Low Vision

# Visually Impaired Drivers Who Use Bioptic Telescopes: Self-Assessed Driving Skills and Agreement With On-Road Driving Evaluation

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Submitted: October 28, 2013
Accepted: December 12, 2013

Citation: Owsley C, McGwin G Jr, Elgin J, Wood JM. Visually impaired drivers who use bioptic telescopes: self-assessed driving skills and agreement with on-road driving evaluation. *Invest Ophthalmol Vis Sci*. 2014;55:330–336. DOI:10.1167/iovs.13-13520

**Purpose.** To compare self-assessed driving habits and skills of licensed drivers with central visual loss who use bioptic telescopes to those of age-matched normally sighted drivers, and to examine the association between bioptic drivers' impressions of the quality of their driving and ratings by a "backseat" evaluator.

**Methods.** Participants were licensed bioptic drivers ($n = 23$) and age-matched normally sighted drivers ($n = 23$). A questionnaire was administered addressing driving difficulty, space, quality, exposure, and, for bioptic drivers, whether the telescope was helpful in on-road situations. Visual acuity and contrast sensitivity were assessed. Information on ocular diagnosis, telescope characteristics, and bioptic driving experience was collected from the medical record or in interview. On-road driving performance in regular traffic conditions was rated independently by two evaluators.

**Results.** Like normally sighted drivers, bioptic drivers reported no or little difficulty in many driving situations (e.g., left turns, rush hour), but reported more difficulty under poor visibility conditions and in unfamiliar areas ($P < 0.05$). Driving exposure was reduced in bioptic drivers (driving 250 miles per week on average vs. 410 miles per week for normally sighted drivers, $P = 0.02$), but driving space was similar to that of normally sighted drivers ($P = 0.29$). All but one bioptic driver used the telescope in at least one driving task, and 56% used the telescope in three or more tasks. Bioptic drivers' judgments about the quality of their driving were very similar to backseat evaluators' ratings.

**Conclusions.** Bioptic drivers show insight into the overall quality of their driving and areas in which they experience driving difficulty. They report using the bioptic telescope while driving, contrary to previous claims that it is primarily used to pass the vision screening test at licensure.

Keywords: bioptic telescope, driving, low vision

An estimated 2.4 million Americans older than 40 years have best-corrected visual acuity worse than 20/40 yet better than 20/200.[1] Since population-based visual acuity data are not available for the under-40 population in the United States, this is likely to be an underestimate of the number of adults in the United States who have visual acuity in this range. Under current vision standards in most states in the United States and in other countries, individuals with this level of visual acuity impairment would be denied a driver's license. However, there are 43 states in the United States where persons with moderate vision impairment (ranging from worse than 20/40 to 20/100 or 20/200 depending on the state) can obtain a driver's license if they demonstrate proficiency in the use of a bioptic telescope and other licensure criteria are met.[2,3] Bioptic driving is also permitted in The Netherlands[4] and in some Canadian provinces,[3] but is prohibited in most countries.

A bioptic telescope is an assistive device for persons with central vision impairment.[5] The telescope is mounted in the upper portion of a regular spectacle lens ("carrier" lens) or attached to the spectacle frame. The carrier lens consists of the distance refractive correction (it is plano if no correction is needed). Most use a monocular bioptic telescope, although binocular telescopes are also used. The most common telescope magnifications used for driving are 2× and 4× and provide a field of view between 6° and 16°. The bioptic driver views the roadway environment through the carrier lens for the vast majority of the time when driving, dipping the head very briefly to spot signs, traffic signals, pedestrians, and other potential obstacles through the telescope.[6]

Previous research on bioptic drivers[7–9] suggests that a bioptic license strongly enhances life satisfaction including employment options. However, the driving safety and performance of bioptic drivers have not been extensively studied, and as a result there are many unanswered questions.[10] A few studies have examined motor vehicle collisions among bioptic drivers.[11–17] The results of these studies are inconsistent, which may be attributable to methodological problems such as small samples, uncertainty as to whether the driver was wearing the bioptic, and inappropriate comparison groups. A recent driver safety study by Vincent et al.[18] compared motor vehicle collisions between a small group of bioptic drivers and two comparison groups and demonstrated elevated but not statistically significant increases. In a recent driving performance study, Wood et al.[19] assessed on-road driving performance by bioptic drivers in regular traffic. Bioptic drivers were more likely to display problems with steering steadiness and lane position and had lower rates of correct road sign recognition but were indistinguishable from normally sighted drivers in terms of many driving skills (e.g., pedestrian detection, speed, gap judgment, braking, obeying signs). All but 1 of 23 bioptic drivers were rated as safe to drive by the backseat evaluators and also by a certified driving rehabilitation specialist.

