Vision saver: The evaluation of a software tool designed to relieve computer related eyestrain by prompting frequent rest breaks

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Vision saver: The evaluation of a software tool designed to relieve computer related eyestrain by prompting frequent rest breaks

Abstract
As computer use has skyrocketed, visual symptoms related to their use have surfaced. These have been given the name Computer Vision Syndrome (CVS). We postulated that frequent short breaks would reduce the frequency and severity of these symptoms. To investigate the effects of frequent short breaks on CVS, heavy computer users were recruited to participate in this study. Participants completed an initial survey, then used a special computer program to enforce frequent short breaks, and completed a second survey at the end of two weeks of use. The use of the program was then discontinued for two weeks and a third survey was completed. The data were then analyzed to assess the predicted reduction in CVS symptoms. Although the small numbers in the study prevented drawing a definite conclusion regarding any individual symptom, a statistically significant reduction in the overall symptom index was shown. The discussion concludes that although there are some preliminary indications that frequent short breaks may lead to reduction in CVS symptoms, further study with control groups and larger sample sizes is necessary to more accurately assess this hypothesis.

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VISION SAVER:
THE EVALUATION OF A SOFTWARE TOOL DESIGNED TO
RELIEVE COMPUTER RELATED EYESTRAIN BY PROMPTING
FREQUENT REST BREAKS

By

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MARLA MOORE, B.S.

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May 2001

Advisor:

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Clare Midson, B.A.

Marla Moore, B.S.

Bradley Coffey, O.D., FAAO
BIOGRAPHIES

Clare Midson was born in Guildford, England in 1969. After spending one year in Montreal, Canada, she moved to Oregon in 1976 and remained in the Portland area. Clare attended Beaverton High School where she was active in cross country, drama, track and German club. She attended the Robert D. Clark Honors College at the University of Oregon in Eugene and graduated in 1992 with both a biology degree and a German degree and a chemistry minor. At U of O, a chance to study overseas in Tübingen, Germany and activities in dorm leadership and German club kept her busy. She received an award for her B.A. thesis entitled, “The Construction of a Genetic Map of the Zebrafish Genome using the R.A.P.D. Method”. Clare spent five years engaged in molecular biology research before continuing her career in optometry and plans to practice in the Portland or Eugene areas in the future.

Marla Moore was born in Fallon, Nevada in 1973. She graduated from Churchill County High School in 1991 where she participated in the Honor Society, Cheerleading, Spanish Club and Jazz Dance. Marla went on to pursue a Bachelor of Science degree with a pre-optometry option from the University of Nevada, Reno and graduated in 1995. She then worked for two years as an Ophthalmology technician to gain hands on training and knowledge before embarking upon her career in Optometry. She is currently planning her wedding in Hawaii on December 31, 2000. After graduation from Pacific University College of Optometry in May 2001, Marla and her husband Larry, will begin building an Optometry/Ophthalmology practice in Reno, Nevada.
ABSTRACT

As computer use has skyrocketed, visual symptoms related to their use have surfaced. These have been given the name Computer Vision Syndrome (CVS). We postulated that frequent short breaks would reduce the frequency and severity of these symptoms. To investigate the effects of frequent short breaks on CVS, heavy computer users were recruited to participate in this study. Participants completed an initial survey, then used a special computer program to enforce frequent short breaks, and completed a second survey at the end of two weeks of use. The use of the program was then discontinued for two weeks and a third survey was completed. The data were then analyzed to assess the predicted reduction in CVS symptoms. Although the small numbers in the study prevented drawing a definite conclusion regarding any individual symptom, a statistically significant reduction in the overall symptom index was shown. The discussion concludes that although there are some preliminary indications that frequent short breaks may lead to reduction in CVS symptoms, further study with control groups and larger sample sizes is necessary to more accurately assess this hypothesis.
ACKNOWLEDGEMENTS

We would like to acknowledge the sincere interest and guidance of Bradley Coffey, O.D. in preparation of this thesis. His knowledge of statistics and critical editing skills were indispensable. We also would like to offer an earnest thank you to Alan LeRoy, O.D. who set up the web based questionnaire format and data storage design for us. In addition, Robert Yolton, O.D., Scott Brase and Brian Molitor deserve kudos for help in accessing that data. The College of Optometry has also earned our praise for allowing us to utilize its website. Lastly, we wish to acknowledge Mark Hutchinson for his excellent programming skills and for the creation of the Vision Saver program.
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INTRODUCTION

The new millennium has seen an onslaught of computer technology expansion. Nearly every aspect of our lives is in some way related to computers. Computers are used extensively in the workplace to send and retrieve data. As more and more information is shared and expanded upon through the Internet or World Wide Web, people are becoming globally connected. Knowledge and quick communication is available at the stroke of the keyboard. We may spend hours on a computer at work or at school only to return home and “surf the web” as part of our leisure activities. The computer technological age has taken us on a great journey, giving us many advantages and opportunities. Some would say it has made the world faster, more efficient and more productive. It is true that computers can solve many complex and complicated problems, however, their use may in fact create some non-user friendly symptoms, specifically of visual and musculoskeletal discomfort.

Anyone who has used a computer can attest to the time lapse that is often experienced while on the computer. We become so intrigued with the activity we are observing and participating in while on the computer that we are unaware of the amount of time that has gone by. Most computer users are also unaware that their blink rate is significantly reduced when working at the computer (Sheedy, JE). A decrease in blink rate may be only one of several predisposing factors that lead to symptoms commonly reported by VDT (Visual Display Terminal) users. The symptoms related to decreased blink rate include eye irritation (red, watery, sore or dry) and eye fatigue (tired, achy or heavy eyelids) (Hunt, L) and are only aggravated by long hours in front of the computer.

Vision is the sole means by which most computer users obtain information to perform their work (Sheedy JE). The literature estimates that nearly 10 million Americans suffer from Computer Vision Syndrome (CVS) (Von Stroh). As computers continue to be integrated into our everyday lives, the number of people who experience CVS will be on the rise. According to James Sheedy O.D., Ph.D., anyone using a computer regularly for
two hours or more a day is at risk for CVS. CVS is a blanket term used to describe the symptoms most often experienced by Visual Display Terminal (VDT) users.

Visual symptoms result whenever the visual demands of the task exceed the individual’s visual abilities (Von Stroh). A laundry list of symptoms have been reported by computer users including: eye strain, headaches, blurred vision, double vision, ocular irritation, burning eyes, after images, frontal and occipital headaches, and ocular fatigue, (Sheedy, Parsons)(Smith, AB et. al.). Previous research has suggested that the two most commonly reported symptoms were eyestrain at 80% and headaches at 50% with blur at near, blur at far and neck/shoulder pain also high on the list (Salibello C)(Sheedy, JE). Gender differences also exist in relationship to the symptoms reported with VDT use. Females are more likely to report headaches (Salibello, C). Most VDT users report symptoms as occurring on a daily basis (Sheedy, JE). Rey and Meyer found symptom complaints to be functions of age, task (VDT versus non-VDT use), and duration of work, and they concluded that the increase in symptom complaints among VDT operators was not due to excess eye defects (Smith et al).

