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The Use of Task-Specific Lenses by Presbyopic Air Traffic Controllers at the En Route Radar Console

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16. Abstract

Introduction: The configuration of the radar console to control aircraft traffic has similar features to a visual display terminal (VDT) work station. Task-specific lenses have been found in clinical studies to reduce visual symptoms while working at the VDT. The American Optical Corporation TruVision Technica®, a task-specific lens design, was evaluated to see if visual benefits from such a lens could be transferred from the VDT environment to the radar console work environment.

Methods: Presbyopic Air Traffic Control Specialists (ATCSs) at the Houston Air Route Traffic Control Center were fitted with two prescription spectacles, using their current and Technica® lens designs, in similar ophthalmic frames. Each ATCS used both lens designs at the radar console and provided subjective evaluations of their appropriateness in that environment.

Results: Thirteen (13) subjects (45.6 ± 5.9 years of age, range 36-55 years) completed the study. Subjects who used larger near viewing area (single vision and executive) lens designs generally preferred their current lens design. The Technica® was preferred by mature presbyopes (add power of ≥ 1.25 diopters) and those using smaller near viewing area (FT-25, FT-28 and general progressive addition) lens designs. The primary complaints reported by ATCSs with the Technica® were peripheral distortion and limited field of view.

Conclusions: Task-specific lens designs are an alternative for presbyopic ATCS who work at a radar console. However, distortion and limited field of view from the lens may require prolonged adaptation times before such designs are acceptable to ATCS on the job, especially for those accustomed to lens designs with larger viewing areas.

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general, the ATCSs preferred their original lenses if they incorporated near and/or intermediate segments with large surface areas, such as the bifocal and trifocal executive (current: Technica® = 2:0) or SV lens (6:2) designs. Those controllers that use smaller bifocal (0:2) and general-purpose PAL (0:1) designs preferred the Technica® to their original prescription eyeglasses. For the more mature presbyopic ATCSs, intermediate distance viewing becomes more difficult with SV lenses, and traditional multifocal lens designs with higher add powers are required. The study found that 55.6% of subjects ≥ 44 years of age and requiring add powers ≥ 1.25 D preferred the Technica® with its progressive design. It was anticipated that this percentage would be higher. However, for some individuals, the scanning requirements of an ATCS may not be compatible with the limitations imposed by the Technica's® relatively narrow intermediate viewing area and the induced distortions of the lens, compared to SV and other multifocal lens designs.

Even with the visual limitations of the Technica®, there is evidence that some controllers felt its benefits were significant. While ten controllers (76.9%) reported limited field of view when using the Technica®, two (20%) of these subjects preferred the Technica® to their current eyeglasses. With the Technica®, eight controllers (61.5%) complained of distortion, and two (25.0%) of these preferred the Technica® to their current eyeglasses. It is possible that older ATCSs accustomed to the wider viewing areas of their current lens designs, would require a prolonged adaptation period to rehabilitate their visual scanning skills and learn to ignore the negative features reported with the Technica®, namely the limited field of view and peripheral distortion.

It is important to note that a substantial number of the test subjects (5) felt that vision with their original lenses contributed to their job stress. Whether this was due to inadequate refractive corrections or unsuitable fit of the eye glasses was not determined. The five controllers who subsequently preferred the Technica® lenses reported that the lenses decreased stress, increased efficiency and decreased fatigue, or had little to no effect on these work-related symptoms.

Technica® was designed for the VDT user and office employees who work at a desk. When asked if they found the TechnicaÒ useful in other situations, nine ATCSs (69.2%) reported using their TechnicaÒ at home while working at the VDT, during casual reading, and for watching television. A VDT user normally views a screen equal to 60-80% of their near add and at a viewing angle 10-20° below straight ahead gaze. The fact that the average intermediate working distance of the ATCS test subjects was 88.9 (35") ± 2.9 cm, approximately 45% of the wearer's total add power, makes it considerably further away than the typical computer screen, 40 - 76 cm (16" - 30"). Many people find 51 - 66 cm (20" to 26") most comfortable. A 1989 National Transportation Safety Board recommendation to the FAA states that for the ATCSs, "all corrections required to demonstrate 20/20 vision at all applicable distances should be present in the same pair of corrective lenses" (). However, an all-inclusive lens for the mature presbyopic ATCS that would provide adequate viewing of all components of the radar console would be difficult, if not impossible to design. For the mature presbyope, improved viewing at one distance, or area of the field of vision, is almost always at the decrement of viewing another. A prior study on the visual ergonomics of the radar console environment revealed that the primary components of the radar console require the ATCS to scan over large surface areas, and specialty lenses may be required for viewing components overhead. It also found that an individual's eye height in relation to the ATCS radar console environment would be an important factor in fitting vision correcting lenses (4). These factors should be included in any future ergonomic redesigns of the en route radar work station.