The purpose of this study was to examine how bioptic drivers self-assess their own driving skills and how their impressions compare to those of normally sighted drivers. Domains addressed by our questionnaire were driving difficulty, exposure, and space (how far one drives away from home base), as well as self-rated quality of driving. Bioptic drivers were also asked to indicate whether or not they used their bioptic in a variety of roadway situations. We have also compared bioptic drivers' self-reports of their driving quality with ratings provided by a backseat evaluator during an on-road driving assessment to examine their self-awareness of their driving problems.

## Methods

Informed consent was obtained from all participants. This research was compliant with the Health Insurance Portability and Accountability Act (HIPAA) of the United States. Approval for this research was obtained from the Institutional Review Board at the University of Alabama at Birmingham (UAB). This research adhered to the Declaration of Helsinki.

Participants were persons who had previously prepared for bioptic licensure through the UAB Driving Assessment Clinic and successfully obtained a bioptic license in the state of Alabama. We also enrolled a group of drivers who were normally sighted and age matched to the visually impaired drivers ($\pm$2 years within the bioptic driver's age). To qualify for bioptic driving in Alabama, persons must have visual acuity with the carrier lens of 20/200 or better in each eye and 20/60 or better through the bioptic telescope. Visual fields without the bioptic telescope must extend 110° across the horizontal and 80° across the vertical. Both monocular and binocular telescopes are legal in Alabama. Prior to an individual's becoming a candidate for licensure, an ophthalmologist or optometrist verifies that visual acuity and fields meet eligibility criteria. Patients must have this confirmed by an ophthalmologist or optometrist on an annual basis thereafter. Licensed bioptic drivers are not allowed to drive at night in Alabama unless they undergo additional on-road training at night and receive an acceptable night driving rating by a certified driving rehabilitation specialist (CDRS).

The Driving Habits Questionnaire[20] was modified for use in this study. It was interviewer administered prior to the driving assessment and addressed the following domains: driving exposure (annual miles driven, number of places and trips driven per week), whether the bioptic was used during driving and if it was useful, driving difficulty in 24 driving situations, and some general driving information. Responses to driving difficulty items ranged from "no difficulty at all" to "a little difficulty," "moderate difficulty," "extreme difficulty," or "don't do this because of my visual problems" (scored 5, 4, 3, 2, or 1, respectively). We collected demographic information and characteristics of the bioptic telescope, years driving experience with the telescope, and whether the bioptic driver had received on-road driver training. Information was obtained from the medical record on the etiology of the vision impairment and the presence/absence of nystagmus.

Visual acuity with habitual correction through the carrier lens was assessed for the right eye, the left eye, and binocularly using the standard protocol of the Electronic Visual Acuity tester[21] and expressed as logarithm of the minimum angle of resolution (logMAR). Visual acuity through the bioptic telescope was also assessed. Letter contrast sensitivity was measured binocularly and monocularly for each eye through the carrier lens using the Pelli-Robson chart[22] under the recommended testing conditions, scored by the letter-by-letter method,[23] and expressed as log sensitivity.

