Driving with bioptic telescopes: Recent research updates

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Symposium abstract

Bioptic telescopes are small telescopes mounted at the top of a spectacle carrier lens. People with moderately reduced visual acuity are permitted to drive with the aid of a bioptic in The Netherlands, 45 states in the U.S.A., and the province of Quebec, Canada. Bioptic drivers view through the carrier lens most of the time. When magnification is needed, *e.g.*, to read a road sign, the wearer tilts his or her head down to view through the telescope. Glances through the telescope are usually brief and infrequent.

Although driving with a bioptic is permitted in the majority of states in the USA, little is known about bioptic use in everyday driving. Moreover, many questions remain about the safety of driving with a bioptic. This symposium will report recent research addressing some of these questions, including whether bioptic drivers have higher crash rates than fully-sighted drivers, whether people who use bioptics should be permitted to drive at night, whether the ring scotoma

around the magnified view impairs detection of road hazards, and how bioptics are used in everyday driving.

1. Collision rates of bioptic drivers compared to matched controls

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Introduction: The State of Ohio permits the licensure of drivers using a bioptic telescope following systematic procedures for evaluation, training and testing. The state maintains a database of driving-related events, and we were provided access to that database to examine collision data of bioptic drivers.

Methods: Following approvals from state and university bodies, driving records were accessed from the State of Ohio database. A sample of 199 bioptic drivers was identified. Each bioptic driver was matched (by age, gender, population density, and time since first licensure) to a composite group of control drivers. Of the 199 bioptic drivers, control groups could be compiled for 176. Within the 10 years from 2004 through 2013, collision rates were computed for the years in which the driver was licensed with the bioptic. For each bioptic driver, we also compiled data on collisions for the three years before and after licensure with the bioptic.

Results: Bioptic drivers are involved in collisions three to four times the rate of their control groups. Consistent with an earlier report, previous driving experience is a strong predictor of collision rates when someone begins driving with a bioptic. For the 3 years before and after being licensed to drive with a bioptic, 65% of bioptic drivers had no collisions, with 9% of drivers having a decrease in collisions, and 23% having an increase. Most of that increase is attributed to an increase in driving exposure with the initial use of a bioptic.

Conclusions: Real-world driving performance indicates that bioptic drivers are involved in collisions at a greater rate than control drivers matched by age, gender, population density, and duration of driving history. Nevertheless, collisions are rare, and most bioptic drivers have had no collisions during the comparison period.

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Disclosures: None

2. A study of bioptic driving at night

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Introduction: Bioptic driving is legal since early 90’s in parts of the USA and since 2009 in The Netherlands. So far, bioptic driving in the Netherlands was restricted to daylight hours because little is known about the performance of bioptic drivers at night. The hypothesis is that some bioptic drivers are able to drive safely at night, but it is unclear which (visual) parameters contribute to the fitness to drive at night.

Methods: All 125 current bioptic drivers in the Netherlands were asked to volunteer in a practical fitness to drive test at night. From the 70 positive responses, we selected 30 drivers and distributed them evenly over three groups, based on their medical background, expected success rate and age: A) low chance, mostly progressive retinal (macular) diseases; B) high chance, mostly congenital diseases like albinism and nystagmus; C) mixed ocular disease. Subjects received a complete visual assessment in different lighting conditions ranging from 159 cd/m^2 (‘daylight’) to 0.1 cd/m^2 (‘night’). Subjects took one or more driving lessons in the dark at an official driving school. Finally they performed an official practical fitness-to-drive test in the dark.

Results: From the 30 candidates, 10 (33%) passed the practical fitness-to-drive test in the dark. There was no apparent effect of any visual function or medical background on success rate. Most errors were made on adjusting speed, maintaining lateral position, anticipation of unexpected events and detection of traffic signs.

Conclusions: Some low vision drivers can drive safely with a bioptic at night. Success rate cannot be predicted reliably from dedicated visual assessment, nor from the kind of eye disease. A practical fitness-to-drive test remains an essential tool to determine the ability to drive safely with a bioptic telescope system at night.

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Disclosures: None

3. Detection of road hazards when viewing through a bioptic telescope

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Introduction: It has been suggested that the ring scotoma of a bioptic telescope may impair detection of peripheral hazards when viewing through the telescope. Using a realistic task in a driving simulator, we are examining whether the fellow eye can compensate for the ring scotoma when using a monocular bioptic telescope.

Methods: While driving, participants use a monocular bioptic telescope to read information from road signs which appear at pseudo-random intervals. They are also instructed to press the horn whenever they saw a pedestrian hazard. About 60% of the pedestrians are programed to appear and run across the road ahead of the driver for 1 s while participants are reading signs through the bioptic. If participants look into the telescope at the expected time, then these pedestrians will be within the area of the ring scotoma. Head movement recordings are analyzed to determine when each participant actually dipped their head to use the bioptic and to determine whether the pedestrian appeared before or only while using the bioptic.

Results: Twelve normally-sighted participants wearing spectacles with diffusing filters that reduced visual acuity to median of 6/36 (decimal acuity 0.16) have completed the study. Under binocular viewing conditions, there was no significant difference in detection rates for pedestrians that appeared before or while using the bioptic; 80% vs. 91%, $p = 0.20$. However, under monocular viewing conditions with the fellow-eye patched (equivalent to using a binocular telescope), detection rates were significantly higher when the pedestrian appeared before using the bioptic than when it appeared while using the bioptic and was likely within the area of the ring scotoma; 77% vs. 28%, $p < 0.001$. Detection rates were 100% for pedestrian hazards not coincident with signs. Participants were slower to react to pedestrians when using than not using the telescope; 1.2 vs. 0.9 s, $p = 0.002$. Data collection from visually impaired bioptic drivers is ongoing ($n = 6$ to date) with similar results thus far.

Conclusions: Our results suggest that the fellow eye is able to compensate for the ring scotoma when performing a sign-reading task through a monocular bioptic telescope. However, detection rates are lower and reaction times longer than when not using the bioptic.

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