

FUNCTIONAL PROBLEMS OF TELESCOPIC SPECTACLES IN THE DRIVING TASK*

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IN MOST OF THE STATES IN THIS COUNTRY A MINIMAL ACUITY OF 20/40 TO OBTAIN A drivers license is selected because the lettering on freeway control signs is sized to be read by a driver with acuity of at least 20/40 at usual roadway speeds, under normal weather conditions, and at sufficient distance to make appropriate vehicular maneuvers.

Sixteen states including Massachusetts, New Hampshire, California, Maine, North Carolina, and Florida have granted licenses for driving motor vehicles to people who can pass the static test of central acuity with telescopic spectacles. The telescopic spectacle promoted for this purpose is named *Bioptic* because the telescope is placed in the upper part of the carrier spectacle lens, permitting vision through the spectacle lens by lowering fixation (Figure 1A). The telescopic component is brought into use by raising the fixation line through slight flexion of the neck (Figure 1B).

Korb (1) reported his experience on twenty patients with low vision who were licensed to drive a motor vehicle in Massachusetts. He recommended the following for motor vehicle operation by visually handicapped persons utilizing telescopic systems:

1. Visual acuity with telescopic systems must meet minimal state requirements.
2. The visual field should be within normal limits when measured by standard methods through the carrier spectacle lens.
3. The telescopic unit should be designed to be available for use with minimal head movements but when not in use should not impair the visual field utilized in driving.

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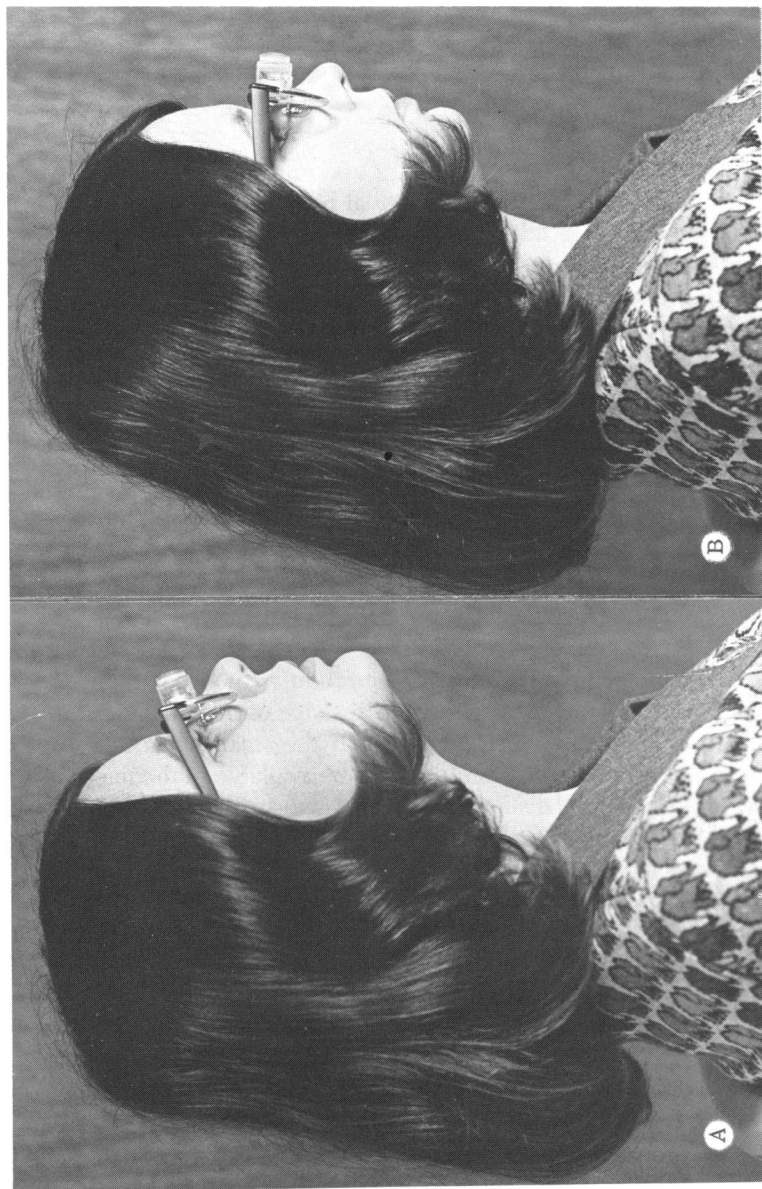


FIGURE 1
A: Fixation lowered (looking through spectacle lens) B: Fixation raised (looking through telescope).