Two "backseat" evaluators trained in the use of a driving performance rating scale provided judgments about on-road driving performance by the bioptic and normally sighted drivers. The details of the on-road assessment are provided in a previous report,[19] and thus only key elements will be summarized here. On-road driving performance was assessed under natural in-traffic conditions on a 14.6-mile course during the day in commercial and residential areas. A CDRS sat in the front passenger seat of the test vehicle and monitored safety. She had access to a passenger-side vehicle brake for the purposes of maintaining safety. Each backseat evaluator independently provided ratings on eight driving behaviors/skills using a 3-point scale described in detail elsewhere,[24] with "1 = Failure to execute skill/behavior," "2 = Some problems with executing skill/behavior but not complete failure," and "3 = Good execution of skill/behavior." One backseat evaluator, designated as the primary evaluator, sat in the middle of the backseat (positioned so that she did not obscure the driver's view of the rearview mirror), with the second evaluator sitting behind the driver. The eight driving behaviors evaluated were (1) scanning and attention to other road users, signs, and markings; (2) lane position of the vehicle; (3) steering steadiness, involving smoothness of steering at any point of the drive; (4) appropriate use of speed relevant to road conditions and the speed limit; (5) gap judgment between the driver and other cars when entering traffic flow or intersections or passing moving or parked cars and following distance; (6) appropriate use of braking to allow smooth driving and stopping as required; (7) directional indicator use to signal to other road users intention to change direction; and (8) obeying signs and signals. After the drive was complete, each rater also provided a global rating of performance on a 5-point scale, which summarized the rater's overall impression of the quality of driving for that behavior. The 5-point scale was 1 = driver is unsafe and the drive was, or should have been, terminated; 2 = driver is unsafe, the drive was completed; 3 = driver's performance was unsatisfactory but not unsafe; 4 = driver was safe but demonstrated several minor flaws; and 5 = driver was safe and demonstrated either flawless or near flawless driving performance. An instraclass correlation coefficient (ICC) evaluated agreement for the global ratings between the two backseat evaluators; the ICC was 0.93.[19] For analytic purposes, the primary evaluator's ratings were used.

Correct detection of pedestrians, road signs, and traffic lights was also recorded by the backseat evaluators. As participants drove the route, they were asked to "call out" each time they saw pedestrians and to identify all road signs and traffic lights on the route, which the evaluators then recorded. Correct detection was verified subsequent to the drive by reviewing four-channel video that recorded the driver and vehicle environment during the drive. Pedestrian detection was determined by identifying the number of times participants correctly reported the presence of a pedestrian, which was broadly defined as a pedestrian, road worker, or cyclist encountered on the route. In real-world driving such as that

**Table 1.** Demographic and Visual Function Characteristics of Bioptic Drivers and Normally Sighted Drivers

| Characteristic | Bioptic Drivers | Normally Sighted Drivers | *P* Value |
|---|---|---|---|
| Age, y, mean (SD) | 33 (12) | 33 (12) | 0.95 |
| Sex, *n* (%) | | | |
| Female | 5 (22) | 13 (56) | 0.03 |
| Male | 18 (78) | 10 (44) | |
| Race/ethnicity, *n* (SD) | | | |
| White, non-Hispanic | 20 (87) | 19 (83) | 1.0 |
| African American | 3 (13) | 4 (17) | |
| Visual acuity OU, *n* (%) | | | |
| 20/20 or better | 0 | 21 (91.3) | <0.0001 |
| 20/60 or better but worse than 20/20 | 0 | 2 (8.7) | |
| 20/100 or better but worse than 20/60 | 18 (78.3) | 0 | |
| 20/200 or better but worse than 20/100 | 5 (21.7) | 0 | |
| Worse than 20/200 | 0 | 0 | |
| Visual acuity OD, *n* (%) | | | |
| 20/20 or better | 0 | 16 (70.0) | <0.0001 |
| 20/60 or better but worse than 20/20 | 0 | 7 (30.4) | |
| 20/100 or better but worse than 20/60 | 12 (52.2) | 0 | |
| 20/200 or better but worse than 20/100 | 10 (43.5) | 0 | |
| Worse than 20/200 | 1 (4.3) | 0 | |
| Visual acuity OS, *n* (%) | | | |
| 20/20 or better | 0 | 18 (78.3) | <0.0001 |
| 20/60 or better but worse than 20/20 | 0 | 5 (21.7) | |
| 20/100 or better but worse than 20/60 | 15 (65.2) | 0 | |
| 20/200 or better but worse than 20/100 | 8 (34.8) | 0 | |
| Worse than 20/200 | 0 | 0 | |
| Visual acuity through the bioptic telescope,* *n* (%) | | | |
| 20/20 or better | 6 (24) | Not applicable | |
| 20/40 or better but worse than 20/20 | 19 (76) | | |
| 20/60 or better but worse than 20/40 | 0 | | |
| Worse than 20/60 | 0 | | |
| Contrast sensitivity OU, log sensitivity, *n* (%) | | | |
| 1.80 or better | 7 (30.4) | 23 (100) | <0.0001 |
| 1.60 to <1.80 | 8 (34.8) | 0 | |
| 1.40 to <1.60 | 4 (17.4) | 0 | |
| 1.20 to <1.40 | 4 (17.4) | 0 | |
| <1.20 | 0 | 0 | |

