2017 SENATE TRANSPORTATION

SB 2123

2017 SENATE STANDING COMMITTEE MINUTES

Transportation Committee
Lewis and Clark Room, State Capitol

SB 2123
1/6/2017
26643

☐ Subcommittee
☐ Conference Committee

Committee Clerk Signature Mary Meunder

Operator's license renewal
Minutes:

Attachments #1-5

Chairman Laffen: Opened the hearing on SB 2123.

Mark Nelson, Deputy Director for Driver Vehicle Services at the North Dakota Department of Transportation: See Attachment #1.

(7:32) Glenn Jackson, Director of the driver's license division: See Attachment #2 and #3. This will not be a safety concern. Passport photos are every 10 years and have not had any issues. The people will apply online every other renewal year. We are looking to utilize our services without hiring new employees.

(14:17) Chairman Laffen: When you say business profit what is that pertaining to?

Glenn Jackson: Just meaning the business transaction in itself. We are trying to keep the transactions down to minimize the expense.

Senator Clemens: You say this is not a safety issue but what about CDL license carriers?

Glenn Jackson: That is a federal motor carrier process and they have not addressed this issue yet.

Senator Nelson: Why is the part that says we have so many days to change our address so small on the back of our driver's license?

Glenn Jackson: We have so much information to get on that area and we do it as small as is readable to include all the information needed.

Senator Rust: I am concerned about the accident reports where it states this person needs glasses and is not wearing them and has an accident. Does this go on the accident report?

Mark Nelson: It is possible but as of now there is no code on the crash reports for that.

Senator Clemens: With fraudulent things like eyeglasses already happening, is the online renewal going to be good enough?

Mark Nelson: The photos have to be secured and I think we have a secure system.

Chairman Laffen: Opposition to the Bill.

Nancy Kopp: I am the Executive Director for the North Dakota Optometric Association. Vision is vital in driving. How accurate is the vision test? We have professional testimony from Dr. Taya Patzman.

Dr. Taya Patzman, member, State Board of Optometry: See attachment #4

Jack McDonald, lobbyist for North Dakota Medical Association: See attachment #5

Brittany Schauer: **Doctor of Optometry, Mandan, ND**: So many people out there have gradual vision changes that they are unaware of till they have an eye exam. I would much rather see every 6 years for a vision test than to have it go to 12. Too much can happen in 12 years to diminish the eyesight of an individual.

Chairman Laffen: Did anyone from the DOT consider having renewals online take an eye exam within one year?

Glenn Jackson: No, not a human step, as then that would require another person to do the job.

Senator Casper: What if we change the renewals from every 6 years to 4 years and then it would be an 8-year gap instead of a 12-year gap.

Glenn Jackson: That would increase our work load tremendously. Please don't do that.

Senator Campbell: I want to counteract the information on your data. Could you comment on it?

Glenn Jackson: Let me just say that there will be a few that will slip through the cracks as it happens in any process that we have. We have looked into the safety process and there is no issue and through the motor carrier process and found no issue, administration no issues, other states no issues; so that would be my response to the question.

Mark Nelson: We looked at the data and looked at the studies and screening tests conducted and have found no issues with the safety of this process.

Senator Nelson: What is the penalty for perjury when filling out these applications?

Glenn Jackson: There is no penalty for lying on the forms but if they get caught their license is revoked.

Senator Rust: Is there a third party that can give us some input on this bill?

Glenn Jackson: No.

Nancy Kopp: This is truly a health and safety issue.

Chairman Laffen: Closed the hearing on SB 2123.

2017 SENATE STANDING COMMITTEE MINUTES

Transportation Committee
Lewis and Clark Room, State Capitol

SB 2123
1/26/2017
27482

☐ Subcommittee
☐ Conference Committee

Committee Clerk Signature *Mary Munder*

Explanation or reason for introduction of bill/resolution:

Relating to operator's license renewal.

Minutes: Attachments 1-4

Chairman Laffen: Reopened hearing for SB2123: This was the bill that proposed an online renewal for your driver's license in the sixth year and the issue had to do with eye exams. I threw out the idea to see if it would be possible to attach an online digital version of your last eye exam prescription. The Department of Transportation guys have taken that idea and have an amendment they all liked. So we will hear from them.

Glenn Jackson, Director of the Driver's License for the North Dakota Department of transportation: At the hearing Senator Rust had asked a question, I did some research and came up with a couple of papers for you all. See Attachments 1 – 4

Chairman Laffen: Glenn, you also brought us an amendment?

Glenn Jackson: Yes, I did. When they are filling out the information online it will get to the vision part, they will have a box to check, has your vision changed, and it will read, attach a document about your vision.

Chairman Laffen: If they send you an eye exam from five years ago then what?

Glenn Jackson. We are establishing a 16-month cut-off. The exam has to be within the last 16 months. Right now we can move 10 months in advance and we can accept the results from 6 months from the optometrist for that period.

Chairman Laffen: So if they click the box no there is no requirement for any documentation only if they clicked the box yes.

Glenn Jackson: If they clicked the box yes that stops it. They have to bring in to us whatever it was that changed their vision. With this amendment even if they click no they would still have to attach some vision information so we could review it.

Chairman Laffen: is that only if they previously had a restriction?

Glenn Jackson: No that's not the way this is phrased. It would be anyone. Even if they don't have glasses they would still have to attach a vision test before they could follow through with this process.

Chairman Laffen: Well that would be a significant change in this bill.

Glenn Jackson: That's correct.

Chairman Laffen: So under this change everyone would need a test somewhere along the line whether you have glasses or not.

Glenn Jackson: Correct.

Senator Casper: I have never had glasses in my life so I would not go pay money for an exam to send online when I could just go into the DMV and do it the old way that I always had done it.

Glenn Jackson: With this change that is correct. Our original intent was that people would self-certify and based on that self-certification we would move forward.

Senator Casper: Bottom line is we are not requiring everyone to take an eye test.

Chairman Laffen: Only if you apply online you would have to have a test.

Glenn Jackson: That is correct with this amendment.

Senator Rust: So it is fair to say if I hadn't had an eye test in the last 16 months I won't be applying online.

Chairman Laffen: Questions for Glenn? None. Thank you.

Nancy Kopp: North Dakota Optometric Association.

Senator Nelson: Will the doctors be satisfied with this?

Nancy Kopp: I did do a sample survey of our optometric members a week or so ago based on the proposed amendment by the DOT. I asked them who is this burden going to lie on, the DOT or the providers on this vision screening. Would you release the information to your patients that need it for the online application? Response was absolutely.

Senator Nelson: My husband's doctor did send a letter that said he was sight impaired and I am wondering if all doctors will do this or is it just ours.

Nancy Kopp: I think with the technology we have now it would not be a problem.

Nancy Kopp: I would like to question what kind of form would the DOT accept with the online application other than a specialist. That's why you have the other amendment that states the word specialist.

Chairman Laffen: Glenn what I understand then is you just need an eye exam with in the last 16 months prior to renewing your license online.

Glenn Jackson: Correct The information would have to come from a reliable source.