The causative factors for symptoms experienced by computer users are speculated to range from decreased blink rate (as mentioned above), discomfort glare, excess reflections, poor character resolution, accommodative and binocular vision disorders, spectacle design problems, and uncorrected or undercorrected refractive errors (Sheedy, Parsons) (Sheedy). Discomfort glare may be caused by disturbing reflections on the screen or by contrast glare (Ward). Von Stroh’s research concluded that 63% of VDT user symptoms were caused by visual disorders while 37% were due to environmental factors. Electrostatic charge on the screen has even been suspected as causing some common health complaints of VDT operators (Wedberg).

It has been postulated that inadequate vision correction not only causes some visual symptoms expressed by VDT users but is also implicated in musculoskeletal stresses of the neck and shoulders secondary to improper positioning and use of the keyboard as compensation. (Dickerson). From these data we might hypothesize that a significant
correlation exists between refractive error and the incidence of symptoms however; this was not found to be true in a report by Daum.

In one research study by Mourant et. al., observation of subjects’ blink rate, outfocus time, and infocus time for the CRT (cathode ray tube display terminal) concluded that even those individuals with little or no refractive error were symptomatic. The contrast and texture of characters on the computer screen is different from those on hard copy. Dark characters on a light background were found to be more fatiguing than reading from the printed page (Daum et. al.). A survey by Von Stroh, reported that of 1,307 Optometrists surveyed, a majority of them (55.3%) indicated that their VDT patients have symptoms that are different than those experienced by patients with other nearpoint activities (anyone working intensively with their eyes). Most of the symptoms found when comparing VDT use to hard copy differed in respect to lighting, reflection and glare.

People performing VDT work who already have compromised accommodative systems (discovered upon visual examination) experience symptoms sooner and are usually the first to seek care for such symptoms as compared to those individuals working with hard copy text (Von Stroh). A similar study noted that work at the VDT is particularly demanding upon the accommodative mechanism, therefore individuals with pre-existing accommodative disorders experience symptoms and seek eye care earlier than their hard copy counterparts (Sheedy, JE).

It is widely known and accepted among the optometric community that visual and musculoskeletal symptoms related to VDT use exist. Although vision and eye problems are more frequent, much of the public and professional attention has been directed toward musculoskeletal disorders (Sheedy JE). Methods for alleviating visual problems at computers are largely known, and it is not difficult to design eye care programs to specifically meet the special needs of computer users (Sheedy, JE). In order to assist their VDT patients in alleviating or eliminating these VDT symptoms, eye care providers suggest many different treatment approaches.
Ergonomic solutions may include appropriate workstation arrangements, reduction of glare through the use of anti-glare filters, or the prescription of special occupational eyewear or vision therapy to enhance visual abilities at the computer (Miller, SC). The screen should be positioned relative to windows, overhead lights, and other glare sources to minimize these reflections (Dickerson et al). Also, the American Optometric Association has issued a list of recommended components for an eye examination for computer operators as well as ergonomic and visual recommendations to alleviate symptoms (Sheedy, JE) (Hunt, L).

Other proposed solutions have been VDT glasses, progressive lenses, AR coatings, and artificial tears. Wallin et al, concluded that VDT-related symptoms were reduced through the use of task specific computer glasses (Salibello, et al). Another option that Dr. Stuart Lazarus suggests is the use of yoked base-up and base-in prism for reducing eyestrain at the computer. Both ergonomic intervention and eye care are needed for optimal comfort in the VDT worker population (Sheedy, JE). Eye care providers can elicit symptoms experienced by VDT users and address the issue of prevention through careful vocational and avocational questioning. They can then provide the necessary evaluation, diagnosis, treatment, and management services to help patients more effectively and comfortably work in today’s technological age (Miller SC).

It is unclear in the current research whether frequent rest periods are seldom helpful in reducing visual symptoms among VDT users. It is generally assumed that visual display unit (VDU) operators are unwilling and/or incapable of taking short breaks on a regular basis (Henning et al). Many tasks demand intense concentration and do not lend themselves to disturbances. However; Swanson and Sauter suggest that breaks should be an enforced routine because when employees self regulate breaks, they work beyond the time of symptom onset and shorten the break before recovery is complete. Business productivity may suffer when an employee experiences visual problems stemming from work with the computer. (Sheedy JE)
Many authors suggest rest breaks for users that include exercises in order to reduce or eliminate both visual and musculoskeletal symptoms (Swanson, NG et. al.). All computer users should take periodic “vision breaks” to let the eyes rest for five to ten minutes after every two hours of continuous computer use. Employees should be encouraged to get up, move around and let their eyes relax by focusing on objects at least 20 feet away (Von Stroh R). However, limited research has been done in this area to verify if rest breaks do indeed relieve or eliminate visual complaints related to VDT use and what sort of break schedule and length of break would be useful. In addition, there is a lack of information regarding implementation of rest breaks into practical use.

In order to understand the benefit of rest breaks and determine what effect these breaks have on common CVS symptoms, we created and tested a “vision break” reminder program for VDT users to evaluate. We probed their subjective experience with CVS symptoms before, during and after using this program. We hypothesized that symptomatology would initially decrease after initiating the reminder program and then be seen to return with its discontinuance. From this information, we wished to create a useful and practical tool for the reduction of CVS in the workplace.
METHODS

Subjects

Individuals who worked at least four hours per day with PCs running Windows 95, NT or 98 for were solicited for this study. This amount of computer use has a measurable fatigue impact on vision (Mourant et. al.), making a person likely to experience symptoms. Email and flyer requests describing the study were sent out to students and staff at Pacific University as well as employees of software companies such as Intel, Wellsource and Oracle. For this study no requirement was made regarding participant occupation, although we were targeting groups that did intensive work on the computer. Email recipients were asked to forward the project information on to additional likely candidates. Students and professors associated with optometry were excluded from the study due to their prior knowledge of visual symptoms associated with computer use. The researchers of the study and the creator of the Vision Saver program were also excluded.

Forty-six individuals were originally recruited for the study, however only 20 completed the trial. Respondents to all three surveys ranged in age from 19-50 years of age and included 9 males and 11 females. Of these, 11 held a job in the computer industry as a software engineer or web manager. The other nine held positions in administration, research or legal professions. The average number of hours each individual typically spent on the computer each day was 6.7 hours, with 90% working more than half of the day in front of the computer. Most participants were not continuously on the computer for the duration of 6.7 hours. Computer time was shared with various activities such as viewing a hard copy paper or text. All of the participants used a computer at work and 90% also used a computer at home. An additional 10% worked with computers at school. Most judged their work as being fairly demanding. On a scale from 0 (easy) to 4 (most difficult), 80% rated themselves as 3's or 4's. Fourteen participants had received a full eye exam in the last two years and of those, 5 wore a special prescription solely for
computer use. In addition, 90% of participants had experienced eyestrain before hearing of this project.

Procedure

Interested participants were encouraged to access the project via the world wide web. The questionnaires and the Vision Saver program were located on a separate web page at the Pacific University College of Optometry web site. Subjects were given a direct address (http://www.opt.pacificu.edu:591) or located the page via the general PUCO web site (http://www.opt.pacificu.edu). Another alternative for interested parties was available at a personal web page (http://www.teleport.com/~hutchma/VS).