OU, both eyes together; OD, right eye; OS, left eye.
* Twenty-five eyes are represented here because 2 of the 23 participants had binocular telescopes.

used in this study, it is impossible to control pedestrian events; for the 46 drivers in this study, there were a total of 77 pedestrians (45 for the bioptic drivers and 32 for the normal control drivers). There were 58 road signs and 25 traffic lights on the route.

The bioptic and normal control groups were compared using paired *t*-test and McNemar's test to account for the pair-matched nature of the study design. Statistical significance was defined as $P \leq 0.05$ (two-tailed).

## Results

Forty-three bioptic drivers were eligible to participate in the study based on their having licensure through Alabama's bioptic telescope program at the time of the study. The final sample consisted of 23 bioptic licensed drivers; reasons for declining participation in the study have been reported previously.[19] None of the bioptic drivers were licensed for night driving. The bioptic drivers had on average 3.7 years of driving experience with a bioptic telescope (SD 5.8 years), ranging from starting bioptic driving less than a year before they enrolled in the study to 28 years of bioptic driving experience. Seven of the bioptic drivers had nonbioptic driving experience before they became bioptic drivers; they averaged 21.7 years of nonbioptic driving (SD 14.8 years).

Twenty-three age-matched normally sighted licensed drivers were also enrolled. Table 1 provides information on demographics and visual function for drivers in both groups. By design, the ages of the two groups were the same. Men were more common among the bioptic drivers than among the normally sighted. Whites and African Americans were similarly distributed in the two groups. As would be expected, the bioptic drivers had worse visual acuity through the carrier lens as compared to the normally sighted drivers. Through the bioptic telescope, the visual acuity of all the bioptic drivers was much improved, with all drivers being 20/60 or better. Table 2 provides information on the bioptic driver sample with respect to etiology of vision impairment, nystagmus, and telescope characteristics. Nearly all bioptic drivers had received formal

**Table 2.** Characteristics of Bioptic Drivers

| Characteristic | *n*, %* |
|---|---|
| Primary etiology of vision impairment | |
| Hereditary optic atrophy | 7, 30 |
| Ocular albinism | 5, 22 |
| Stargardt's disease | 3, 13 |
| Cone dystrophy | 1, 4 |
| Oculocutaneous albinism | 1, 4 |
| Optic atrophy from trauma | 1, 4 |
| Optic nerve trauma at birth | 1, 4 |
| Achromatopsia | 1, 4 |
| Congenital cataracts | 1, 4 |
| Aniridia | 1, 4 |
| Myelinated retinal nerve fibers associated with myopia | 1, 4 |
| Nystagmus | 9, 39 |
| Telescope type | |
| Monocular | 21, 91 |
| Binocular | 2, 9 |
| Telescope manufacturer | |
| Designs for Vision (Ronkonkoma, NY) | 8, 35 |
| Ocutech (Chapel Hill, NC) | 15, 65 |
| Bioptic telescope focus | |
| Fixed | 6, 26 |
| Manual | 17, 74 |
| Magnification | |
| 2.2× | 5, 22 |
| 4× | 18, 78 |

* Percentage will not add to 100 on all variables because of rounding.

on-road training with the bioptic telescope (22 of 23, 96%); and on average, bioptic drivers had 6 years (SD 8 years) of experience driving with the bioptic telescope after they were licensed.

Figure 1 displays whether or not bioptic drivers reported that they used the telescope in various on-road situations and that it was helpful. Over 50% of drivers reported that they used the telescope because it was helpful in judging when to make turns and when safe to pass; identifying pedestrians, other roadway hazards, brake/signal lights on the vehicle in front, and traffic lights; and reading street-name signs and road signs. Very few drivers reported that the telescope was useful in checking the speedometer or judging distance. All but one driver reported using the telescope in at least one or more driving tasks. This driver, who had 20/80 binocular acuity through the carrier lens, did not report using the telescope in any tasks. Over half the sample (56%) reported using the telescope in three or more tasks. The number of tasks for which drivers reported using the telescope was unrelated to binocular acuity ($P = 0.413$) and contrast sensitivity ($P = 0.580$).