Chairman Laffen: The information from Nancy and from Glenn are two versions of the same amendment with different language. Committee, I don't know if we are going to act on this anymore today. I am struggling a little bit with it as you were all about government, trying to make it simpler, cheaper, and my opinion is if we put this in here it is going to wipe out any value of online renewal, having to attach something from an eye doctor is simply going to make it easier to go into the DMV and get a new license.

Senator Casper: I agree with you, having gone through this the last session. I predict that those of us who will be back here in 2 years from now, this will get passed and the folks from the Dot will be back to have it changed back again and this might become an old friend.

Senator Nelson: if the idea is to save money, going to an eye specialist isn't going to do it, even with our good health plan that we have.

Senator Rust: It is just easier to go to the DMV and get your license. Neither one of these amendments will do it.

Chairman Laffen: We are scarce on work next week so we will discuss this again then. Tomorrow is committee work and we will be short one so I think we will cancel tomorrow and we will adjourn till next Thursday.

2017 SENATE STANDING COMMITTEE MINUTES

Transportation Committee
Lewis and Clark Room, State Capitol

SB 2123
2/2/2017
27796

☐ Subcommittee
☐ Conference Committee

Committee Clerk Signature *Mary Mundes*

Explanation or reason for introduction of bill/resolution:

Relating to operator's license renewal.

Minutes:

Attachment #1

Chairman Laffen: I will bring the hearing to order on Groundhogs Day. We are going to SB 2123. This was the bill that the Transportation Department brought forward to create an online renewal for driver's license. The only concern is the vision requirement. We had an amendment proposed by the Optometric Association at our last hearing and we have another amendment by the same group, which has been handed out. Nancy or Courtney, would you like to explain this new amendment.

Courtney Koebele, from the North Dakota Medical Association: The new amendment just leaves it up to the department how they get the vision requirement. It is a process and not as easy as you would like it to be. See Attachment #1.

Chairman Laffen: If I understand this right the first Amendment says the DOT could waive the vision requirement and in the new amendment they may use information from the vision care provider. It still leaves it pretty open.

Courtney Koebele: Yes, that is correct, it leaves it open for them to see what works the best, and there won't be 100% of the people renewing their licenses this way. They have indicated maybe 20% would use this procedure.

Chairman Laffen: Both the original bill and the amendment still read that this is for people under 65.

Courtney Koebele: Yes, anyone over 65 will have to go through the regular process and can't use online anymore.

Chairman Laffen: Questions? None. Thank you.

Nancy Kopp with the Optometric Association: Basically our thoughts on striking the word waive on the vision requirements and using the word use, if you are waiving the vision requirements for online renewals, what type of a perception would that leave the general public in comparison to the in person. Are you going to start waiving the vision requirements for in person also? Just the word waive kind of disturbed us, as you are waiving it for this special population. We hope we can work with the department when they use the documentation for the online renewals to encourage accountability for the visual needs.

Chairman Laffen: Questions? None. Thank you. **We have a motion for the second North Dakota Optometric Association Amendment, from Senator Nelson. Seconded from Senator Clemens**. Discussion. None. **All in favor? Motion carried 5 to 1.**

Chairman Laffen: Any more thoughts or discussion on the bill?

Senator Rust: I will move a Do Pass as amended on SB 2123

Senator Campbell: Seconded

Chairman Laffen: Any discussion?

Senator Casper: I am voting against this as I just think we should do one thing or the other. I am not in favor of the middle ground here, though I do appreciate everyone's work on it.

Chairman Laffen: Senator Casper, there is a bill sitting in the house that deals with this just so you know.

Roll Call taken. Yeas-5, Nays-1, Absent-0

Senator Clemens will carry the bill.

ET
2-2-17
p. 1 of 1

17.8094.01001
Title.02000

Adopted by the Transportation Committee

February 2, 2017

PROPOSED AMENDMENTS TO SENATE BILL NO. 2123

Page 3, line 6, replace "waive" with "use vision information provided by the applicant to meet"

Renumber accordingly

Date: 2-2-17
Roll Call Vote #: 1

2017 SENATE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. "Enter Bill/Resolution No."

Senate Transportation Committee

☐ Subcommittee

Amendment LC# or Description: North Dakota Optometric Association brought amendment in. See Attachment #1

Recommendation: ☒ Adopt Amendment
☐ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions: ☐ Reconsider ☐ ____________

Motion Made By Nelson Seconded By Clemens

Senators	Yes	No	Senators	Yes	No
Chairman Lonnie J. Laffen	✓		Senator Carolyn Nelson	✓	
Senator Tom Campbell	✓				
Senator David Rust	✓				
Senator David Clemens	✓				
Vice Chairman Jonathan Casper		✓			

Total (Yes) 5 No 1

Absent 0

Floor Assignment ____________

If the vote is on an amendment, briefly indicate intent:

Date: 2.2.17
Roll Call Vote #: 2

2017 SENATE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. "Enter Bill/Resolution No." 2123

Senate Transportation Committee

☐ Subcommittee

Amendment LC# or Description: 17.8094.01001

Recommendation: ☐ Adopt Amendment
☒ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☒ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions: ☐ Reconsider ☐ ____________

Motion Made By Rust Seconded By Campbell

Senators	Yes	No	Senators	Yes	No
Chairman Lonnie J. Laffen	✓		Senator Carolyn Nelson	✓	
Senator Tom Campbell	✓				
Senator David Rust	✓				
Senator David Clemens	✓				
Vice Chairman Jonathan Casper		✓			

Total (Yes) 5 No 1

Absent 0

Floor Assignment Clemens

If the vote is on an amendment, briefly indicate intent:

REPORT OF STANDING COMMITTEE

SB 2123: Transportation Committee (Sen. Laffen, Chairman) recommends **AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS** (5 YEAS, 1 NAYS, 0 ABSENT AND NOT VOTING). SB 2123 was placed on the Sixth order on the calendar.

Page 3, line 6, replace "waive" with "use vision information provided by the applicant to meet"

Renumber accordingly

2017 HOUSE TRANSPORTATION

SB 2123

2017 HOUSE STANDING COMMITTEE MINUTES

Transportation Committee
Fort Totten Room, State Capitol

SB 2123
3/9/2017
#28591

☐ Subcommittee
☐ Conference Committee

Committee Clerk Signature	Jeanette Cook

Explanation or reason for introduction of bill/resolution:

A bill relating to operator's license renewal.

Minutes:

Attachments # 1 - 3

Chairman Ruby opened the hearing on SB 2123.

Glenn Jackson, Director, Driver's License Division, North Dakota Department of Transportation, spoke to introduce SB 2123. Written testimony was presented. See attachment #1, pages 1-9 10:20

Representative Nelson: Since you testified that the vision test is not related to vehicle safety, why are you still doing it?

Glenn Jackson: After reviewing all of the information that I have found on this topic, I am at a loss to understand why we still maintain the vision screening test at the counter. I can see doing it for initial permits because we have a lot of people coming in who have never even had an eye test before. After a certain age we should probably do a couple of tests for age conditions that might occur. For the vast majority of the people in the middle, I'm not sure why we should continue the screening. It would be a such a drastic change that it might be more difficult than just doing it online at this time.

