q199: Your work objectives are well defined.	0.749
Q191: Your work is interesting to do.	0.266
Factor 4:	
Q205: You have more than one week's work piled up to do.	0.758
Q202: Your job leaves you with little time to get things done.	0.438
Q192: You dislike the amount of work that you are expected to do.	0.397
Q206: You can choose the kind of work you do.	0.331
Q196: You are unhappy about your current work load.	0.308
Q203: There is a great deal to be done.	0.293
Q194: You are dissatisfied with the pace of your work.	0.244
Q209: You have time to think and contemplate.	-0.396
Q211: There are lulls between heavy workload periods.	-0.414
Q210: You have time to do all your work.	-0.801

-Continued-

TABLE 8 (continued)

Factor 5:	
Q212: You daydream on the job.	0.767
Q211: There are lulls between heavy workload periods.	0.655
Q209: You have time to think and contemplate	0.384
Q202: Your job leaves you little time to get things done.	-0.261
Q207: Your job requires your full attention.	-0.459
Factor 6:	
Q208: You are concerned about losing your job or being laid off.	0.797
Q213: You worry about being reprimanded by your supervisor.	0.730
Factor 7:	
Q204: You can set the pace at which you work.	0.740
Q206: You can choose the kind of work you do.	0.650
Q209: You have time to think and contemplate.	0.495
Q205: You have more than one week's work piled up to do.	0.334
Q207: Your job requires your full attention	0.262
Q192: You dislike the amount of work that you are are expected to do.	-0.280
Q213: You worry about being reprimanded by your supervisor.	-0.363

TABLE 9

FACTOR LOADING*, QUESTIONS 109-121

	Factor 1	Factor 2	Factor 3	Factor 4	Sum of Communalities** from 4 factors
Q109	.	.	0.541	.	0.368
Q110	.	0.358	0.529	.	0.479
Q111	.	0.826	.	.	0.722
Q112	.	0.717	.	.	0.578
Q113	.	0.739	.	.	0.558
Q114	.	-0.308	.	0.704	0.593
Q115	.	.	.	0.616	0.437
Q116	.	.	.	0.785	0.645
Q117	.	.	0.717	.	0.538
Q118	0.886	.	.	.	0.823
Q119	0.896	.	.	.	0.842
Q120	0.890	.	.	.	0.819
Q121	.	.	0.724	.	0.604

* = Variable/factor correlation

** = Amount of variation of question explained jointly by the retained factors

TABLE 10

"Your headaches...:

		Factor loading
Factor 1:		
Q120:	...occur during periods of worry.	0.898
Q118:	...occur during periods of emotional stress.	0.890
Q119:	...occur during periods of tension.	0.886
Factor 2:		
Q111:	...are associated with your usual job at work.	0.826
Q113:	...first occur within the second four hours of work.	0.739
Q112:	...first occur within the first four hours of work.	0.717
Q110:	...occur upon awakening, but do not actually awaken you from sleep.	0.358
Q114:	...occur off the job.	-0.308
Factor 3:		
Q121:	...occur with changes in the weather.	0.724
Q117:	...are due to an allergy.	0.717
Q109:	...awaken you from sleep.	0.540
Q110:	...occur upon awakening, but do not actually awaken you from sleep.	0.529
Factor 4:		
Q116:	...occur hours after work.	0.785
Q114:	...occur off the job.	0.704
Q115:	...occur soon after work.	0.616
Q109:	...awaken you from sleep.	0.273
Q110:	...occur on awakening.	0.251

TABLE 11

FACTOR LOADINGS*, QUESTIONS 122-167

	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Factor 11
Q122	.	.	.	0.336	.	0.524	.
Q123	0.276	.	.	0.360	.	.	.
Q124	.	.	.	.	.	0.291	.
Q125	.	.	.	.	.	.	.
Q126	.	.	.	.	.	0.517	.
Q127	.	.	.	.	.	.	.
Q128	.	.	.	.	.	0.713	.
Q129	.	0.296	.	.	.	0.345	.
Q130	.	.	.	.	.	.	.
Q131	.	0.316	0.305	.	.	0.336	.
Q132	.	.	.	.	.	0.442	.
Q133	.	.	.	.	.	.	.
Q134	.	.	.	.	.	.	.
Q135	.	.	.	.	.	.	0.362
Q136	.	.	.	.	.	.	0.269
Q137	.	0.367	.	.	.	.	.
Q138	.	.	.	.	.	.	.
Q139	.	0.260	.	.	.	.	0.846
Q140	.	0.249	.	.	.	.	0.837
Q141	.	0.701	.	.	.	.	0.304
Q142	.	0.774	.	.	.	.	0.262
Q143	.	0.553	.	.	.	.	.
Q144	.	0.758	.	.	.	.	.
Q145	.	.	0.751	.	.	.	.
Q146	.	.	0.828	.	.	.	.
Q147	0.437	0.284	.	0.348	.	.	.
Q148	0.463	.	0.402	.	.	.	.
Q149	0.824	.	.	.	.	.	.
Q150	0.826	.	.	.	.	.	.
Q151	.	.	0.804	.	.	.	.
Q152	.	.	0.790	.	.	.	.