Driving space refers to the spatial extent one drives in one's environment. Bioptic drivers were very similar to normally sighted drivers with respect to reported driving space ($P = 0.29$; Fig. 2). All drivers, regardless of whether they were bioptic telescope users or normally sighted, drove to neighboring towns, and all but one in each group drove to more distant towns. There was a small tendency for normally sighted drivers to be more likely to venture outside Alabama; however, both groups had four drivers who drove outside the southeast region of the United States.

Bioptic drivers reported driving fewer miles per week as compared to normally sighted drivers ($P = 0.0224$; Table 3). In addition, they traveled to slightly fewer places per week ($P = 0.0022$) and made fewer trips per week than did normally sighted drivers ($P = 0.0002$). All but one driver in each group preferred to be the driver when traveling with another driver, rather than have the other person drive ($P = 1.0$). Bioptic drivers were more likely to report that they drove more slowly than the general traffic flow ($P = 0.0006$). Only one bioptic driver reported that someone had suggested she stop driving, with none of the normally sighted drivers reporting this ($P = 0.5$). When asked to rate the quality of their driving as excellent, good, average, fair, or poor, the distribution of ratings was shifted to lower ratings among the bioptic drivers as compared to normally sighted drivers ($P = 0.0035$).

Bioptic drivers reported difficulty levels statistically similar to those of normally sighted drivers in a number of driving situations, including left-hand turns across oncoming traffic ($P = 0.935$), interstate/expressway ($P = 0.488$), high-traffic roads ($P = 0.071$), rush hour ($P = 0.069$), changing lanes ($P = 0.233$), merging ($P = 1.0$), driving in areas with traffic lights ($P = 0.215$), driving long distance ($P = 0.460$), backing up ($P = 1.0$), seeing objects on side of road ($P = 0.243$), and finding the places they wanted to go ($P = 0.266$). However, Figure 3 shows five driving situations in which the bioptic drivers reported significantly more difficulty than normally sighted drivers, specifically, driving into bright light, driving in unfamiliar areas, identifying traffic lights, driving in rain, and driving when

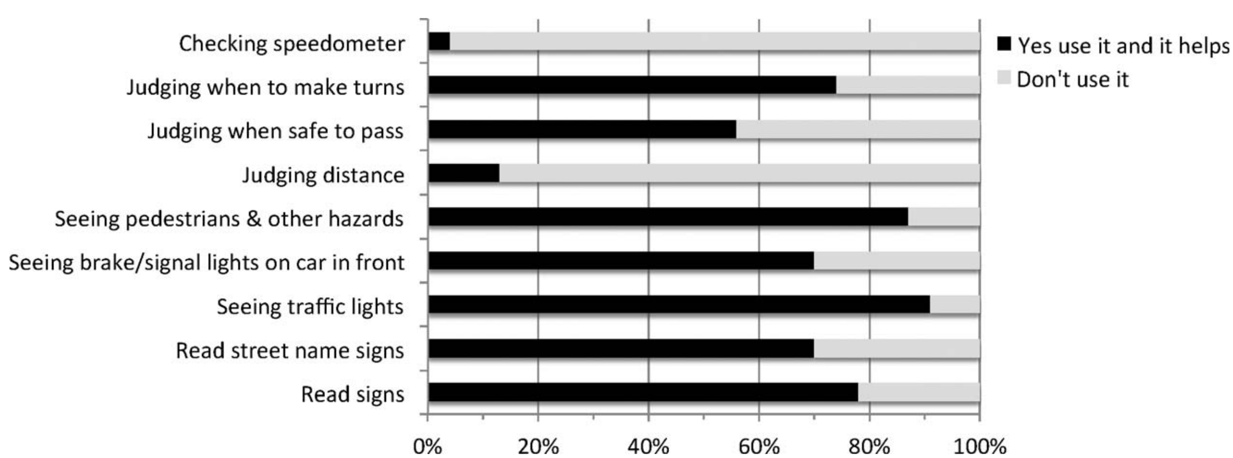


**Figure 1.** Percentage of bioptic drivers who report that telescope is useful and helps them, versus those who report they do not use it, for various driving tasks.