Representative Nelson: What are the changes that limit me from renewing online?

Glenn Jackson: You are not allowed during the actual renewal process itself to update your address. Name changes, medical changes, and vision changes are other examples of those changes.

Representative Jones: Do people use your vision screening to see if they need to have eye problems?

Glen Jackson: A misnomer is that our vision screening is some type of an eye test. It is not an eye test in any way, shape or form. It is simply a vision screening to see that you can see some numbers on this line, which tells us that your vision is better than 20/40, and you can see the dots on each side that tells us that you have peripheral vision. It does not tell you what your needs are.

Vice Chairman Rick C. Becker: What will your staff do if there is a vision test? How will you know if there is a change? What value is someone's vision test? Is your staff trained on how to read a vision report, or if they are what will they compare it to, to know whether the people will be allowed to drive with their current status?

Glenn Jackson: Our staff is trained to read vision tests. We do compare the tests to our standard, which is 20/40 or above – that requires some form of restriction or activity. We have the driver record and can see currently if there is a restriction to wear glasses. All we will do at that time is use the information as a vision screening. If they already have to wear glasses, and they give us information that would fit into that category; we are going to process it. If they don't wear glasses at the present time, we get something that shows if their vision was 20/20, and we look at your record that shows you don't have to wear glasses which is not a change; we move forward. If someone sends us something, like 20/60, and we look at their record which has no restriction; that stops the process. They can't go forward because now they have had a significant change. We will assume that since there is no restriction on their record now, their visual acuity is at or better than 20/40. Now we get new information that they send us that shows a change that requires us to take steps. We will have to stop the renewal process and have them come into the office to do a screening with staff, or we have to do a medical request to get their vision in the system, so we can put the requirement to wear glasses or whatever is necessary at that point. We won't process changes during this renewal.

Vice Chairman Rick C. Becker: How recent must the vision report be that is uploaded online?

Glenn Jackson: The vision report must be 16 months prior to the expiration date.

Chairman Ruby: We will be asking the person renewing to provide proof of a vision test online. So, is this an increase in requirements from what we have now?

Glenn Jackson: The original bill said waive the requirements. It was because of various issues and reaching compromise that we went with "provide visual information" versus "providing a vision test". We thought that waiving it would be satisfactory because there is no evidence that visual acuity testing either supports or hinders driver safety.

Chairman Ruby: How much do you anticipate that this will save in either time or money?

Glenn Jackson: Time wise, if we get 10% of the people to do the online renewal, that is 10,000 renewals a year. It takes about 10 minutes to do a renewal; that is 20,000 minutes. It takes us 20 minutes to do a Class B road test, so that is 5,000 road tests. We looked at it from the perspective: how much real work can we do or how much capacity can we increase in our offices by not having so many people standing in the lobby to renew their license.

Chairman Ruby: Will that help address issues where you are way behind in letting people take driving tests?

Glenn Jackson: Yes, that is correct.

Representative Schobinger: Will this bill take away the ability to go to a local DMV to renew a driver's license?

Glenn Jackson: We are not changing anything right now. You can still do everything that you can do today after this takes effect.

Representative Schobinger: What if I start the process online and run into a problem. Then I stop the online process. Will the workers at DMV know that I have had a problem and stopped?

Glenn Jackson: The workers will not have any access to know if you started a process and didn't finish it. It will only be after you submit that we actually get it. If you drop out of the system, it will just go away.

Representative Jones: We passed a bill in the house to change renewals from 6 years to 8 years. If we pass this bill, we will be renewing every other time online. That would be a 16-year renewal cycle. Are you comfortable with that?

Glenn Jackson: I am. Going to the 16 years, people can't do it more than twice. That is if they renew as soon as they possibly could, depending on timing. If you get your license, 8 years later you renew online, eight years later you come into the office, eight years later online, and then the office. Before the eight years later renewal comes around you will be at the age that you have to come in anyway. You won't be able to do it more than two times, and I am very comfortable with that.

Representative Owens: (Recapped.) In your experience has anyone has ever shown up up for an eye exam that has never been to the eye doctor?

Glenn Jackson: I am sure that there are a lot of people that have never been to an optometrist. They don't go to a doctor if they don't need to.

Representative Owens: Then we do have people out there that pass the test, are out there driving, and have never been to see an eye doctor. So, the screening that you are giving is not a test, but a snapshot in time of a couple of key items. Would you agree?

Glenn Jackson: I would agree.

There was no further support for SB 2123.

33:45
Nancy Kopp, Executive Director for the North Dakota Optometric Association, spoke in opposition to SB 2123.

Nancy Kopp: The North Dakota Optometric Association is not necessarily in opposition to the online renewal option for drivers' licenses. We do, however, have grave concerns over the language on Subsection 9, Page 3, when it stated in the original bill that the director **may** waive the vision information. We amended the bill to say that the director may use information provided by the applicant as far as their visual requirements or changes. I was surprised to hear about the type of information that the Department would use to verify the 20/40 or better vision requirements when applying online, as opposed to just allowing self-attestation in answering the question: Has your vision changed? Our main concern is that it is self-attestation as to any changes that have occurred in the previous six or eight years upon renewal.

Representative Schobinger: When do you believe it might be plausible, that under current law, people actually use the non-test as a reason **not** to go see their optometrist because they take the screening and get their driver's license. Then they think they are okay. Do you think that if something like this is going to be on the form, they might actually go in and see their optometrist?

Nancy Kopp: We do not view this online option as a self-serviceness to get people to come in and see an optometrist regularly. I do not think that answering a question, "Has your vision changed?" will make someone think that maybe they should go get a comprehensive eye exam.

Representative Schobinger: If I go in and take an eye screening at the Department of Transportation and get my license, I might think that is good enough. I don't need to go see my optometrist. Do you think that is possible? We might think it is a test, but it is not really a test at all.

Nancy Kopp: That is a misconception that the general public has; that a screening is acceptable in comparison to a comprehensive eye examination.

38:48
Doctor Taya Patzman, optometrist in Bismarck and Jamestown and past president of the North Dakota Optometric Association and member of the State Board of Optometry, spoke to oppose SB 2123. Written testimony was provided. See attachment #2
42:58

Representative Jones: Do you have an idea of what percentage of people wear corrective eyewear?

Doctor Taya Patzman: I don't know a percentage. Our main concern with driving is being near sighted. There is a much higher percentage of that in the first world driving countries.

Representative Owens: You think that waiving the requirement was irresponsible. Now the bill does not waive it, but requires you to present it and in the process, present it no older than 16 months. I was wondering if that is not good enough, or would it better if it said a prescription specifically, rather than proof of current vision?

Doctor Taya Patzman: Our problem with the bill is that there isn't any do tell of what they are going to require. There was some testimony that said 20/40, but that wasn't stated in the bill. As far as saying that you need a prescription, if you come in for an eye exam, and your vision is 20/20 or better, many people don't need a prescription. So, if they come in and their vision is good enough, they will not leave with a prescription. We do have the Department of Transportation forms available. If someone comes in who has failed their vision test at the Department of Transportation, I actually fill out a Department of Transportation form and send it in.