At the Vision Saver site, participants read a description of the project and a disclosure statement (appendix 1). At this point, subjects could quit and decline participation in the study or continue to a page containing the first questionnaire (appendix 2). Subjects registered by entering a name and email address. This information was used by the researchers only as a way to track of participants. The questionnaire consisted of 20 items inquiring information about demographics, computer usage, rest break habits, common computer ergonomic measurements and a list of commonly experienced visual and musculoskeletal symptoms derived from previous research (Ruskin et. al.)(Sheedy, JE) relating to computer use. Computer ergonomic measurements and questions were common to each of the study's 3 questionnaires in an attempt to rule out any relief of visual symptoms noted by the subjects due to a change in computer ergonomics. The visual symptom list was essential to the analysis of the Vision Saver program's effect on visual comfort. Each symptom was rated on a five point scale of severity from 0 (never experienced / mild) to 4 (often experienced / severe). Results could then be analyzed non-parametrically.

We created the questionnaires based on a template provided by Drs. Dennis Ruskin, Brian Feidman, and Martin Thomas from their previous study of a computer based rest break reminder (Feidman) and from a survey conducted by Smith, Tanaka and Halperin
querying the specifics of Computer Vision Syndrome (Smith). Additional questions were added specifically directed to the Vision Saver program.

The data from all three questionnaires were stored in a File Maker Pro database on the optometry server. Data were tracked by subject's email address. This identification was deleted once all data were collected. Subjects were then referred to by number in order to protect their anonymity.

After completion of the first survey, interested participants were asked to download the Vision Saver program (described in the following section) and instructions for installing the program were provided (appendix 3). This version was a trial. Participants were to use this Vision Saver version within their normal work environment for 2 weeks at which time the program would expire. A visual prompt (a blacked out screen and countdown timer) cued both the breaks and break intervals. Participants were instructed to look away into the distance for 20 seconds every 20 minutes in order to relax their accommodation and vergence systems when prompted. The escape key would override the prompts but participants were discouraged from using that program feature.

When Vision Saver ceased to appear at the end of two weeks, the subject was prompted to return to the website to complete questionnaire number two (appendix 4). It contained 11 questions that revisited the visual and musculoskeletal symptom list and again asked the participant to rate each symptom on the five point scale listed above. Musculoskeletal symptoms were expected to remain unchanged while visual symptoms declined. Subjective comments on eyestrain symptoms were encouraged on this questionnaire and suggestions on how to improve the program were also solicited. Some questions were repeated from the first survey to serve as an internal consistency control. New questions were added which probed the compliance of the subject to the correct use of the Vision Saver program.

When two weeks had elapsed, with subjects continuing to use their computer as usual without Vision Saver, a third questionnaire (appendix 5) was administered on the web
site. This questionnaire consisted of eight questions very similar to the second survey. We hypothesized that after 2 weeks without the Vision Saver prompt for rest breaks, the participants' visual symptoms would return. Internal consistency questions were again repeated.

At the completion of questionnaire three, the subject was given the opportunity to download a fully functional, non-expiring version of Vision Saver if he/she so desired.

The Program

The 300+ line program was written in Delphi 4 Professional by Mark Hutchinson in October 1998. The program is 365K and is designed to work on Windows platforms. Vision Saver is installed into the "Start Up" folder of the "Programs" folder which is inside the "Start Menu" folder of the operating system. Vision Saver thus starts up automatically with computer start up and is always running. An icon for Vision Saver also appears in the system tray.

During normal computing, Vision Saver prompts the user to take a visual rest break. It does this by blanking out the screen and displaying a countdown timer from a previously chosen number of seconds at a previously chosen interval. After the countdown, the previous screen is restored unharmed and unaltered. If the subject is working on time sensitive material, the Vision Saver prompt can be overridden by pressing the escape key.

Several improvements were made to the program which allowed it to be used in this study. A special version was created for the study which expired in two weeks from the time of installation onto any PC. This version also did not have adjustable intervals between rest break prompts nor did it have adjustable rest break times. The study version was set at 20 second breaks every 20 minutes of real time at the request of the researchers. It did not matter whether the computer was in use or not; every 20 minutes, Vision Saver prompts a break.
The design and set up of the web site administration of these surveys was performed by Alan Leroy, O.D. The Pacific University College of Optometry web site was used to house the program, instructions and questionnaires. A File Maker Pro database was created to house the individual data from the questionnaires and to identify participants as they returned to the website to answer each questionnaire. The design required the first questionnaire to be filled out before the Vision Saver program could be downloaded. Thus, the next time a participant visited the web site, they were identified by the database and given an option to fill out the appropriate questionnaire, either two or three.

The researchers kept track of when each participant was due to complete a questionnaire and e-mail reminders were sent within a few days to those individuals due to complete a 2nd or 3rd survey. Several pitfalls were encountered by administering a survey via the web. First, participants were difficult to motivate in the completion of the 2nd and 3rd survey. Some participants were lost due to downloading and installation problems. Others were discouraged due to downtime experienced by the server and a mysterious password query preventing access to our website. Some larger companies had very conservative firewall protection policies in place which did not allow eager participants to download from our site. In order to bypass some of these problems, the Vision Saver program was put onto an alternate website (see above) and questionnaires were emailed to the participants. The responses were then typed into the database by hand.
RESULTS

We were mainly interested in studying the effects of computer eyestrain on individuals who worked strenuously on the computer for most of the day. Before the trial, the average amount of time spent on the computer was 6.7 hours per day with a low of 3.4 hours and a high of 10 hours (N=20). Most participants (89%) reported working on the computer for more than half of the day. These individuals were all eligible for the study. This information was useful in dividing the questionnaire data into high and low computer usage groups. During the trial period, after questionnaire number two was administered, we found the average hours of computer usage to be 5.7 hours per day (low: 3, high: 10, N=18). Unfortunately, this small difference in usage was found to be significant (p < 0.05) when evaluating the data with a t-test. Our participants were reporting less hours at the computer during the two week usage of the Vision Saver program. This knowledge weakens, yet does not negate the rest of the findings when comparing questionnaire one data to questionnaire two.

Our hypothesis depends on the assumption that eyestrain occurs when insufficient breaks are inserted into the day. We surveyed the participants as to their work habits. An average of 5 short work breaks (shorter than 5 minutes) and 5 longer work breaks (longer than 5 minutes) were taken per subject per day before we started the trial. The most common time interval between taking breaks away from the computer terminal was between 41 and 60 minutes of continuous use. Only one participant noted taking no breaks throughout the day. These values were useful in analyzing the data according to short and long break habits.