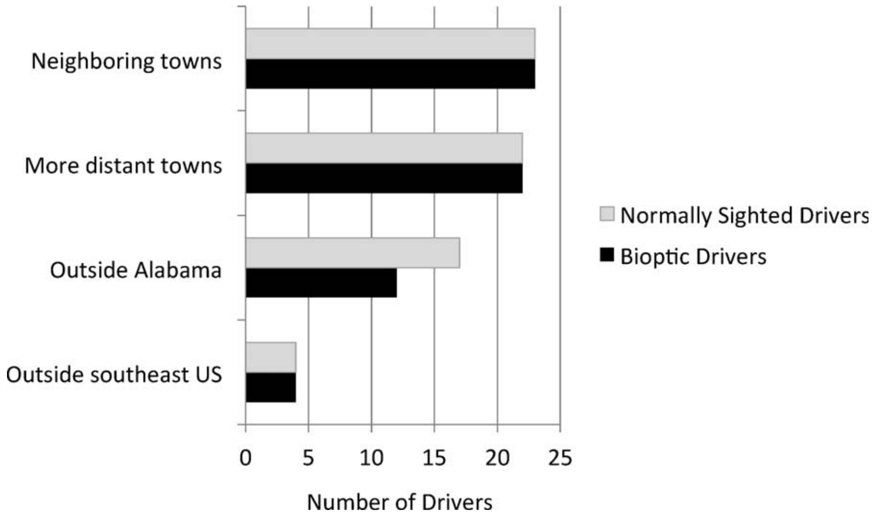


**Figure 2.** Number of bioptic and normally sighted drivers who report driving to increasingly distant geographic areas ("driving space").

alone. Although not shown in Figure 3, the following situations also elicited more self-reported difficulty from bioptic drivers: driving at dusk ($P = 0.046$) and driving into the sun when it is near or at the horizon ($P = 0.005$).

We examined whether self-reported overall quality of driving by the bioptic drivers corresponded to the backseat evaluator ratings. We had only one bioptic driver who was rated unsafe (defined as overall ratings of 1 or 2 on the 5-point scale) by the backseat evaluator, yet this driver rated her driving as good. The remaining bioptic drivers were rated as safe, and all described their driving as good or average. None of the normally sighted drivers were rated as unsafe, and all normally sighted drivers self-rated their driving as average, good, or excellent. There was a great deal of agreement between the backseat evaluator ratings of driving skills and bioptic drivers' self-ratings of driving difficulty in various situations. Backseat evaluators rated all bioptic drivers as having excellent or good scanning skills, and all reported either no or a little difficulty in seeing objects off to the side, changing lanes, merging, and passing vehicles on a two-lane road—maneuvers that involve scanning. Backseat evaluators also rated all bioptic drivers as 2 or 3 (i.e., good or some problem but not complete failure) in lane positioning, and all bioptic drivers reported no or little difficulty in changing lanes, merging, and passing. With the exception of one driver in each of the following comparisons, bioptic drivers expressed no or a little difficulty in changing lanes, merging, and passing another vehicle, and correspondingly the backseat evaluators also rated steering steadiness as 2 or 3. There was good agreement between bioptic drivers' self-rating of their ability to identify traffic signals and the ratings by backseat evaluators, with ratings for 20 out of 23 drivers being commensurate between bioptic drivers and the evaluators.