Courtney Koebele, North Dakota Society of Eye Physicians and Surgeons, spoke to oppose SB 2123. Written testimony was provided. See attachment # 3. 49:40

There was no further testimonoy on SB 2123.
The hearing was closed on SB 2123.

2017 HOUSE STANDING COMMITTEE MINUTES

Transportation Committee
Fort Totten Room, State Capitol

SB 2123
3/10/2017
#29039

☐ Subcommittee
☐ Conference Committee

Committee Clerk Signature	

Explanation or reason for introduction of bill/resolution:

A bill relating to operator's license renewal.

Minutes: | 1 |

Chairman Ruby brought SB 2123 back before the committee.

Representative Jones brought an amendment to the committee. See attachment # 1 (17.8094.02001) The amendment came from the optometrists to deal with the concerns that they had about the length of the period of a time between screenings. This makes it so an online renewal under the age of 65 will have to submit to the Director vision information that is verified by an eye specialist.

Vice Chairman Rick C. Becker: Is "eye specialist" defined in Code?

Representative Jones: I'm not sure how it is defined.

Representative Owens: I have two issues with the amendment. The "may" instead of "must" because I thought that is what they (North Dakota Optometric Association) were pushing. I also thought that they were really asking for a time restriction on the examination (24 months). They wanted it specified in the bill. I know they support the amendment if we put in a period of time. I don't know if they support it this way.

Representative Jones: I got this wording directly from them. It was taken to Legislative Council, and I am uncertain of why it was dropped. We have since had a couple of discussions about the may being changed to shall. I think we can change the amendment by changing the may to shall, and include the 24 months to cover both bases. I think it is appropriate

Chairman Ruby: Where would the "24 hours" go?

Representative Owens: It would go after "…verified by an optometrist (within 24 months)."

Nancy Kopp, North Dakota Society of Eye Physicians and Surgeons rose to answer questions.

Vice Chairman Rick C. Becker: I had an indication that eye specialist is defined in statute. I can't find it.

Nancy Kopp: It is in the administrative rules under (inaudible) requirements. It is defined as an optometrist or ophthalmologist.

Representative Jones: Is the amended amendment what you had in mind?

Nancy Kopp: We did have that discussion about the time frame. I was surprised when Mr. Jackson indicated the Department's desire to use a 16-month attestation to drivers and vision requirements to meet the 20/40. Traditional standard of care is 24 months for adults to have an eye examination. Then I thought that maybe leaving it open-ended and requiring the Director to come up with what the procedures of the program will be in cooperation with eye care providers, we could implement the program.

Chairman Ruby: I don't think it matters if you say "shall" or "may" because it says, "to meet the requirements of the license renewal", so it does indicate that there is a requirement. We don't need to say shall; the "may" language is more permissive for their options.

Vice Chairman Rick C. Becker: Going back to the discussion of "eye specialist". If we are going to put a term in Code, it needs to be defined in statute, not in administrative code. Under 37-801 we do have vision specialist defined. It would seem that we need to change "eye specialist" to "vision specialist", or we would need to define "eye specialist" in statute, the former preferably.

Courtney Koebele: That is correct. It should be "vision specialist". It would be easiest to change "eye" to "vision".

Chairman Ruby: I hear three potential changes to the amendment:
1) Instead of eye specialist, we would use vision specialist.
2) Add 24 months
3) ...

Representative Weisz: Twenty-four months is a long time. Once we change it to eight years, and the vision test can be 24 months old, that is ten years. I still have issues with shall and may. If it is online and says, "may submit", it doesn't say that they are required to submit the information to the Director. Then what?

Chairman Ruby asked Courtney Koebele, North Dakota Society of Eye Physicians and Surgeons to rise to answer questions.

Chairman Ruby: Is your concern, Representative Weisz, that it isn't directing enough?

Discussion on using "may" versus "shall".

Representative Owens: If we assume, and we were told it would be, that they will set up the procedure in administrative rules, then the procedure will include the requirement to submit. It will set up a contradiction because the law says you "may". Implying you have a choice, when in reality of administrative rules in the process of the program, we are saying that you **have** to have it. The "may" can stay for the Director, but for the individual it should be "must" or "shall" for the application.

Vice Chairman Rick C. Becker: If we were to change it to shall, we also have to change it to say, "to meet the vision requirements for a license renewal **under this Subsection**, and applicant under the age of 65 **shall** submit...". Otherwise it could be construed to mean that any time you want to renew under the age of 65 you MUST submit.

Representative Jones: Can we ask the optometrists if they would rather have the 24 month in the bill or not?

Nancy Kopp: The standard of care for an eye examination is two years. Contacts are one year. Prescription glasses are three years. Two years will work; we are comfortable with that.

Terry Effertz, law intern, read the amendment. (17.8904.02002)

Representative Jones moved the amendment, 17.8904.02002.
Representative Sukut seconded the amendment.
A voice vote was taken. (Vote #1) The motion carried.

Vice Chairman Rick C. Becker moved an additional amendment. P. 3 will revert back to the original bill as submitted to the Senate. Also "The director may waive vision requirement to applicants."
Representative Weisz seconded the amendment.

Vice Chairman Rick C. Becker: Number 9 would say: "A non-commercial applicant may apply by mail or electronically for renewal of a license during every other renewal cycle. The director may waive vision requirements for applicants under the age of sixty-five and adopt procedures necessary to implement this subsection."

The reason for my amendment is the testimony that we heard yesterday. When you go to DMV in person, it is not a test of any sort. It has very little applicability to visual acuity. Other states don't have it. We have testimony that .005% are turned away. What we have been doing for the past decades is not really what it is cracked up to be. So, we are then going to hold people to an even higher standard than what you would have if you would be coming in to renew in person. The concern is expressed that we want people to renew online, but then we have additional requirements, and that would be counter to idea of trying to get people to renew online. Everything that we were told by the Department of Transportation yesterday indicates that we really don't need that test for a driver's license.

Representative Weisz: If you say, "may waive", is the intent that the director would waive the requirements for all the online renewals? Or would he just waive it under special circumstances?

Vice Chairman Rick C. Becker: It is only waiving it for people who are noncommercial applicants who want to renew by mail or online. Then the director can say that we don't need vision requirements if the renewal is online. That is how the bill was originally crafted.

Representative Paur: Whatever we decide, I am going to oppose the bill. The main justification was to reduce the traffic into the centers by 10% by doing this. With the bill increasing from six to eight years, we are reducing traffic by 33%. We have already reduced the traffic more that asked for. I think we have a decent working system the way that it is.

A voice vote was taken on the additional amendment. The motion failed.

Representative Paur moved a DO NOT PASS as amended on SB 2123.
Representative Schobinger seconded the motion.

Vice Chairman Rick C. Becker: I still support the idea of being able to renew online. It is the way we are going to be doing things in the future.