We wished to rule out inadequate computer setup as a reason for increased overall eyestrain. Viewing distances from nose to screen averaged 22 inches (high: 41 in., low: 12 in.). The recommended optimal visual zone reported by Dickerson et. al. is 32-45.9 inches while viewing a microfiche viewer. This type of viewing usually has even smaller characters than a typical computer screen. It is stressed that computer viewing should be
at a distance slightly greater than that used for reading printed text. Participants outside of this optimal range of VDT viewing may experience more eyestrain. It is suggested that the screen not be placed too high because this can result in neck aches, backaches and dry irritated eyes due to decreased blinking (the current recommendation is 10-20 degrees down gaze) (Sheedy, JE). Most of our participants viewed their computers with eyes positioned correctly (even with the top of the screen, 20%, or above the center of the screen, 35%); both of these situations created a downward gaze while viewing the screen. Others were positioned incorrectly with their eyes aiming at the center of the screen (40%) or slightly below the center (5%), resulting in upward gaze viewing. When we evaluated this variable against the subjective symptom index (see below) reported by each participant, no difference was found between those with relatively high versus relatively low monitor viewing heights. Both groups reported the same degree of eyestrain symptoms.

All in all, the participants accepted the program very well initially. Of the participants surveyed 13 (65%) said they would like to continue the use of the program in the future. This interest dropped to 44% after the 3rd questionnaire had been administered and the memory of using the program had waned. 70% of participants found the program to be an interruption to their work. This seemed to cause some lack of use. Overall, compliance with the program was good during the 2-week trial period and 65% of participants reported that they followed instructions and looked away (20 feet into the distance) when prompted at least three quarters of the time. Some (10%) were noncompliant and looked away from the screen less than a quarter of the time. The program is equipped with an override capability. Most participants avoided using this feature the majority of the time. The override feature was used by 60% of the subjects less than one quarter of the time while 20% were noncompliant and used the override more than three quarters of the time.

We were seeking information regarding the type of visual and musculoskeletal symptoms experienced by the participants before, during and after the trial period. We asked each participant to identify symptoms from a list (see below). In a separate question, we asked
each participant to subjectively note the worst, or most bothersome, symptom he/she had experienced from that list of symptoms. The worst symptoms experienced before starting the trial were reported to be neck ache (20% of respondents), headache (15% of respondents) and dry eyes (15% of respondents). After 2 weeks of using Vision Saver, headache (15% of respondents), neck ache (15% of respondents) and tired eyes (15% of respondents) were reported as the worst symptoms. At 2 weeks after the end of the Vision Saver trial, tired eyes (25% of respondents) appeared to be the worst symptom, followed by neck ache (20% of respondents) and dry eyes (15% of respondents).

The specific symptom data for all three questionnaires were analyzed in more depth using Stat View statistical software. These data were collected on a five point scale as values reported from 0 (representing no symptoms experienced by the subject) to 4 (representing symptoms often noticed by the subject and/or interfering with work on the computer). The sum of all ratings reported per symptom for each of the three questionnaires was tabulated (Table 1). This provides an idea of which symptoms were most bothersome to the participants in general and includes both the incidence and the severity of the reported symptoms. Note that tired eyes, eye strain, neck ache, dry eye, slow refocusing and headache are rated the most, which is consistent with the subjective account of the worst symptoms as explained above.

Since these are non-parametric data, we tested each symptom for a significant change over the three time intervals with the Friedman test. The p-values shown are corrected for ties occurring in the data. We expected to find a significant decrease in symptoms experienced by the whole group between the pre- and post-treatment with the Vision Saver program. We also expected to see a return of these symptoms for the whole group as the subjects ceased using the Vision Saver program. The symptoms showing the strongest effect over the treatment period were headache, wrist pain, gritty/sandy eyes and difficulty with comprehension (Table 1). Significant findings are highlighted in bold text, meaning a difference in intensity of symptoms is found between questionnaires.
Table 1: Friedman analysis: symptom specific trends including all 3 questionnaires.

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<tr>
<td>Blurry vision at the computer</td>
<td>p &lt; 0.0798</td>
<td>18</td>
<td>11</td>
<td>13</td>
<td>42</td>
</tr>
<tr>
<td>Blur in the distance</td>
<td>p &lt; 0.1846</td>
<td>18</td>
<td>7</td>
<td>14</td>
<td>39</td>
</tr>
<tr>
<td>Eye pain</td>
<td>p &lt; 0.7891</td>
<td>13</td>
<td>10</td>
<td>11</td>
<td>34</td>
</tr>
<tr>
<td>Wrist pain</td>
<td>p &lt; 0.0346</td>
<td>16</td>
<td>5</td>
<td>10</td>
<td>31</td>
</tr>
<tr>
<td>Glare sensation</td>
<td>p &lt; 0.1750</td>
<td>13</td>
<td>6</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td>Itchy eyes</td>
<td>p &lt; 0.4464</td>
<td>13</td>
<td>7</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>Watery eyes</td>
<td>p &lt; 0.1409</td>
<td>14</td>
<td>5</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>Gritty/sandy eyes</td>
<td>p &lt; 0.0434</td>
<td>11</td>
<td>3</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Flicker sensation</td>
<td>p &lt; 0.2122</td>
<td>10</td>
<td>4</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Finger pain</td>
<td>p &lt; 0.5538</td>
<td>9</td>
<td>5</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Difficulty with comprehension</td>
<td>p &lt; 0.0439</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Double vision</td>
<td>p &lt; 0.1561</td>
<td>8</td>
<td>1</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Observing jumping letters/text</td>
<td>p &lt; 0.0556</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Dizziness</td>
<td>p &lt; 0.0663</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>11</td>
</tr>
</tbody>
</table>

Only the most frequently occurring symptoms in Table 1 were seriously considered as measuring a true effect from the Vision Saver program (we chose the top 12). The rest of the symptoms were reported so infrequently as to question if meaningful conclusions could be drawn from so few non-zero data points (see column 6 in Table 1). The relevant variables were then further analyzed in Stat View using the Wilcoxon test. We were most curious about the magnitude of the reduction of symptoms between questionnaires one and two, before and immediately following use of the program. A significant
reduction of symptoms was noticed regarding dry eyes and tired eyes between the first and second questionnaires. Interestingly, there was no change in these symptoms between questionnaire two and three. The dry and tired eyes did not reoccur to the original intensity with the disuse of the Vision Saver program. These results are listed in Table 2. It is also of note that dry eyes and tired eyes do not show a significant difference with the Friedman analysis, yet they do with the pairwise Wilcoxon comparisons.

Table 2: Wilcoxon analysis: pairwise comparison of questionnaires.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Comparing Questionnaire 1 to 2</th>
<th>Comparing Questionnaire 2 to 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tired eyes</td>
<td>p &lt; 0.0128</td>
<td>p &lt; 0.1228</td>
</tr>
<tr>
<td>Dry eyes</td>
<td>p &lt; 0.0180</td>
<td>p &lt; 0.2180</td>
</tr>
<tr>
<td>Eye strain</td>
<td>p &lt; 0.0696</td>
<td>p &lt; 0.3924</td>
</tr>
<tr>
<td>Headache</td>
<td>p &lt; 0.0667</td>
<td>p &lt; 0.3590</td>
</tr>
<tr>
<td>Photophobia</td>
<td>p &lt; 0.1621</td>
<td>p &lt; 0.3591</td>
</tr>
<tr>
<td>Stinging</td>
<td>p &lt; .7389</td>
<td></td>
</tr>
<tr>
<td>Eye pain</td>
<td>p &lt; 0.0180</td>
<td>p &lt; 0.2180</td>
</tr>
</tbody>
</table>

We then divided the participants into two groups and analyzed each symptom accordingly. One group consisted of the heaviest computer users (more than 6 hours a day) and the other was less frequent users. We also evaluated the data based upon the number of short rest breaks each participant took per day (few vs. many). The same was done with long rest breaks. Data were also collected on the average amount of time each person worked without a break and the data pool was divided into relatively long versus short times between breaks. As mentioned above, groups were also divided by monitor viewing height (high or low), monitor viewing distance (closer or further than 20 inches to the screen), gender, and those individuals previously bothered by screen flicker and glare (yes or no). When analyzing these various groupings within each specific symptom we utilized the Mann-Whitney test. All comparisons were insignificant. Most likely, the groups were too small to reveal any potential effects.