4. The individuals should undergo a minimum of two months of adaptation with the custom designed telescopic spectacles.
5. An individual test of road competency while wearing and using the telescopic prosthesis should be made by the motor vehicle examining body of the particular state.
6. The telescopic prosthesis should be worn at all times when operating a motor vehicle.
7. Operation at night, on expressways, and under extreme conditions should be considered on an individual basis.

Korb acknowledged that adaptation to the Bioptic systems is not accomplished without difficulty and that a multitude of problems have been encountered during adaptation.

On attempted use of the telescopic spectacles for driving, we have found the following problems:

1. A nearness illusion due to increased image size.
2. Image movement in the opposite direction of any head motion.
3. Difficulty and fatigue in maintaining the head in slight extension as required, to see through the spectacle lens portion of the system.
4. Difficulty in shifting rapidly from the magnification of the telescopic unit to the unmagnified image of the carrier lens.
5. A ring scotoma surrounding the central magnified field which presents a significant jack-in-the-box hazard especially when passing other vehicles and at intersections.
6. Exaggerated resolution decay by vibration, which has long been known to reduce acuity even in the absence of magnification.
7. A need to maintain reference points in the small magnified field; some portion of the automobile should be available in the magnified field to reduce both distance and angular disorientation.
8. Difficulty in trying to use side and rear view mirrors.

Fonda's reported experience² is based upon six patients including himself on whom visual fields were plotted on a tangent screen through the Bioptic telescope. His concern was aroused by claims that the monocular field through a $2.2\times$ Bioptic telescope was 22° , the binocular field 35° and the ring scotoma only 8° . With the telescope fitted at a vertex distance of 12 mm, Fonda reported the outer isopter to be unconstricted, except above, but the central magnified field for his dominant left eye was limited to seven degrees and the binocular central field was no greater (Table 1).

His ring scotoma extended 12° or more beyond this magnified central field. He states "I was as conscious of the size of the ring scotoma as I was of the narrow field." We found a central magnified field of only 10°

TABLE I. VISUAL FIELD CHANGES THROUGH $2.2 \times$ BIOPTIC SPECTACLE MOUNTED TELESCOPE

| | Peripheral Field | Central Diameter Field | Binocular Field | Ring Scotoma | Illusory Movements |
|--------------------------------|---------------------------|------------------------|-----------------|----------------|--|
| Manufacturer's Claim | unconstricted | 22° | 35° | 8° | Not described |
| Fonda's Field | constricted only above | 7° | 7° | 12° | Not reported |
| Keeney, Weiss & Silva's Fields | constricted only above | 10° | Not reported | 12-18° wide | To opposite direction of head movements |
| Bier's Fields (3) | unconstricted | 14° | Not reported | Not reported | Not reported |

diameter and a ring scotoma 15° wide.

The wearer of the Bioptic lens looks through the carrier spectacle lenses except when he wants to spot details such as a sign or car at a distance, then he flexes his head and looks through the telescope. People trying the Bioptic state that they are useful for this purpose on a highway, but not in the city where distances are less and traffic is complex.

The principal purpose of the telescope is to pass the driver's static test of acuity, and possibly to assist in reading road signs. Since the wearer does not use the telescope while driving except for distance spotting, he continues for all practical purposes to drive with sub-normal or low vision.

SUMMARY

The technical objective of passing a static screening test of central acuity is negated by several major operational limitations, namely:

1. Size distortion or nearness illusion leading to impaired judgement.
2. A major ring scotoma intruding on the visual field.
3. Illusory movement of objects in opposite direction to any head movement.
4. The need for maintaining extension of the head for looking through the spectacle lens.
5. Compounded decay in resolution induced by vibration.