A voice vote was taken: Aye 2 Nay 12 Absent 0
The motion failed.

Representative Jones moved a DO PASS as amended on SB 2123.
Representative Owens seconded the motion.

Representative Schobinger: I will support the Do Pass. I think whatever we can do online is the way to do it. I'm not sure we have found the right solution here, but I will support it.

A voice vote was taken: Aye 13 Nay 1 Absent 0
The motion carried.

Representative Jones will carry SB 2123.

2017 HOUSE STANDING COMMITTEE MINUTES

Transportation Committee
Fort Totten Room, State Capitol

SB 2123
3/16/2017
#29303

☐ Subcommittee
☐ Conference Committee

Committee Clerk Signature	Jeanette Cook

Explanation or reason for introduction of bill/resolution:

A bill relating to operator's license renewal.

Minutes: | Attachments #1

Chairman Ruby brought SB 2123 back before the committee.

Representative Owens moved to reconsider our actions on SB 2123.
Representative Jones seconded the motion.

A voice vote was taken. The motion carried.

Glenn Jackson, North Dakota Department of Transportation, Director of the Driver's License Division, stood to explain the concerns that the Department of Transportation had about the bill and the way that it was amended. Written testimony was provided. (See attachment # 1, page 1) He also provided an idea of what their new verbiage would look like. (Attachment 1, page 2) Someone who has a vision restriction would have to give the Department of Transportation information verified by a vision specialist, but someone who does not have a vision restriction, the screening could be waived for them. Then, they could use the online process. A proposed amendment was also provided. (Attachment 1, page 3)

Representative Nelson: I am wondering why we are keeping a vision restriction on the driver's license at all if you are saying that research doesn't show that it has any benefit.

Glenn Jackson: We are talking about the visual acuity screening. That is not someone who has vision issues that are identified, and has vision that needs to have some type of restriction. There is a difference. The vision screening is the one that is not connected to driver safety.

Representative Jones: The concern is that we want to have vision screening for those that may be having a huge change in their vision, and the people that actually have restrictions on their licenses already have eye glasses and get exams. Isn't this counterproductive?

Glenn Jackson: The idea in this compromise language is to take someone who does have a current vision restriction, is most likely is going to an optometrist, and would have access to their prescription. They would be able send it to us to do the online renewal. Someone who doesn't go to the optometrist because their vision is fine, should not be required to go to an optometrist for a vision test. They should be able to do an online renewal. I would rather do without vision screening for this age group, but I understand that we need to find a compromise between the two. That is what this language seeks to achieve.

Representative Dobervich: Is the two tiered system going to be complicated in terms of management? What would it look like in terms of staffing and time.?

Glen Jackson: It would be very easy because it comes down the one question: Has your vision significantly changed? Yes, or no. If the person says, "no", and they don't have a vision restriction; they continue to process. If the person says, "yes", then they will be kicked out of the system. If you say, "no", but have a vision restriction, it will ask you to attach your vision information. It's not going to be difficult.

Representative Sukut: If we are using 6 or 8 years for renewal, how do we catch the person that didn't need eye correction when he started, but when it is time to renew, he now needs correction, but he checks the "no" box? Are we able to make sure that everyone that needs correction actually gets it before they get a license?

Glenn Jackson: At some point we have to depend on people to tell us and be responsible for their own actions. We can't do an eye test for each person every so often because that would be unmanageable. If someone who has vision that is so bad that they can't function in society, I would think that they would go and get their eyes tested and try to correct it. I think the number of those types of people would be very small.

Vice Chairman Rick C. Becker reviewed the intent of the three versions of the bill.

Representative Paur: If we agree to this, and a person wants to renew at the DMV, do they still have to take the screening?

Glenn Jackson: Yes, they do. Prior to 1983 we only checked people for vision who were under 21 and over 70. Now we are trying to go back to that. We have learned by looking at the data, that the visual acuity screening test does not tie to driver's safety on the highway. If we can go back to that, we can get this big group of people to use technology to renew online.

Representative Jones: If we were to go back to the bill as it came from the Senate, saying that, "the director ***may*** use vision information provided by the applicant...", how would you feel about that? I will resist your amendment.

Glenn Jackson: I believe that it would be preferable to have that original language, than to have the amendment that was adopted by the committee last week.

Representative Weisz: Is the language in the original bill (The way that it came to us from the Senate.) preferable to you than the amendment that you offered this morning?

Glenn Jackson: The tough thing about the verbiage that says, "vision information", is that it still lends itself to isolate the 280,000 people out of the system, because the only way to get vision information is to...

Representative Weisz: If it would say, "the director ***may*** waive...", does that give you the freedom to waive the information or not for that age group?

Glenn Jackson: No, because prior statute in that section **requires us** to use vision information to verify and do screening tests. So, unless we are given the authority in this situation to waive the requirement, then we are required to comply with that requirement.

Chairman Ruby: So, your preference would be what you brought in this morning?

Glenn Jackson: Yes, that is correct. It would have the least impact to all concerned because people who have a vision restriction currently see a vision specialist. People who do not don't need to see one. Hopefully we could get a good portion of both of those groups to do an online renewal process.

Representative Jones: When they check the box that says there has been no substantial change in their vision, could that be the vision information that is used by the director, rather than the statute that states they have to have a screening?

Glen Jackson: 39-06.19 #7 is what we use to justify the visual screening in the office. That is still in statute. Absent the language that we had originally proposed to allow us to waive that requirement in order to do online renewal, we still have to do it. We have to have a way to get past that so that we can actually do an online renewal. The only way to do that is to say that we are going to waive the screening, which is what the original bill does. That was the original idea, and that was the preference. After discussion with the Optometrists Association the compromise was to do "vision information". That requires something be sent to us, and then that isolates half of the drivers. The original idea behind this is to try to use technology to gain efficiencies, so that we can reduce the number of people coming into the office which helps us to manage our staff better and reduce costs in the long term. It would be preferable to say that if people don't have a vision restriction, we can waive theirs because they haven't demonstrated a need. For people who do currently have a vision restriction, let's say that they have to show us something, since they already have it in their possession. They see an optometrist on a regular basis. Hence the language in this draft, which I think is the best of all of them.

Representative Weisz: The original Senate bill is the optimal solution for you, is that correct?

Glenn Jackson: Yes.

Nancy Kopp, North Dakota Optometric Association: Our biggest concern about the original Senate bill was the word "waive". We feel that is absolutely sending the wrong message to drivers and about their safety. That is why we suggested using alternative language of "the director may use vision information". The definition wasn't spelled out in the amendment. We were not necessarily saying that was an exam by an eye specialist. The amendment that you passed last week included information that Glenn Jackson suggested last week in testimony. It would be uploaded by an optometrist or the applicant himself. That is what brought us to the language of verifying by a vision specialist. I would like to know how it works in other states (17). We are willing to work with the Department of Transportation to find solutions, but I don't have a solution this morning. I would suggest that we stick with using "vision information". We do support the ability to provide online renewal every other time, but we think verification of a person's vision is critical.

