

Looking Beyond Bioptic Telescopes

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For the past 40 years, bioptic telescopes have been the most frequently used option to allow drivers with visual impairments to maintain driving independence. However, bioptic telescopes require a switching of visual attention, potentially leading to driver distraction and emphasizing the need for additional research on modern alternatives.

BIOPTIC TELESCOPES

A distance vision-enhancing device that magnifies between two and six times and is used to improve distance vision for those with impaired vision.



Key points:

- Thousands of Americans with visual impairments use bioptic telescopes to maintain mobility and independence. Since their use in driving began in the last half century, driving culture and technologies have dramatically evolved.
- There are no uniform qualification vision standards for driving in the US. Many states require the use of bioptic telescopes for an individual with visual impairments to obtain a driver's license
- Bioptic telescopes require a driver to switch attention and may result in inattention blindness. Additionally, wayfinding has advanced dramatically with modern technologies like GPS and advanced driver assistance systems.
- More research is needed on less distracting alternatives to bioptic telescopes.
- It is essential to establish a national vision standard for driving that allows for individual review via behind the wheel testing for those who do not meet basic standards of visual acuity and/or visual fields but who still feel they can safely operate a motor vehicle. As part of this individual review, policies must be developed that consider the benefits of operating a car with advanced safety features, similar to how individuals with physical limitations have been able to do so with adapted cars over the last few decades.

First reportedly used for driving in 1970, bioptic telescopes aid drivers with visual impairments in reading street signs while hopefully still maintaining awareness of the environment around them. Bioptic telescope proponents assert that these devices are only used for a small percentage of driving time (5-10%) for wayfinding tasks^{1,2} such as reading street signs. Currently, there are several thousand drivers with visual impairments in the US using bioptic telescopes, though the exact number is unknown.

As driving culture and technologies change, our laws and policies may also need to evolve. The vast majority of states require the use of a bioptic telescope for individuals with low vision to qualify for driving privileges. But since using bioptic telescopes while driving was introduced

half a century ago, new technologies have been developed to decrease visual distraction for drivers. To improve safety for everyone on our roadways, more research is needed into bioptic telescope alternatives and state laws, as well as reexamining policies.

EXISTING LAWS

There are no uniform qualification vision standards for driving. States have different standards for restricted driving privileges in a number of categories, including the use of bioptic telescopes. These variations result in an individual being able to be licensed in some states, while not even being considered for driving in others.

Forty-three states require the acquisition of a bioptic telescope as the only way for an individual with visual acuity of less than

20/70 to obtain a driver's license.³ However, research has never shown that drivers using bioptic telescopes are safer than drivers with vision loss who do not use a bioptic telescope.³

DISTRACTION

Individuals cannot attend to two tasks simultaneously. Tasks involving significant visual demand have the greatest potential for negative effects on driving performance,⁴ as there is a time lag⁵ associated with switching attention from one activity to another. With bioptic telescopes, 'switching' of visual attention when trying to read a street sign is similar to trying to read a cellphone when driving. Both of these activities remove vital attention from the forward roadway and interfere with safe driving. Additionally, inattention blindness, when cognitively distracted, can reduce a driver's ability to see and process important hazards in the road. Bioptic telescopes exacerbate this effect further as they can virtually eliminate the driver's peripheral awareness and restrict the visual field when being used. It is well documented that eyes-on-road time is most predictive of missing a hazard in the forward view.^{6,7} And an ill-timed switch of view with a bioptic telescope could result in missing a pedestrian or slowing/stopped vehicle ahead. It is important to recognize that glancing at the speedometer, rearview mirror, sideview mirror, or blind spot detector light on a sideview mirror are considered check glances, which take little time (200-400ms) compared to the time it takes to view a sign with a bioptic telescope (requires a sustained glance off the forward roadway).

At 55mph, taking one's eyes off the road for five seconds to view a street sign, with or without a bioptic telescope, is long enough to travel the length of a football field.⁶ Additionally, research has found that a driver cannot look away from the forward roadway for more than two seconds before lane position begins to breakdown.⁸

ALTERNATIVES

Research has shown significant reduction in driver workload with speech interfaces for drivers who do not have visual impairments.^{9,10,11} One significantly cheaper and readily available modern alternative to bioptic telescopes is the GPS navigation system that uses voice to announce turns and destinations. With GPS, the need to read street signs for wayfinding has been greatly reduced to a secondary validation. Drivers become familiar with the timing of the auditory voice alerting them to upcoming turns, thus allowing them to remain focused on the road and traffic.

Additionally, advanced driver assistance systems (ADAS) are increasingly available on cars at all price points, often with no additional costs. Some manufacturers now have almost all of their entire product line equipped with such technologies. These systems are designed to assist drivers by providing information, alerts, and varying levels of control based

on the environment around the vehicle. ADAS reduces the number and severity of crashes, making all drivers and those on our roadways safer.^{12,13,14}

WHAT CAN WE DO?

Not only is the switching of view within a bioptic telescope demanding, the visual field restriction of such devices reduces overall situation awareness by narrowing the driver's attention. Driver distraction principles support safer alternatives to bioptic telescopes because these audio options allow the driver to maintain their eyes and attention on the road and traffic around them. Ubiquitous technologies like phone and vehicle GPS systems could be inexpensive alternatives to requiring a bioptic telescope for driving.

In working toward better understanding driver performance of those with visual impairments, in fall 2019, the University of Iowa National Advanced Driving Simulator and University of Iowa Hospitals and Clinics will conduct a research study evaluating on-the-road driving performance of trained individuals using bioptic telescopes versus matched individuals using a talking GPS for wayfinding in unfamiliar driving environments. This study builds on a strong foundation of research from our experienced UI team.¹⁵

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