Since we could not pinpoint any specific symptoms that were affected by use of Vision Saver, the data were analyzed in a more general manner. We were curious to know if there was a trend between the questionnaires when symptomatology at the computer was
analyzed as a whole. For each participant, we summarized all of the symptom ratings that they had provided into one value for each test period. This was simply the sum of all ratings for all 24 symptoms for each questionnaire. We call this value the symptom index (Table 3). When the symptom index score was analyzed with the Friedman statistic, a very significant effect was found in the symptom index of the participants over all three questionnaires \( p < 0.0003 \). To understand the nature of this effect, we summed the symptom index scores for all participants for each questionnaire. Participants responding to questionnaire one exhibit a total symptom index of 451, participants responding to questionnaire two exhibit a total symptom index of 280 and participants responding to questionnaire three exhibit a total symptom index of 370. The effect follows the expected relief of symptoms throughout the trial period, i.e. the participants experienced relief of their symptoms after using Vision Saver and describe a worsening of symptoms again after discontinuing use of the program.

Table 3: Number of all symptoms experienced by each subject (symptom index).

<table>
<thead>
<tr>
<th>Subject</th>
<th>Questionnaire 1</th>
<th>Questionnaire 2</th>
<th>Questionnaire 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>26</td>
<td>6</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>29</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>16</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>41</td>
<td>40</td>
<td>32</td>
</tr>
<tr>
<td>8</td>
<td>13</td>
<td>18</td>
<td>32</td>
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<tr>
<td>9</td>
<td>20</td>
<td>21</td>
<td>17</td>
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<tr>
<td>10</td>
<td>23</td>
<td>20</td>
<td>13</td>
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<tr>
<td>11</td>
<td>26</td>
<td>9</td>
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<tr>
<td>12</td>
<td>15</td>
<td>12</td>
<td>16</td>
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<tr>
<td>13</td>
<td>11</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>28</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>16</td>
<td>18</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>25</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>18</td>
<td>22</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>19</td>
<td>39</td>
<td>19</td>
<td>41</td>
</tr>
<tr>
<td>20</td>
<td>41</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td>451</td>
<td>280</td>
<td>370</td>
</tr>
</tbody>
</table>
Further investigation of the trend in symptom index was done with the Wilcoxon statistic. The total symptom index decreases significantly between questionnaires one and two (p < 0.0007). There is also a significant decrease in total symptom index noted between questionnaires one and three (p < 0.0042). However, it is interesting to note that the increase in total symptom index between questionnaire two and three is insignificant (p < 0.0903). We then tried to relate this effect to the type of computer user. Comparing subjects with high versus low hours of computer use, many versus few short breaks away from the computer, many versus few long breaks away from the computer and short versus long times in between those breaks, we found no significant difference between groups using the Mann-Whitney test.

Upon reexamination of these symptom index results in light of the significant drop in the number of hours spent in front of the computer pre and post test, we observe no significant correlations when comparing each symptom index (Q1, Q2, Q3) to each report of computer hours used (Q1, Q2) in a correlation matrix. Therefore, in our data there is not a significant relationship between hours in front of a computer and the amount of eyestrain reported. This adds support to the strength of the symptom data on its own. Above, we note a significant difference in hours of computer use before and after using Vision Saver program. This knowledge does not discount the very strong reduction in symptom index scores between questionnaire one and two.

In summary, there is a very significant decrease of overall eyestrain symptoms following the use of Vision Saver and an insignificant increase of these symptoms after Vision Saver is discontinued. No work habits or ergonomic factors can be identified that affect total overall symptom ratings. Subjective reports of the most bothersome symptoms match those that were reported most frequently and include headache, neck ache, dry eyes and tired eyes. Of these, dry and tired eye symptoms demonstrate a significant drop between questionnaire one and questionnaire two and may be used as an indicator that the Vision Saver Program provides some relief from symptoms experienced by computer users.
DISCUSSION

Studies indicate that between 70% and 75% of computer workers experience Computer Vision Syndrome (Ruskin et al). All computer users should take periodic “vision breaks” in order to reduce the adverse effects experienced with computer vision syndrome (Von Stroh, R). The question remains how long should these breaks be and how often should they occur? Von Stroh recommend letting the eyes rest for five to 10 minutes for every two hours of continuous computer use (Von Stroh, R). A more practical question is raised regarding the practicality of administering these rest breaks. This study has attempted to investigate many of these considerations with an automated reminder system administering 20 second breaks every 20 minutes.

Our statistical analysis between the first two surveys showed that on average the participants spent one hour less time on the computer per day while testing the Vision Saver program. This difference is statistically significant and the total symptom index score in questionnaire one is much greater than in the other questionnaires. However, when correlating hours of computer use to symptom index, no significant correlation is found. The overwhelming difference in symptom index before and after using Vision Saver is most likely explained by the increased number of breaks taken by the subjects when prompted.

The subjects’ break patterns remained consistent from the first to the third questionnaire. These data are reliable between questionnaires and the pattern of computer usage, meaning breaks and work periods, remained constant. The literature suggests that short rest breaks from computer work at 15-minute intervals throughout the work day improves worker productivity and well being (Henning et al). From the employees we surveyed it seems that the majority of them are only taking 1/2 to 1/3 of the breaks they should to prevent eyestrain symptoms by this standard. Dr. Kenneth Haik suggests that the rest time should be even longer and reports that within half an hour of resting the eyes, difficulty with focus usually ends.
We hypothesized that people who already took short breaks in their day would show supporting evidence for relief of symptoms. This was not the case. Vision Saver prompts a rest break much more frequently than most workers actually take one, unless frequently interrupted by phone calls or errands. Vision Saver requires a break every 20 minutes. Our participants were taking between zero and 15 breaks per day, which is at maximum one break every 30 minutes. Job requirements with computers are so varied that this was difficult to analyze and more investigation is needed into what consists of a "visual break".