Chairman Ruby: What I see the amendment doing is almost a compromise of the original version and the one that we amended. I would gather that you still have an issue with the drivers that can be waived.

Nancy Kopp: I guess it is a compromise, and we are willing to communicate and cooperate going forward. We can try it.

Representative Schobinger: Do optometrists have a quick screen process that they can offer at low cost?

Nancy Kopp: No, we do not.

Representative Schobinger: Maybe we should just require a quick screen from an optometrist ever six years or so. That could be kept in the driver's car, and they would have it if they got stopped. Maybe we should have some requirement but separate the two, license renewal and vision testing. But, if we don't have a process that is cheap and quick, it will be a problem.

Nancy Kopp: We will have to use creativity going forward to address advancements in technology. Maybe we need two more years to work this out by looking at other states and other processes.

Representative Jones: What does it cost to have an eye exam, and how long does it take?

Nancy Kopp: Approximately $90 and about 30 minutes.

Representative Weisz moved an amendment to go back to the original Senate version of the SB 2123. (17.8094.02003)
Vice Chairman Rick C. Becker seconded the motion.

Vice Chairman Rick C. Becker: The compromise that Glenn Jackson brought in today was a nice compromise. A person could further argue that if we pass Representative Weisz's amendment, that we go into conference committee with our intended fallback position to be the compromise.

A voice vote was taken: Aye 10 Nay 4 Absent 0
The motion carried.

Representative Jones moved a DO PASS as amended on SB 2123.
Representative Weisz seconded the motion.

A roll call vote was taken: Aye 10 Nay 4 Absent 0
The motion passed.

Representative Jones will carry SB 2123.

17.8094.02002
Title.03000

Adopted by the House Transportation Committee

March 10, 2017

3/10/17
SB 2123
#1

PROPOSED AMENDMENTS TO ENGROSSED SENATE BILL NO. 2123

Page 3, line 6, remove "The director may use vision information provided by"

Page 3, replace line 7 with "To meet the vision requirements for a license renewal under this subsection, an applicant under sixty-five years of age shall submit to the director vision information verified by a vision specialist within the last twenty-four months. The director may"

Renumber accordingly

3/16/17 DA

17.8094.02003
Title.04000

Adopted by the Transportation Committee

March 16, 2017

PROPOSED AMENDMENTS TO ENGROSSED SENATE BILL NO. 2123

In lieu of the amendments as printed on page 945 of the House Journal, Engrossed Senate Bill No. 2123 is amended as follows:

Page 3, line 6, remove "use vision information provided by"

Page 3, line 7, replace "the applicant to meet" with "waive"

Renumber accordingly

Date: 3-10-17
Roll Call Vote #: 1

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. SB2123

House Transportation Committee

☐ Subcommittee

Amendment LC# or Description: 17.8094.02002

Recommendation:
☒ Adopt Amendment
☐ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions: ☐ Reconsider ☐ ________

Motion Made By Jones Seconded By Sukut

Representatives	Yes	No	Representatives	Yes	No
Chairman Dan Ruby			Rep. Gretchen Dobervich		
Vice Chair. Rick C. Becker			Rep. Marvin Nelson		
Rep. Bert Anderson					
Rep. Jim Grueneich					
Rep. Terry Jones					
Rep. Emily O'Brien					
Rep. Mark Owens					
Rep. Gary Paur					
Rep. Randy Schobinger					
Rep. Gary Sukut					
Rep. Robin Weisz					
Rep. Greg Westlind					

- Voice Vote
Motion Carried

Total (Yes) ________ No ________

Absent ________

Floor Assignment ________

If the vote is on an amendment, briefly indicate intent:

Date: 3-10-17
Roll Call Vote #: #2

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. SB 2123

House Transportation Committee

☐ Subcommittee

Amendment LC# or Description:

Recommendation: ☒ Adopt Amendment
☐ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar
Other Actions: ☐ Reconsider ☐

Motion Made By Becker Seconded By Weisz

Representatives	Yes	No	Representatives	Yes	No
Chairman Dan Ruby			Rep. Gretchen Dobervich		
Vice Chair. Rick C. Becker			Rep. Marvin Nelson		
Rep. Bert Anderson					
Rep. Jim Grueneich					
Rep. Terry Jones					
Rep. Emily O'Brien					
Rep. Mark Owens			Voice Vote		
Rep. Gary Paur			Motion failed		
Rep. Randy Schobinger					
Rep. Gary Sukut					
Rep. Robin Weisz					
Rep. Greg Westlind					

Total (Yes) No

Absent

Floor Assignment

If the vote is on an amendment, briefly indicate intent: Remove amend put on. & p. 3. — Revert back to original bill as submitted to the Senate.

Date: 3-10-17
Roll Call Vote #: #3

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. SB 2123

House Transportation Committee

☐ Subcommittee

Amendment LC# or Description: 17.8094.02002

Recommendation: ☐ Adopt Amendment
☐ Do Pass ☒ Do Not Pass ☐ Without Committee Recommendation
☒ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions: ☐ Reconsider ☐ ______

Motion Made By Paur Seconded By Schobinger

Representatives	Yes	No	Representatives	Yes	No
Chairman Dan Ruby		✓	Rep. Gretchen Dobervich		✓
Vice Chair. Rick C. Becker		✓	Rep. Marvin Nelson		✓
Rep. Bert Anderson		✓			
Rep. Jim Grueneich		✓			
Rep. Terry Jones		✓			
Rep. Emily O'Brien		✓			
Rep. Mark Owens		✓			
Rep. Gary Paur	✓				
Rep. Randy Schobinger	✓				
Rep. Gary Sukut		✓			
Rep. Robin Weisz		✓			
Rep. Greg Westlind		✓			

Total (Yes) 2 No 12

Absent 0

Floor Assignment ______

If the vote is on an amendment, briefly indicate intent:

Date: 3-10-17
Roll Call Vote #: 4

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. 2123

House Transportation Committee

☐ Subcommittee

Amendment LC# or Description: 17.8094.02002

Recommendation:
☐ Adopt Amendment
☒ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☒ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions:
☐ Reconsider ☐ ____________

Motion Made By Jones Seconded By Owens

Representatives	Yes	No	Representatives	Yes	No
Chairman Dan Ruby	✓		Rep. Gretchen Dobervich	✓	
Vice Chair. Rick C. Becker	✓		Rep. Marvin Nelson	✓	
Rep. Bert Anderson	✓				
Rep. Jim Grueneich	✓				
Rep. Terry Jones	✓				
Rep. Emily O'Brien	✓				
Rep. Mark Owens	✓				
Rep. Gary Paur		✓			
Rep. Randy Schobinger	✓				
Rep. Gary Sukut	✓				
Rep. Robin Weisz	✓				
Rep. Greg Westlind	✓				

Total (Yes) 13 No 1

Absent 0

Floor Assignment Jones

If the vote is on an amendment, briefly indicate intent:

Date: 3-16-17
Roll Call Vote #: 1

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. 2123

House Transportation Committee

☐ Subcommittee

Amendment LC# or Description: ______

Recommendation: ☐ Adopt Amendment
☐ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions: ☒ Reconsider ☐ ______