**Table 3.** Self-Reports of Driving Exposure and Self-Rated Quality of Driving for Bioptic Drivers and Normally Sighted Drivers

| Characteristic | Bioptic Drivers | Normally Sighted Drivers | *P* Level |
|---|---|---|---|
| Miles per week, mean (SD) | 250 (220) | 410 (236) | 0.0224 |
| Places per week, mean (SD) | 5 (1.5) | 6 (1.5) | 0.0022 |
| Trips per week, mean (SD) | 12 (4.8) | 18 (6.0) | 0.0002 |
| Quality of driving, *n* (%) | | | |
| Excellent | 0 (0) | 8 (35) | 0.0035 |
| Good | 17 (74) | 13 (57) | |
| Average | 6 (26) | 2 (9) | |

## Discussion

The vast majority of bioptic drivers in our study indicated that they found the telescope useful for a number of driving tasks (e.g., seeing traffic lights, pedestrians, roadway obstacles). These results, together with those from previous work,[7,9] argue against claims that the bioptic telescope is principally used to pass the vision screening test for licensure determination and subsequently not used during actual driving.[25,26] These data are from self-reporting, and some may question the veracity of participants' responses, yet naturalistic driving studies using video of a driver's behavior[27] can ultimately confirm the real-world, on-road use of the telescope.

Compared to normally sighted drivers, bioptic drivers had reduced driving exposure in terms of the number of miles, trips, and places driven per week. This reduced exposure behind the wheel may reflect cautiousness about driving since these drivers are well aware of their vision impairment, and/or the reduced exposure may represent their adopting efficient and well thought-out strategies for planning and executing trips. In any case, though, it is important to underscore that the bioptic drivers, while driving less than the normally sighted drivers, reported considerable levels of driving exposure on the road, on average driving 250 miles per week. In addition, the driving space of the bioptic drivers was not more limited than that of the normally sighted drivers in that the bioptic drivers were just as likely to venture out of their own community, making excursions to distant towns and other regions of the state, as well as outside the state. This illustrates the importance of the bioptic telescope in facilitating their independent mobility.

In some challenging situations, bioptic drivers reported little or no difficulty, as did the normally sighted drivers (e.g., left turns, interstates/expressways). Yet in other situations the bioptic drivers experienced more difficulty compared to the normally sighted drivers. These situations fell into three categories—poor visibility conditions (rain, dusk, bright light, and into sun), lack of familiarity with the spatial characteristics

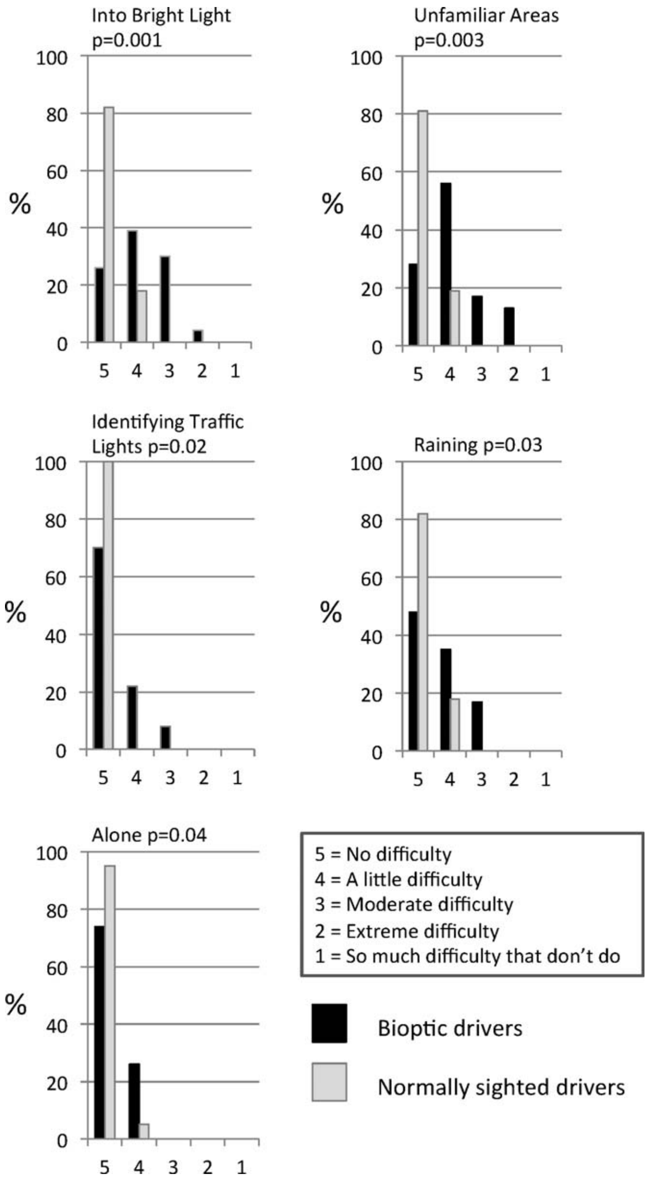


FIGURE 3. Difficulty ratings reported by bioptic and normally sighted drivers for various driving situations. Shown as percent of each group expressing no difficulty (5), a little difficulty (4), moderate difficulty (3), extreme difficulty (2), and so much difficulty that the person does not engage in that driving situation (1).