In the Vision Saver study, subjects reported headache, wrist pain, gritty/sandy eyes, and difficulty with comprehension as their most common symptoms. Statistically reported worst symptoms in previous literature show only a slight variation. The most frequently occurring symptoms in ranked order, according to doctors polled are eyestrain, headaches, blurred vision, temporary myopia (nearsightedness), dry or irritated eyes, neck and backaches, photophobia (increased sensitivity to light), double vision and afterimages (Von Stroh, R). Branscum (as cited in Salibello et al) reported that a 1991 Harris poll identified eyestrain as the top office job-related complaint, affecting some 47 percent of the office workers questioned. Dry eyes can feel gritty, tired, and irritated, and raising the viewing position of the screen can result in more eye surface exposure, resulting in another cause for eye dryness and reduced blink rate (Dickerson et al).

Visual fatigue is not a well-defined physiologic or clinical entity, and just because one cannot measure visual fatigue does not mean it does not exist (Haik KG). Clearly, CVS is a significant and measurable problem. One survey of optometrists revealed that 14% of those patients who go for an eye exam (nearly 10 million annually) do so primarily because of problems related to VDTs (Von Stroh, R). Sheedy (cited by Von Stroh) reports: "My clinical experience suggests that 75% of all people who work extensively at VDTs will have at least occasional problems". Two hours of CRT usage produced measurable fatigue in the eye accommodation mechanism as well as an increased blink rate (Mourant et al).
Whether or not symptoms will occur in a particular patient depends upon the vision and visual skills of the individual in relation to the visual demands of the tasks (Sheedy et al). The possibility that people with superior and more efficient visual systems seek out and/or survive in visually demanding jobs, while people with more inferior or inefficient visual systems likewise seek out jobs with less computer tasks was not overlooked when analyzing the data. We realize that due to this possibility the data may become muddled when comparing high versus low computer usage or many versus few vision breaks.

Musculoskeletal symptoms have been studied more often than visual symptoms in ergonomic literature. For this reason we included musculoskeletal questions in the surveys. Carpal tunnel syndrome has received much attention from healthcare professionals, ergonomists, government agencies, manufacturers, employers, employee groups, the legal profession and the media (Von Stroh, R). We must be concerned about the neck and backaches that are frequently heard complaints from VDT users. This is simply because “the eyes lead the body.” (Anshel, J). As humans, we will adjust our body posture to adapt to any eye dysfunctions to make the job easier for our eyes (Anshel, J). Frequent rest breaks have been proposed as a means to reduce the musculoskeletal discomfort and mood disturbances associated with long periods of continuous computer-mediated work (Henning et al). It has often been difficult to assess the relative contributions of environmental and vision factors to the patient’s symptoms (Sheedy, JE).

We hypothesized a decrease in vision related symptoms with frequent visual breaks (looking off into the distance for 20 seconds). We also assumed there would be a decrease in musculoskeletal symptoms as well, since some sort of break is being taken relieving tension on the body. Some musculoskeletal symptoms were shown to be affected by Vision Saver, but were not reported often enough to be of reliable validity. On the other hand, the participants were not required to do any active stretching or movement during the breaks. For this reason, patients should be encouraged to get up,
move around and let their eyes relax by focusing on objects at least 20 feet away (Von Stroh, R).

We eliminated some of the significant symptoms such as from further analysis because of low incidence of reported symptoms. In essence, an effect was seen, but so few subjects reported the effect, it was inconsequential. Many of these symptoms came at the end of the list in the questionnaire. Possibly these are more infrequent symptoms or possibly the subjects were experiencing impatience with the questionnaire. The list of symptoms is quite long and includes 24 different symptoms. Any future studies should pare down the list to make it more manageable for the subject.

When looking at individual symptoms, we found that dry eye, tired eyes and headache were the symptoms that showed a significant difference through statistical analysis and were reported with high frequencies. These symptoms are similar to those reported as "worst symptoms" as stated above. These results are also consistent with previous research. One study reported symptoms (ranked in order of severity for occasional and frequent degrees of these symptoms) including "tired eyes," "eyestrain," "neck, shoulder or back ache", "headaches", "general fatigue", "wrist pain", and "dry eye" (Ruskin et al.).

Between questionnaire one and two (test period) subjects reported significant drops in headache symptoms; we attribute this relief to the use of Vision Saver. It is interesting to consider the fact that there was not a significant change in the headache symptomatology between questionnaire two and three (post test period). We expected the symptoms to reoccur after the subject ceased using the reminder to take rest breaks. It is possible that even with the short time using the program (two weeks), the participants had developed a habit of taking more short 20 second breaks. They had only been instructed to discontinue use of the Vision Saver program, but no instructions were given on altering their break habits. The same situation holds for dry eye and tired eye symptoms using the Wilcoxon analysis. Again, it is unlikely that two weeks of short 20-second breaks will cure a dry eye. However, a subconscious habit may have been formed by participants in which they looked away from the computer more often, thus interrupting the cycle of
decreased blink rate reported with computer use. We reasoned that the symptoms would slowly reoccur over time as the newly induced habit of rest breaks would cease and bad work habits returned. Constant use of the Vision Saver program would be recommended to reinforce the habit to look away from the computer monitor.

We could not find a specific group of computer user that benefited more from the use of the Vision Saver program than others. When analyzing the data by categorical variables (subgroups: heavy/light computer users, many/few short breaks, many/few long breaks long/short work period before break), no true trends were seen. The group of 20 participants was too small to be divided into subgroups and discover any significant differences. More survey data would have to be gathered in order to really dissect the characteristics of these groups. It appears our selection criteria were strict enough to yield a fairly homogenous group. The minimum of 4 hours of computer work was required in order to be included in the project.

Perhaps a control group was needed to account for the learning effect of the surveys. It is possible that after taking the first survey and actively noticing the amount of breaks, work time and symptoms at the computer, the participants became more aware of their symptoms and habits. Perhaps they were under-reporting symptoms at first and over-reporting symptoms at the end. This could account for the stronger effect that is seen between questionnaire one and two and not between two and three. One aim of the study was to make computer users more aware of their break and work habits and to become more sensitive to ocular symptoms caused by computer use over long periods of time. A good control group would have been comprised of people who used computers but did not test out the Vision Saver program.

We could not pinpoint many specific indicators of eye stress while using the computer that were radically reduced by the use of the Vision Saver program. When analyzed as a whole, though, we noted a significant decrease in general symptoms after the use of the Vision Saver program for 2 weeks. We can explain this observation, in part, by noting that there were several subjects with multiple symptoms that all responded in about the
same manner to the Vision Saver program, i.e. there was an overall reduction in symptoms. When looking at the data as a symptom index, reduction in overall symptoms experienced by the participants is emphasized and an individual response to each symptom is less important. This analysis suggests that the subjects had a more individualized response to the computer eyestrain symptoms and an individualized reduction in those symptoms. This makes sense in the light of so many symptoms being reported by computer users. Each is sensitive to a different facet of asthenopia and may experience marked reduction in some symptom over others.

Some of the comments our participants provided for suggestions to improve the program were for simpler instructions. Others wanted a small window to pop-up as a reminder, instead of the whole screen blanking out. The authors feel that this option would only allow a user to ignore the reminder. Blanking out the whole screen is a necessary disturbance in order to force a rest break. One poor soul did not have a window in his/her very small office and suggested a three dimensional picture of a far away tranquil scene to look at and relax the eyes during the breaks. A variable mode where the user can adjust the time out periods and the interval in between them is suggested many times. The original program includes this feature. This may make it more user friendly and allow people to shut off the feature when playing computer games, for example, where they don’t want to be interrupted. Participants were definitely concerned about their eyes and requested information about using the program long term and information on how to properly align their workstation for optimal performance and comfort.