Motion Made By Owens Seconded By Jones

Representatives	Yes	No	Representatives	Yes	No
Chairman Dan Ruby			Rep. Gretchen Dobervich		
Vice Chair. Rick C. Becker			Rep. Marvin Nelson		
Rep. Bert Anderson					
Rep. Jim Grueneich					
Rep. Terry Jones					
Rep. Emily O'Brien					
Rep. Mark Owens					
Rep. Gary Paur					
Rep. Randy Schobinger					
Rep. Gary Sukut					
Rep. Robin Weisz					
Rep. Greg Westlind					

Voice Vote
All aye

Total (Yes) ______ No ______

Absent ______

Floor Assignment ______

If the vote is on an amendment, briefly indicate intent:

Date: 3-16-17
Roll Call Vote #: #2

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. SB 2123

House Transportation Committee

☐ Subcommittee

Amendment LC# or Description: 17.8094.02003

Recommendation: ☒ Adopt Amendment
☐ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☐ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions: ☐ Reconsider ☐ ___

Motion Made By Weisz Seconded By Becker

Representatives	Yes	No	Representatives	Yes	No
Chairman Dan Ruby	✓		Rep. Gretchen Dobervich		✓
Vice Chair. Rick C. Becker	✓		Rep. Marvin Nelson		✓
Rep. Bert Anderson	✓				
Rep. Jim Grueneich	✓				
Rep. Terry Jones	✓				
Rep. Emily O'Brien	✓				
Rep. Mark Owens	✓				
Rep. Gary Paur		✓			
Rep. Randy Schobinger		✓			
Rep. Gary Sukut	✓				
Rep. Robin Weisz	✓				
Rep. Greg Westlind	✓				

Total (Yes) 10 No 4

Absent 0

Floor Assignment ___

If the vote is on an amendment, briefly indicate intent:

Go back to original Senate version of SB 2123, 17.8094.02003

Date: 3-16-17
Roll Call Vote #: #3

2017 HOUSE STANDING COMMITTEE
ROLL CALL VOTES
BILL/RESOLUTION NO. SB 2123

House Transportation Committee

☐ Subcommittee

Amendment LC# or Description: 17.8094.02003

Recommendation:
☐ Adopt Amendment
☒ Do Pass ☐ Do Not Pass ☐ Without Committee Recommendation
☒ As Amended ☐ Rerefer to Appropriations
☐ Place on Consent Calendar

Other Actions:
☐ Reconsider ☐ ______

Motion Made By Jones Seconded By Weisz

Representatives	Yes	No	Representatives	Yes	No
Chairman Dan Ruby	✓		Rep. Gretchen Dobervich		✓
Vice Chair. Rick C. Becker	✓		Rep. Marvin Nelson		✓
Rep. Bert Anderson	✓				
Rep. Jim Grueneich	✓				
Rep. Terry Jones	✓				
Rep. Emily O'Brien	✓				
Rep. Mark Owens	✓				
Rep. Gary Paur		✓			
Rep. Randy Schobinger		✓			
Rep. Gary Sukut	✓				
Rep. Robin Weisz	✓				
Rep. Greg Westlind	✓				

Total (Yes) 10 No 4

Absent 0

Floor Assignment Jones

If the vote is on an amendment, briefly indicate intent:

REPORT OF STANDING COMMITTEE

SB 2123, as engrossed: Transportation Committee (Rep. D. Ruby, Chairman) recommends **AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS** (13 YEAS, 1 NAYS, 0 ABSENT AND NOT VOTING). Engrossed SB 2123 was placed on the Sixth order on the calendar.

Page 3, line 6, remove "The director may use vision information provided by"

Page 3, replace line 7 with "To meet the vision requirements for a license renewal under this subsection, an applicant under sixty-five years of age shall submit to the director vision information verified by a vision specialist within the last twenty-four months. The director may"

Renumber accordingly

REPORT OF STANDING COMMITTEE

SB 2123, as engrossed: Transportation Committee (Rep. D. Ruby, Chairman) recommends **AMENDMENTS AS FOLLOWS** and when so amended, recommends **DO PASS** (10 YEAS, 4 NAYS, 0 ABSENT AND NOT VOTING). Engrossed SB 2123 was placed on the Sixth order on the calendar.

In lieu of the amendments as printed on page 945 of the House Journal, Engrossed Senate Bill No. 2123 is amended as follows:

Page 3, line 6, remove "use vision information provided by"

Page 3, line 7, replace "the applicant to meet" with "waive"

Renumber accordingly

2017 TESTIMONY

SB 2123

SENATE TRANSPORTATION COMMITTEE
January 6, 2017; 9:00 AM, Lewis & Clark Room

North Dakota Department of Transportation
Mark Nelson, Deputy Director for Driver Vehicle Services
Senate Bill 2123

Mr. Chairman, members of the committee, my name is Mark Nelson, Deputy Director for Driver Vehicle Services at the North Dakota Department of Transportation (DOT). Thank you for giving me the opportunity to speak with you today regarding SB2123.

The business process for renewing an operator's license is the same process as for the issuance of an original operator's license. Currently, the individual is required to complete the application, provide any necessary documentation, complete a vision screening test, pay a fee, take a photo, and get their license. SB2123 seeks to implement an option for individuals to renew online during every other renewal cycle, if they so choose, in an effort to continue to provide flexible customer service options to our citizens. In order for the department to provide this service online, there are two parts of the business process that must change.

The first part of the business process requiring change would be the photo. Current technology does not allow an applicant to update the photo stored in the database. However, there are technology applications close to completion that will allow an applicant to take a 3D photo, send it in as an attachment, verify identity through facial recognition software and allow the photo to be upgraded. Once this technology becomes available, the DOT will look at incorporating this into the online renewal process.

In recent conversations with law enforcement, there has been potential concern expressed in the area of the photo and the twelve year gap between updated photos. After discussions regarding the future technology advances that will occur, the concern expressed from law enforcement has been addressed.

The second part of the business process to change is the vision screening. Under SB2123 applicants would not be required to complete a vision screening in order to participate in the online renewal process. In this proposed change to the business process we use to license individuals, we carefully reviewed our driver's license data to validate that we were not proposing a bill that generated potential safety issues.

What our data showed for the past three years, 2014, 2015 and 2016, is that of the 359,608 vision screenings conducted by our agency, 2412 individuals failed the screening test. This puts the rate of failure at .006. It is important to remember that of these 2412 failures, many were first time permit applicants (teenagers), or were elderly and under the provisions of this bill proposal these individuals would still be required to be screened.

Having served in the North Dakota Highway Patrol for nearly 29 years, I understand the importance of safety on our roadways, I lived it day in and day out as I was called to cover serious injury and fatal traffic crashes statewide, and I truly believe that one life lost on our roads is one life to many.