The study was compromised by the small number of participating controllers. Age may have contributed to this since, for en route controllers, there is not only a maximum entry age (i.e., may not have reached their 31st birthday prior to initial appointment), but also a mandatory separation at 56 years of age from positions requiring direct separation and control of air traffic (). Other reasons for not participating may have been changing work schedules, the limited num-

ber of presbyopic ATCSs who work at the console (many senior controllers were in supervisory/management positions and could not meet the required number of hours working at the radar console), concern about reporting additional medical information to FAA, and satisfaction with their current vision correction. The requirement that the participants have a current refractive prescription further limited our subject pool, since many individuals do not have routine eye examinations. Even when this condition was met, some current prescriptions were problematic, since several were reported questionable by the contractual vision specialists for the intermediate distance for which they were being used.

A study with quantitative test results of controller performance would have been preferred. However, a performance-based test was not an option in this study, since we could not interrupt the ATCSs while they were controlling air traffic. The use of subjective responses to survey questions, which are not easily quantifiable and are sometimes difficult to interpret, was the most practical method of evaluating the usability and feasibility of these ophthalmic lenses on the job.

In conclusion, for en route ATCS working at the radar console, our test results suggest that a lens type with a wider field of view (SV or Executive) is generally preferable to a Technica® lens design. However, Technica® may be preferable for those ATCSs using smaller multifocal lens designs, such as FT-28, FT-35 or general-purpose PALs. Although the Technica® provides a relative wide intermediate and near vision area, it may not be wide enough for the visual scanning required for work at the radar console, resulting in complaints of distortion and limited field of view. It is possible that the TechnicaÒ may be more acceptable in other air traffic activities, such as automated flight service stations, which use more traditional VDT equipment. Although not a panacea for all presbyopic controllers who need corrected vision for near and intermediate distances, the Technica® is a viable option for eyecare practitioners correcting ATCSs with occupational vision problems. The five controllers who preferred the Technica® lenses in this study reported decreased work-related stress, increased efficiency, and/or decreased fatigue. With a longer period of adaptation or with improvements in refractive prescriptions, it is possible that all of our subjects could have adapted to the TechnicaÒ. Further study on the corrective needs of presbyopic ATCSs is needed as current demographics of the ATCS population forecast a substantial increase in early and mature presbyopic controllers in the next decade, many of whom will be full performance level ATCSs working at the radar console (4).

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APPENDIX A

Evaluation of Current Lenses

Subject # _____ Date _____

Please feel free to indicate values such as 2.5 or 4.5

How well do your current glasses meet your visual needs at work?

1	2	3	4	5
not at all	poorly	satisfactorily	well	perfectly

What limitations do you experience with these glasses?

_____

_____

What do you like about your current glasses?

_____

_____

Do you feel that your vision with your current glasses is the same as when you first received them?

yes no

If no, in what way is your vision different?

_____

How comfortable are you with your present glasses at work?

1	2	3	4	5
very uncomfortable	uncomfortable	satisfactory	comfortable	very comfortable

Are you experiencing any specific discomfort with your present glasses?

yes no

Please continue to next page.

Appendix A (cont.)

Subject #: _____

If yes, please check off the category and severity of symptoms:

1)	eyestrain	severity:	mild _____	moderate_____	severe _____
2)	blurred vision	severity:	mild _____	moderate _____	severe _____
3)	headaches	severity:	mild _____	moderate _____	severe _____
4)	neckpain	severity:	mild _____	moderate _____	severe _____
5)	back pain	severity:	mild _____	moderate _____	severe _____
6)	other	severity:	mild _____	moderate _____	severe _____

Do you feel that your vision with your glasses contributes to job related stress?

1	2	3
not at all	to some degree	significantly

Please explain:

_____

_____

Do you have any observations about your vision or your glasses that have not been touched on in these questions? If so, please note below:

_____

_____

_____

APPENDIX B

Subject Information

Date:_____/_____/19_____

Subject#: _____ Age: _____

Job Title: _____

Hours/week at radar console: _____

How long working at ATCS: _____yrs., _____months

Work related visual complaints (eyestrain, blurred vision, etc.):

_____

_____

Physical complaints (headaches, neck or back pain, etc.):

_____

_____

Health history (please circle all conditions that currently apply):

glaucoma cataracts macular degeneration diabetes
hypertension other_____

Medications (Please list both prescription and non-prescription that are currently used):

_____

_____

Record Subject's Work Measurements:

Distance from eyes to center of screen _____

Distance of eyes from floor when working at radar screen _____

Appendix B (cont.)

Confirm Prescriptions:

Was written Rx available for work Rx? yes / no

Work Rx:

Dates: Rx: _____/_____/_____ Lenses: _____/_____/_____

Rx PD: _____

Lens style: _____

Rx: Distance Add

OD: _____

OS: _____

Seg or MRP location:

pupil center / _____ mm below / _____ mm above

Differences between Rx and lenses worn:

_____

Home Rx:

Dates: Rx: _____/_____/_____ Lenses: _____/_____/_____

Rx PD: _____

Lens style: _____

Rx: Distance Add

OD: _____

OS: _____

Seg or MRP location:

pupil center / _____ mm below / _____ mm above

Differences between Rx and lenses worn:

_____

VAs with current Rx:

	Distance	Intermediate (distance to radar screen)	Near
OD:			
OS:			
OU:			

#1
Monocular PDs: Dist OD:_____ OS:_____
Near OD:_____ OS:_____

Vertical height to pupil center in frame selected for study:

OD: _____mm OS:_____mm

Record Specifications of frame selected for study:

Name:_____Manufacturer:_____

Eye:_____ Bridge:_____ Temple:_____

Color#1: (Technica®)_____
Color#2: (Other style)_____

Availability verified #1:_____ #2:_____
Technica® fitting and cut-out verified:_____

Duplicate Rx: OD:		Rx Technica® OD:
OS:		OS:
Add		Add
Seg Ht	OD:	
	OS:	

Complete orders for Technica® and duplicate work lenses and attach copies to this record.