In questionnaire two, we asked the participants for feedback describing any positive or negative changes in visual comfort that they had experienced after using the program for two weeks. It seems that people with symptoms were helped whereas people without symptoms noticed no changes. One person noted a “dramatic reduction of eye strain and focusing problems”, while another noted “at the end of the workday, my eyes would not be as tired or strained as they typically can be”. Of the respondents, 47% remarked having “not noticed any change”, or “no change, my eyes don’t typically bother me much”. Others noticed, “a slight improvement, but the difference was subtle”. Several
people remembered to look away, refocus and blink more often or "became aware of how
when I looked away from the screen my eyes seemed to relax... previously I was not
aware".

After questionnaire three, the participants had been without the Vision Saver program for
2 weeks. Several people noted a recurrence of previous symptoms at the computer. One
commented, "I've noticed my dry eyes are back!" Another noticed, "more blurring,
more light sensitivity and tired eyes more frequently". One person even said, "I miss the
Vision Saver program". On the other hand, some people "didn't really have any
symptoms before, during or after using the screen saver" or simply commented there
were no changes. The responses were mixed with about 65% noticing no change. Again,
awareness of eyestrain and break habits was heightened. "One thing is for certain,
though... doing this study made me more aware that I need to take breaks, and I will do
so".

The authors' favorite comment is: "Without Vision Saver, I continued to look at the
computer for uninterrupted periods of time without giving my eyes a chance to relax. By
the end of the day or a couple hours on the computer, I could feel my eyes strain, feel
tired and 'achy' and even start a kind of tension headache. I notice I had a tendency to
rub my eyes more without Vision Saver in an attempt to make my eyes feel better. With
Vision Saver I don't remember feeling a desire to do that".

In addition to visual comfort, worker productivity and well being can benefit from short
breaks from continuous computer work (Henning et al). Several laboratory studies show
that better visual displays or better vision result in improved efficiency (Sheedy JE).
When no breaks are taken, we might even expect that 8 hour productivity would be
reduced because of the symptoms and fatigue which accompany uncorrected vision
problems (Sheedy JE). Computer-related vision problems may have significant impact
on worker productivity and frequency of errors, and may result in increased absences on
the job and decreased personal enjoyment from computer use (Miller, SC). Instituting
work breaks assisted by the Vision Saver program in addition to stretching breaks may be a way to increase worker comfort and even boost worker productivity.

It has been reported in previous literature that 39.3 percent of VDT patients receive a special Rx for their work (Sheedy JE). Only 25 percent of our study group wore a specially prescribed spectacle for the computer. Possibly more of those subjects participating in the study could benefit from a computer prescription. On the average, 14.25 percent of optometric patients were reported to present primarily with symptoms related to use of a VDT (Sheedy, JE).

The Computer Vision Syndrome solution is simply a combination of good basic vision care, good visual/work station ergonomics, a good optical correction and controlled environmental factors, all within behavioral optometry's skills (Anshel, J). In addition, frequent rest breaks need to be taken to reduce symptoms of CVS, such as headache, dry eye and tired eyes. The program was well accepted by most subjects and provides a diligent and compelling reminder to rest the eyes.
APPENDIX 1

Vision Saver Clinical Trial Participants Disclosure

Basic Design:
Vision Saver is a computer program designed to remind a person to take a break and look away from the computer. It is the hope of the researchers that Vision Saver will relieve common eye symptoms such as the eyestrain many computer users experience.

Requirements:
Participants volunteering in this study should be currently working on a computer 4-6 hours per day. Participants will be given a copy of Vision Saver and the instructions to install it on their computer. It is assumed that participants are using a PC running Windows 95, 98, 2000 or NT. Once Vision Saver is installed it will only run for 2 weeks. Please be ready at installation to initiate participation in this study. Vision Saver will blank out the screen every 20 minutes for 20 seconds. The screen is blank except for a countdown of numbers in the center of the screen, corresponding to the number of seconds in the break. When the screen goes blank we ask that the participant look away from the monitor into the distance (at least 20 ft) to relax the focusing system of the eye. After the break, the original screen will be restored with no interruption in programs or work on the desktop. In the event that the participant is doing critical work Vision Saver can be immediately interrupted and canceled for that cycle by striking the escape key. The participant will be asked to keep track of how often they use this feature and also how often they follow the countdown on the computer instead of looking away.

Questionnaire:
Phase 1: participants will initially fill out a questionnaire querying their demographics, hours of use on the computer and current visual complaints, if any. Then, as mentioned above they will install Vision Saver onto their computers. After 2 weeks participants will fill out a similar questionnaire exploring any change in visual complaints and also asking about the usefulness of the program.
Phase 2 of the project involves removing the Vision Saver program from the participants computers for a period of 2 weeks. At this time the subjects will be asked to fill out a final symptom questionnaire related to the period of time without Vision Saver.

Time Requirement:
1. Installation of Vision Saver - approximately 5 minutes.
2. 4-6 minutes per day spent looking away from the computer.
3. 3 surveys - approximately 5 minutes per survey.

Rewards/Benefits:
1. Participants will receive a copy of Vision Saver that will not expire.
2. Decrease in eye fatigue and other visual symptoms related to computer use.
3. Increase in work productivity and enjoyment due to a decrease in visual symptoms.

Researchers Plea:
Thank you in advance for agreeing to participate in this exciting trial run of the Vision Saver program. We believe that Vision Saver can alleviate the common eye symptoms many computer users deal with on a daily basis. Due to the study's importance we ask all participants to refrain from using the escape feature and to fill out each questionnaire within a two-day turn around period. Your cooperation will help expedite the study. Thanks again!

Withdrawal:
This study is conducted on a purely voluntary basis. It is our hope that everyone will be as excited as we are and want to participate in the trial run. If however you decide not to participate, you may withdraw at anytime by notifying the researchers at midsone@pacificu.edu or mooremf@pacificu.edu. Withdrawal will not result in any penalty or loss of benefits.

Questions:
Technical questions regarding the installation and operation can be e-mailed to Mark Hutchinson at hutchma@teleport.com. The researchers will be happy to answer any questions you may have at any time during the course of this trial and can be reached at midsone@pacificu.edu or mooremf@pacificu.edu.

Researchers:
Clare Midson and Marla Moore are students of Pacific University conducting this study as part of their thesis required for graduation from the Optometry program. Our research advisor is Bradley Coffey, O.D.

Confidentiality:
After receipt, your questionnaires will be identified by your e-mail address which will be deleted from our database. All data will be maintained in a confidential manner. No names will be released, and only general results will be published.

In order to properly keep track of our data, please enable cookies before continuing further!
Having read the above, I DO NOT wish to participate and do not wish to continue. Please click here.
Having read the above, I DO wish to participate and wish to continue. Please click here.
APPENDIX 2

Vision Saver Questionnaire #1

Please answer the following brief questions, filling in every blank.