REFERENCES

1. Korb DR: Preparing the visually handicapped person for motor vehicle operation. *Am J Optom* 47:619-627, 1970.
2. Fonda, G: Telescopic spectacles for driving a motor vehicle, *Arch Ophthalmol* (in Press), 1974.
3. Bier NV: Correction of Subnormal Vision. 2nd Ed. New York, Appleton — Century Croft, 1970.

DISCUSSION

DR ALBERT E. SLOAN. I wish to compliment the authors for preparing a neat, short, and pertinent paper on an important subject which influences the entire community and has not excited enough of the ophthalmological world. The pertinent facts are: There will be more people with reduced and altered vision as a result of increased life span. The automobile has become a way of life and the need to drive in many cases is essential to earning one's livelihood. It is no wonder that means will be sought to obtain one's license to drive. Dr Keeney describes one method of passing the vision test and the built-in deficiencies of telescopic lenses in driving. One can speculate on the abuses this can produce.

I propose to play the role of the Devil's advocate in the time allotted to me.

The first and most important question is: How much vision is required to drive a car safely? Statistics are lacking. The only sure thing is that — indirect vision is more important than central vision. There is no evidence that there are less accidents with 20/70 than 20/40 vision. It appears that most mishaps are related to factors other than sight. Nevertheless, this does not excuse poor vision.

The person wearing the Bioptic lens does not use the telescope in driving. Rarely it is used even for sighting — but this can be done if the person practices faithfully, and his lenses are meticulously designed and fitted. This is a skill not easy to come by, neither for the patient nor the dispenser.

There is no doubt that driving while viewing through telescopes is hazardous. Even the most ardent advocates would not disagree. I shall comment on each of the problems described by the author.

1. "A nearness illusion due to increased image size." This can be overcome by training, and is also true with aphakic spectacles.
2. "Image movement in the opposite direction of any head motion." Aphakic glasses do this also but to a lesser degree and people can learn to drive.
3. "Difficulty and fatigue in maintaining the head in slight extension as required, to see through the spectacle lens portion of the system." Proper fitting and training can overcome this.
4. "Difficulty in shifting rapidly from the magnification of the telescopic unit to the unmagnified image of the carrier lens." Training and practice can solve this.
5. "A ring scotoma surrounding the central magnified field which presents a significant jack-in-the-box hazard, especially when passing other vehicles and at intersections." This is also true in spectacle corrected aphakia.
6. "Exaggerated resolution decay by vibration, which has long been known to reduce acuity even in the absence of magnification." This can be minimized by sitting on a pillow while driving.
7. "Need to maintain reference points in the small magnified field; some portion of the automobile should be available in the magnified field to reduce both distance and angular disorientation." Hood ornaments are desirable to help orient spatial relationships.
8. "Difficulty in trying to use side and rear view mirrors." The mirror should be large and mounted in an appropriate position. Paraplegics also require special gadgetry.

Pragmatically, I believe the problem cannot be solved by arbitrarily condemning the Bioptic lens or other visual aids. Political pressures supported by the multitudes who rightfully or wrongly feel they are not a menace on the road and can drive safely have to be dealt with. I would suggest that the Registry of Motor Vehicles in each state have a visual consultation board made up of non-political appointees working in cooperation with the special handicapped driver division. Every applicant who does not meet the visual requirements for driving with ordinary spectacles may have his case reviewed and passed upon. Such persons if granted their licenses must drive in cars clearly and appropriately marked so other

drivers can exercise the extra caution one normally uses when following a student operator.

I know the concern that I have and that all of you must have for many of our patients who have incipient cataracts, glaucoma, and miotic pupils who drive into unavoidable lighting conditions that temporarily compromises their vision to terrifying degrees.

The automobile is surely a mixed blessing.

DR ARTHUR KEENEY. I want to thank Dr Sloane, particularly for his efforts in interviewing several patients in the Boston area for whom these spectacles have been prescribed. His comments must be interpreted as "consumer advocacy" and not in terms of safety or functional analysis.

I am concerned about the promotion and sale of these devices not on technical analysis alone but because they have been developed not from field and road needs but apparently in part from the concept of "beating" a static, screening procedure. Economic and political considerations are also suggested in these circumstances. We should each see that the Medical Advisory Boards in our individual states evaluate carefully the role of such devices in driver licensure.

Thank you.