-Continued-

TABLE 11 (continued)

	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Factor 11
Q153	0.364	0.349	.	0.355	.	.	.
Q154	0.415	.	0.308	.	.	.	.
Q155	0.784	.	.	.	.	.	.
Q156	0.820	.	.	.	.	.	.
Q157	.	.	.	.	.	.	.
Q158	.	.	.	0.489	.	0.263	.
Q159	.	.	.	0.753	.	.	.
Q160	.	.	.	.	.	0.274	.
Q161	.	.	0.251	0.329	.	.	.
Q162	.	.	.	0.791	.	.	.
Q163	.	.	.	0.754	.	.	.
Q164	.	0.286	0.501	.	.	.	.
Q165	.	.	.	.	0.767	.	.
Q166	0.257	.	0.288	.	0.812	.	.
Q167	.	.	0.279	.	0.775	.	.

* = Variable/factor correlation

** = Amount of variation of question explained jointly by the retained factors

-(continued)-

TABLE 11 (continued)

	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16	Factor 17	Sum of communalities for 13 factors
Q122	.	.	.	.	.	.	0.584
Q123	.	.	-0.397	.	.	.	0.595
Q124	.	.	.	.	0.564	.	0.575
Q125	.	.	.	.	0.704	.	0.642
Q126	.	.	0.391	.	.	.	0.626
Q127	.	0.814	.	.	.	.	0.714
Q128	.	.	.	.	.	.	0.626
Q129	0.547	.	.	.	.	.	0.661
Q130	0.688	.	.	.	.	.	0.647
Q131	.	.	.	.	.	.	0.549
Q132	.	.	.	0.490	.	.	0.623
Q133	.	.	.	0.799	.	.	0.783
Q134	.	.	.	0.759	.	.	0.741
Q135	0.463	.	.	.	.	.	0.476
Q136	0.499	.	.	0.361	.	.	0.711
Q137	.	.	-0.285	.	0.321	.	0.497
Q138	.	.	.	0.309	0.371	0.316	0.538
Q139	.	.	.	.	.	.	0.846
Q140	.	.	.	.	.	.	0.816
Q141	.	.	.	.	.	.	0.671
Q142	.	.	.	.	.	.	0.763
Q143	0.419	.	.	.	.	.	0.666
Q144	.	.	.	.	.	.	0.667
Q145	.	.	.	.	.	.	0.712
Q146	.	.	.	.	.	.	0.784
Q147	.	.	0.451	.	.	0.321	0.782
Q148	.	.	0.575	.	.	.	0.790
Q149	.	.	.	.	.	.	0.804
Q150	.	.	.	.	.	.	0.756
Q151	.	.	.	.	.	.	0.768
Q152	.	.	.	.	.	.	0.759

-Continued-

TABLE 11 (continued)

	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16	Factor 17	Sum of communalities for 13 factors
Q153	.	.	0.449	.	.	0.279	0.740
Q154	.	.	0.630	.	.	.	0.764
Q155	.	.	.	.	.	.	0.753
Q156	.	.	.	.	.	.	0.792
Q157	.	0.747	.	.	.	.	0.705
Q158	.	.	.	.	.	.	0.611
Q159	.	.	.	.	.	.	0.689
Q160	.	.	.	.	.	0.553	0.575
Q161	.	.	.	.	.	0.672	0.718
Q162	.	.	.	.	.	.	0.695
Q163	.	.	.	.	.	.	0.728
Q164	.	.	.	.	.	0.336	0.557
Q165	.	.	.	.	.	.	0.766
Q166	.	.	.	.	.	.	0.845
Q167	.	.	.	.	.	.	0.773

* = Variable/factor correlation

** = Amount of variation of question explained jointly by the retained factors

TABLE 12

"Your headaches..."