1. What is your name: _____ and email: _____

2. What is your age: _____

3. What is your occupation: _____

4. What is your gender: _____

5. On average, how many hours a day did you use the computer in the last two weeks: _____

6. How many short breaks from the computer do you take per day (shorter than 5 minutes): _____

7. How many long breaks from the computer do you take per day (longer than 5 minutes): _____

8a. In my usual mode, I am on the computer (pick one):
    _____ Less than half a day
    _____ More than half a day

8b. In my usual mode, I am on the computer (pick one):
    _____ Varibly / on and off
    _____ Continually / all the time

9. Rate the mental difficulty of your work from 0 (easy) to 4 (demanding): _____

10. About how many inches away from your nose is the monitor screen: _____

11. Measure the height of lower case text that you typically work with on the monitor (in mm.): _____

12. Had you ever experienced eyestrain before you heard of this study (yes or no): _____

13. Please rate your past experience with EACH of the following symptoms ranging from 0 (never noticed) to 4 (often notice/interferes with work on the computer):
    _____ Eye strain
    _____ Dry eyes
    _____ Blur up close
Stinging
Eye pain
Tired eyes
Slow refocusing
Watery eyes
Itchy eyes
Neck ache
Finger pain
Double vision
Red eyes
Photophobia (light sensitivity)
Headache
Gritty/sandy eyes
Flicker sensation
Difficulty with comprehension
Dizziness
Blur in the distance
Wrist pain
Blurry vision at the computer
Glare sensation
Observe “jumping” letters/text

14. The worst symptom from above is:

15. Where do you use the computer (check all that apply):
   Work
   Home
   School

16. When looking at the monitor, where are your eyes positioned vertically relative to the screen (pick one):
   Even with the top
   Above the center
   Center of the screen
   Below center

17. Are you bothered by screen flicker or glare off of the screen (yes or no):

18. Indicate your approximate time interval of prolonged work on the computer before taking a rest break (pick one):
   1-20 minutes
   21-40 minutes
   41-60 minutes
   61-90 minutes
   91-120 minutes
   121-150 minutes
___ 151-180 minutes
___ Over 3 hours
___ No rest breaks

19. Have you received an eye exam in the last 2 years (yes or no): ___

20. Do you use a special pair of glasses or contacts for use at the computer and/or reading (yes or no): ___
APPENDIX 3

Installation instructions for Vision Saver

For Win 95 & Win 98:

Step 1: download the Vision Saver program from the website.
Step 2: right click on the "Start" button and click "Explore" to open Explorer.
Step 3: navigate to the "Startup" folder in the Windows directory.
   (i.e. C:\WINDOWS\Start Menu\Programs\StartUp)
Step 4: copy Vision Saver program (vissav.exe) to the "Startup" folder
   Each time the computer starts up, Vision Saver will run.
After 2 weeks, the Vision Saver program will expire.

For Win NT:

Step 1: download the Vision Saver program from the website.
Step 2: right click on the "Start" button and click "Explore" to open Explorer.
Step 3: navigate to the "Startup" folder in the WINNT directory.
   (i.e. C:\WINNT\Profiles\All Users\Start Menu\Programs\StartUp)
Step 4: copy Vision Saver program (vissav.exe) to the "Startup" folder
   Each time the computer starts up, Vision Saver will run.
After 2 weeks, the Vision Saver program will expire.

To complete the registration process please click the link below to download the Vision Saver program.
APPENDIX 4

Vision Saver Questionnaire #2

Please answer the following brief questions, filling in every blank.

1. What is your name: ___________ and email: ___________

2. On average, how many hours a day did you use the computer in the last two weeks: ______

3a. In my usual mode, I am on the computer (pick one):
   _____ Less than half a day
   _____ More than half a day

3b. In my usual mode, I am on the computer (pick one):
   _____ Variably / on and off
   _____ Continually / all the time

4. Please rate your past experience with EACH of the following symptoms ranging from 0 (never noticed) to 4 (often notice/interferes with work on the computer):

   __ Eye strain
   __ Dry eyes
   __ Blur up close
   __ Stinging
   __ Eye pain
   __ Tired eyes
   __ Slow refocusing
   __ Watery eyes
   __ Itchy eyes
   __ Neck ache
   __ Finger pain
   __ Double vision
   __ Red eyes
   __ Photophobia (light sensitivity)
   __ Headache
   __ Gritty/sandy eyes
   __ Flicker sensation
   __ Difficulty with comprehension
   __ Dizziness
   __ Blur in the distance
   __ Wrist pain
   __ Blurry vision at the computer
   __ Glare sensation
   __ Observe "jumping" letters/text
5. The worst symptom from above is: ____________________

6. What percentage of time did you use the escape key to override Vision Saver: _____

7. What percentage of time did you look away from the screen into the distance when the computer prompted you to (as opposed to watching the screen or doing other tasks at near): ____

8. Do you notice any change in visual comfort now that you have used Vision Saver for 2 weeks, (whether or not there were any previous symptoms)? Please describe any positive or negative changes:

9. Was Vision Saver an interruption to you (yes or no): _____

10. What improvements would you make to this program to increase its usability:

11. Do you wish to continue to use this program in the future? (yes or no): _____
APPENDIX 5

Vision Saver Questionnaire #3

Please answer the following brief questions, filling in every blank.

1) Name: ____

2) Email: ____

3a) In my usual mode, I am on the computer: (pick one)
    ____ Less than ½ day
    ____ More than ½ day

3b) In my usual mode, I am on the computer: (pick one)
    ____ Variably / On and off
    ____ Continually / All the time

4) Please rate your past experience with EACH of the following symptoms ranging from 0 (never noticed) to 4 (often notice/interferes with work on the computer):
    ____ Eye Strain
    ____ Dry Eyes
    ____ Blur Up Close
    ____ Stinging
    ____ Eye Pain
    ____ Tired Eyes
    ____ Slow Refocusing
    ____ Watery Eyes
    ____ Itchy Eyes
    ____ Neck Ache
    ____ Finger Pain
    ____ Double Vision
    ____ Red Eyes
    ____ Photophobia (light sensitivity)
    ____ Headache
    ____ Gritty/Sandy Eyes
    ____ Flicker Sensation
    ____ Difficulty with Comprehension
    ____ Dizziness
    ____ Blur in the Distance
    ____ Wrist Pain
    ____ Blurry Vision At The Computer
    ____ Glare Sensation
    ____ Observe “Jumping” Letters/Text
5) The worst symptom from above is: ____________________

6) Indicate your approximate time interval of prolonged work on the computer before taking a rest break: (pick one)
   ___ 1-20 min
   ___ 21-40 min
   ___ 41-60 min
   ___ 61-90 min
   ___ 91-120 min
   ___ 121-150 min
   ___ 151-180 min
   ___ over 3 hrs
   ___ no rest breaks

7) Do you notice any change in visual comfort now that you have stopped using Vision Saver for 2 weeks, (whether or not there were any previous symptoms)? Please describe any positive or negative changes:

8) Do you wish to continue to use this program in the future? (yes or no) ___
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