of the route (unfamiliar areas), and circumstances when there is not someone else in the vehicle (driving alone). These findings suggest that it would be prudent for bioptic training programs to teach visually impaired drivers to have backup plans for transportation when visibility conditions are poor (e.g., raining, route heads into the horizon), and that visually impaired drivers using a bioptic need to become thoroughly familiar with new routes ahead of time as a passenger before actually driving the route.

While over 90% of the normally sighted drivers reported the quality of their driving as excellent or good, the range of bioptic drivers' ratings was shifted downward to good and average ratings. This may reflect their self-awareness that indeed their vision impairment makes them on occasion more vulnerable to misperceptions on the road. Over half (56%) of bioptic drivers reported driving more slowly than the general traffic flow, illustrating their use of a practical compensatory strategy, since slower speed likely gives them more time to detect critical features of the roadway environment and adjust vehicle control appropriately. This result is reminiscent of findings that under conditions of simulated visual impairment that reduce visual acuity, drivers on a closed course reduce the speed of their vehicles.[28]

Our study indicates that the vast majority of bioptic drivers are not overconfident about their skill sets. In fact, most of their difficulty ratings were in close agreement with skill ratings provided by the backseat evaluators. There was one noteworthy exception, with the driver rating her driving overall quality as good while the backseat evaluators rated the driving as unsafe. Subsequent to her study visit we learned that soon after she had become licensed to drive with a bioptic, she did not drive for months because she did not have a vehicle. It is possible that her refraining from driving during this period contributed to erosion of her driving skills. This highlights that maintenance of driving skills in this population may depend on routine engagement in driving.

Strengths and limitations of the study must be considered. In this study, in contrast to another recent survey,[9] the size and characteristics of the source population were known, which informs the participation rate and facilitates the generalizability of the results. Although we were not able to enroll all bioptic drivers in Alabama who were licensed at the time, our sample included over half of the population. Our study addressed several driving domains in detail, namely bioptic telescope use and experiences with driving difficulty in challenging driving situations. Visual acuity through the carrier lens and through the bioptic was assessed on all participants on the day they completed the survey and drove on the open road, which was not the case in previous surveys.[7–9] Etiologies of vision impairment were known through access to medical records. Limitations include a relatively small sample. Also, it remains to be determined whether our findings generalize to other states in the United States and other countries where bioptic driving is permitted, given that the eligibility criteria and training programs for bioptic licensure can vary widely across jurisdictions.[2,3]

In summary, our study suggests that the vast majority of bioptic drivers find the bioptic telescope useful as an assistive device in a range of driving tasks. They are not overconfident with respect to their ability to execute critical driving skills, in that their own ratings about the difficulty of driving tasks and overall quality of driving are very similar to backseat evaluators' ratings of their driving. Skills that they find more difficult than normally sighted drivers are those undertaken under diminished roadway visibility conditions, when driving in unfamiliar areas, and when driving alone with no passenger to help with navigation. These results could be useful for guiding rehabilitation specialists in teaching bioptic drivers how to minimize exposure to these more challenging situations.[29] Naturalistic driving studies, in which unobtrusive instrumentation for recording driving behavior and vehicle control is installed in the vehicle,[27] should be useful in examining the extent to which these self-reports of driving habits by bioptic drivers can be documented objectively.


## *Acknowledgments*

Supported by National Institutes of Health Grants R01EY18966 and P30AG22838, the EyeSight Foundation of Alabama, the Able Trust, Research to Prevent Blindness, and a Queensland University of Technology Professional Development grant.

Disclosure: **C. Owsley**, None; **G. McGwin Jr**, None; **J. Elgin**, None; **J.M. Wood**, None

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