Factor 5:		Factor loading
Q150:	...are preceded by flashing bright lights in your field of vision.	0.826
Q149:	...are preceded by spots in your field of vision.	0.824
Q156:	...are accompanied by flashing bright lights in your field of vision.	0.820
Q155:	...are accompanied by spots in your field of vision.	0.784
Q148:	...are preceded by double vision.	0.463
Q147:	...are preceded by blurry vision.	0.437
Q154:	...are accompanied by double vision.	0.415
Q153:	...are accompanied by blurry vision.	0.364
Q123:	...are located around your forehead.	0.276
Q166:	...are accompanied by weakness of one or both arms	0.257
Factor 6:		
Q142:	...are made worse by bright light	0.774
Q144:	...are made worse by use of your eyes to do close work	0.758
Q141:	...are made worse by noise.	0.701
Q143:	...are made worse by poor light.	0.553
Q137:	...are a throbbing sensation.	0.367
Q153:	...are accompanied by blurry vision.	0.349
Q131:	...are deep-seated.	0.316
Q129:	...generally begin on one side of your head, but progress to involve both sides.	0.296
Q164:	...are accompanied by loss of appetite.	0.286
Q147:	...are preceded by blurry vision.	0.284
Q139:	...are made worse by coughing.	0.260
Q140:	...are made worse by sneezing.	0.249
Factor 7:		
Q146:	...are preceded by vomiting.	0.828
Q151:	...are accompanied by nausea.	0.804
Q152:	...are accompanied by vomiting.	0.790
Q145:	...are preceded by nausea.	0.751
Q164:	...are accompanied by loss of appetite.	0.501
Q148:	...are preceded by double vision.	0.401
Q131:	...are deep-seated.	0.305
Q154:	...are accompanied by double vision.	0.308
Q166:	...are accompanied by weakness of one or both arms.	0.288
Q167:	...are accompanied by weakness of one or both legs.	0.279
Q161:	...are accompanied by sweating.	0.251

(Continued)

TABLE 12 (continued)

Factor 8:		Factor loading
Q162:	...are accompanied by itching eyes.	0.791
Q163:	...are accompanied by burning eyes.	0.754
Q159:	...are accompanied by watery eyes.	0.753
Q158:	...are accompanied by nasal discharge.	0.489
Q123:	...are located around your forehead.	0.360
Q153:	...are accompanied by blurry vision.	0.355
Q147:	...are preceded by blurry vision	0.348
Q122:	...are located around your eyes.	0.336
Q161:	...are accompanied by sweating.	0.329
Factor 9:		
Q166:	...are accompanied by weakness of one or both arms.	0.812
Q167:	...are accompanied by weakness of one or both legs.	0.775
Q165:	...are accompanied by disturbances of sensation in your arms or legs.	0.766
Factor 10:		
Q128:	...are generally on one side of your head.	0.713
Q122:	...are located around your eyes.	0.524
Q126:	...are located around your lower face.	0.517
Q132:	...feel like a pressure sensation.	0.442
Q131:	...are deep-seated.	0.366
Q129:	...generally begin on one side of your head, but progress to involve both sides.	0.345
Q124:	...are located around your temples.	0.291
Q160:	...are accompanied by flushing of your skin.	0.275
Q158:	...are accompanied by nasal discharge.	0.263
Factor 11:		
Q139:	...are made worse by coughing.	0.846
Q140:	...are made worse by sneezing.	0.837
Q135:	...are a dull feeling.	0.362
Q141:	...are made worse by noise.	0.304
Q136:	...are a boring sensation.	0.269
Q142:	...are made worse by bright light.	0.262
Factor 12:		
Q130:	...are located superficially.	0.688
Q129:	...generally begin on one side of your head, but progress to involve both sides.	0.547
Q136:	...are a boring sensation.	0.499
Q135:	...are a dull feeling.	0.463
Q143:	...are made worse by poor light.	0.419

(continued)

TABLE 12 (continued)

Factor 13:		Factor loading
Q127:	...radiate into your shoulders.	0.814
Q157:	...are accompanied by muscle tenseness.	0.747
Factor 14:		
Q154:	...are accompanied by double vision.	0.630
Q148:	...are preceded by double vision.	0.575
Q147:	...are preceded by blurry vision.	0.451
Q153:	...are accompanied by blurry vision.	0.449
Q126:	...are located around your lower face.	0.391
Q137:	...are a throbbing sensation.	-0.285
Q123:	...are located around your forehead.	-0.397
Factor 15:		
Q133:	...feel like a tight band.	0.799
Q134:	...feel like a constriction.	0.759
Q132:	...feel like a pressure sensation.	0.490
Q136:	...are a boring sensation.	0.361
Q138:	...are a shooting pain.	0.309
Factor 16:		
Q125:	...are located around the top of your head.	0.704
Q124:	...are located around your temples.	0.564
Q138:	...are a shooting pain.	0.371
Q137:	...are a throbbing sensation.	0.321
Factor 17:		
Q161:	...are accompanied by sweating.	0.672
Q160:	...are accompanied by flushing of your skin.	0.553
Q164:	...are accompanied by loss of appetite.	0.336
Q138:	...are a shooting pain.	0.321
Q147:	...are preceded by blurry vision.	0.279
Q153:	...are accompanied by blurry vision.	0.271