APPENDIX C

Initial Technica® Evaluation

Name: _____ Pt.#: _____ Date _____

1.) How long did it take before you were confident enough in the Technica® lenses to use them routinely at work? _____

2.) Have you noticed anything different when working with these lenses for 4 weeks?

_____

_____

3.) Please rate your overall satisfaction with these lenses on a scale of 1-10, with 1 representing complete dissatisfaction and 10 representing complete satisfaction: _____

4.) Please check one choice for each of the following areas of lens performance:

		Advantage	Disadvantage
A)	Variable Working Distance	_____	_____
B)	Field of View	_____	_____
C)	Glare/Reflections	_____	_____
D)	Vision (Distortion/Clarity)	_____	_____
E)	Other: _____	_____	_____

5.) Please indicate any visual symptoms that you noticed with these lenses:

		Increased	Decreased
A)	Blurred Vision	_____	_____
B)	Eyestrain	_____	_____
C)	Other: _____	_____	_____

6.) Please indicate any physical symptoms that you noticed with these lenses:

		Increased	Decreased
A)	Headaches	_____	_____
B)	Neck Pain	_____	_____
C)	Back Pain	_____	_____
D)	Other: _____	_____	_____

7.) How do you feel that working with these lenses has affected your work related stress? (please check one)

[ ] 1.) Increase greatly
[ ] 2.) Increase slightly
[ ] 3.) not affected
[ ] 4.) decreased slightly
[ ] 5.) decreased greatly
[ ] 6.) have difficulty assessing.

8.) How do you feel that using these lenses has affected your work efficiency? (please check one)

[ ] 1.) Increase greatly
[ ] 2.) Increase slightly
[ ] 3.) not affected
[ ] 4.) decreased slightly
[ ] 5.) decreased greatly
[ ] 6.) have difficulty assessing.

9.) How do you feel that using these lenses has affected your work related fatigue? (please check one)

[ ] 1.) Increase greatly
[ ] 2.) Increase slightly
[ ] 3.) not affected
[ ] 4.) decreased slightly
[ ] 5.) decreased greatly
[ ] 6.) have difficulty assessing.

Comments:

_____

_____

_____

APPENDIX D

Comparative Experience Survey

Name: _____ Pt.#: _____ Date _____

1.) Please note any general observations you made when comparing the two lens designs:

_____

_____

2.) Can you identify any situations in which you found one lens or the other superior? If so, which one, and in what way?

_____

_____

3.) With which lenses did you:

		Technica®	Previous	No Difference
A)	Experience less fatigue	_____	_____	_____
B)	Experience fewer visual symptoms	_____	_____	_____
C)	Experience fewer physical symptoms	_____	_____	_____
D)	Experience less work related stress	_____	_____	_____
E)	Work more efficiently	_____	_____	_____
F)	Experience more overall comfort	_____	_____	_____

4.) Considering all the factors, the statement I most agree with is: (please check one)

[ ] 1.) I strongly prefer the new lenses
[ ] 2.) I prefer the new lenses
[ ] 3.) I have no preference, I like both lenses equally
[ ] 4.) I prefer my previous lenses
[ ] 5.) I strongly prefer my previous lenses
[ ] 6.) have difficulty assessing.

5.) Which pair of lenses to you plan to wear at work in the future?

_____ Technica® lenses _____ Previous _____ Both

6.) Did you find the Technica® lenses useful in any other situations? If yes, please explain:

_____

Comments:

_____

_____

APPENDIX E

Follow-up Evaluation

Name:_____Pt.#:_____Date_____

1.) Which lenses did you use at work?

(Please circle your answer) Technica® Old Lenses Both

2.) Please respond to each statement using the following scale:

1 = strongly agree
2 = agree
3 = no difference
4 = disagree
5 = strongly disagree

(If you circled "both" above, please specify which lens or both for each question)

A) My eyeglass lenses make my job easier to perform: _____ (lens: _____)

B) My eyeglass lenses allow me to see my entire work area clearly : _____ (lens: _____)

C) My eyeglass lenses allow me to work more efficiently: _____ (lens: _____)

D) My eyeglass lenses help me to feel less tired at the end of the day: _____ (lens: _____)

E) My eyeglass lenses have helped to reduce physical discomfort (headaches, neck pain, back pain, etc.): _____ (lens: _____)

F) When I get a new pair of glasses, I would like to get the same eyeglass lenses that I am wearing now: _____ (lens: _____)

Comments:

_____

_____

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