In our agency discussions we were unable to find any empirical or anecdotal evidence that the requirement for the vision screening conducted by the driver licensing authority provides a higher level of driver safety, nor does the lack of a vision screening as proposed in SB2123 rise to the level of a safety concern. What we did find is that currently twelve states allow for an online renewal process every other cycle with four of those being eight year license states equating to sixteen years between required visits. Additionally, seventeen states have no vision screening requirements.

It is important to remember that the expected number of people who will utilize this service is relatively low based on what other states have experienced. It is also important to remember that everyone still must complete a vision screening at initial permitting, and at all renewals completed in the driver license office. This is NOT eliminating the screening in all renewal cases. Additional information on both the vision screening and photo are included in attachments 1 and 2.

The process proposed in SB2123 is to allow individuals to choose to renew online every other renewal cycle. As stated earlier, this would not include new permits or new licenses at any age, nor would it include renewals for those older than 65 years of age. The individuals in the mid-age group would go online and complete an application, pay a fee, and receive their license. The process is unavailable if any information differs from that currently in the record.

The major goal of SB2123 is to provide flexibility, gain efficiencies within the renewal process and use technology to provide improved services to our citizens. For those who desire to renew in the office, that option will still be available and the screening test will be conducted as it is today.

At this time, I would like to review the information contained in attachments 1 and 2

Mr. Chairman that concludes my testimony, I would be happy to answer any questions.

Attachment 1, SB2123 Online Renewal Information

In 2014 we conducted 169,812 vision screenings. Of these, 988 failed the screening. This represents a .005% failure rate, which is insignificant.
In 2015 we conducted 121,465 vision screenings. Of these, 836 failed the screening. This represents a .006 failure rate, which is insignificant.
In 2016 we conducted 68,331 vision screenings. Of these, 588 failed the screening. This represents a .008 failure rate, which is insignificant.

- Some of these were first time permit seekers
- Some were elderly
- Some of these were renewals
- Only 33 states still require vision screening
- All of these individuals walked in the door, filled out an application, and were then asked to take the vision screening. All of these individuals had demonstrated the ability to function visually. None of these individuals were blind or hazardous to others.
- In addition, the 2016 numbers reflect a year in which we conducted minimal renewals. This demonstrates that the majority of our vision screening failures are not at renewal, but at initial issuance.

There is no empirical evidence or data that associates any safety concern with the use or disuse of the vision screening process. If there were, all states would conduct screening and there would be established guidelines for this process. It is not a safety issue.

In a recent review of 50 states and D.C., the following information was provided:

- 13 states have a 4 year license
- 11 states have a 5 year license
- 8 states have a 6 year license
- 16 states have a 8 year license
- 2 states have a 10 year license
- 1 state has no time limit up to age 65
- A significant number of driver photos currently exceed 6 years

In review of on-line renewals of the above states and D.C.:

- 14 states have online renewal
- 12 states only allow renewal every other cycle online
- 4 of those states with online renewal are 8 year licensed states, equating to 16 years between required visits
- 1 of those is Florida
  - Approximately 11% of renewals are online
- 1 of those states is Georgia
  - A number was not available, but the state reports disappointment with the low numbers of drivers who take advantage of the process

In North Dakota, if we get 10% of drivers to renew online every other cycle, it should equate to roughly 10,000 online renewals a year.

- This equates to 5,000 class D skill tests (20 minutes per test)
- This equates to 1,500 commercial skill tests (90 – 120 minutes per test)
- Gaining this much capacity should enable us to improve current wait times and maintain them for the foreseeable future, without the need for additional staff, thus controlling growth in government and costs

The federal passport photo is valid for ten years; Federal Real ID guidelines allow up to 16 years between photos on identification documents

If law enforcement has a problem immediately associating a photo with an individual they have access, through BCI, to the facial recognition software for identity verification. The points used by the software to track the identity of the face do not change significantly over time.

Attachment 2, SB2123 Steps in Online Renewal

Online renewals will not be processed with any changes to the current record. If at any time an individual selects a response that ends the process, the system will not allow an additional attempt, and the individual will be required to go to a Driver's License Division office to process the renewal.

Additionally:

- The photo will be the latest photo in the system.
  - Once technology allows, updating the photo will be required.
- The signature will be the latest signature on file.
- The first possible online renewal period, for those initially licensed between 15 – 20 years of age, will not be the first renewal, as some younger individuals may not have updated their license information by this time. The first renewal will be physical presence in an office. Thereafter, every other may be online.

FEDERAL PRIVACY ACT OF 1974

Disclosure of the individual's social security number in this process is mandatory pursuant to NDCC 39-06-07. The individual's social security number is used by the department for file control purposes and record keeping. If your social security number is not disclosed, we will not issue a license.

1. Applicant enters name, DOB, SSN, DL# and address into identification section.
   - The system either recognizes all information as belonging to a record, or process ends and the applicant is directed to go to a Driver's License Division office to renew their license

2. Once identification is complete and record is recognized, applicant is asked the following questions with corresponding results.

3. Under the provisions of the Uniform Anatomical Gift Act, do you wish to be identified as an organ and tissue donor? Yes/No
   - Neither response stops the process.

4. Have you experienced significant vision changes not reported to the Driver's License Division in the past six years? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
   - If no, the process continues.

5. Do you have a physical or medical condition not reported to the Driver's License Division in the past six years? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
   - If no, the process continues.

6. Do you have a history of epilepsy, blackout attacks, or other lapses of consciousness not reported to the Driver's License Division in the past six years? Yes/No

- If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
- If no, the process continues.

7. Have you been adjudged incompetent or been disabled due to a mental illness? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
   - If no, the process continues.

8. Do you habitually use alcoholic beverages or narcotic drugs to excess? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
   - If no, the process continues.

9. Protect Yourself: If your application contains any false or fraudulent information, your driving privileges will be revoked or cancelled. You may also be subject to criminal penalties.

I certify, under penalty of perjury, that the information hereon is true and correct, and that I do not possess a license to drive or have an active license record in any other jurisdiction, nor are my driving privileges under suspension, revocation, cancellation or disqualified in any jurisdiction.

Electronic Signature ________________________________

10. Once all is complete, the individual will click on the SUBMIT button.

11. At this time the system will automatically perform several checks to validate information.
    - If the system detects an error the process stops and the individual is referred to a Driver's License Division office.
    - If all processes without error, continue.

12. Once all checks complete satisfactorily, the individual will be required to submit payment via a credit card.
    - If it processes without error, the system will generate a receipt the individual can print.
      - The receipt will be valid for 20 days.
      - System automatically updates so law enforcement can determine current license status.
    - If it does not process, the process stops and the individual is referred to a Driver's License Division office.

13. At this point, the renewal goes into a work queue. The next business day an examiner will review the information and print the license, conduct a quality check, and mail the license to the individual. Expected delivery is within 5 business days.

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1-6-17
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NORTH DAKOTA
Optometric Association

SB 2123

Senate Transportation Committee

January 6, 2017

Good Morning Mr. Chairman and Members of the Committee.

For the record, my name is Dr. Taya Patzman and I have optometry practices in Bismarck and Jamestown. I am a past president of the North Dakota Optometric Association and am a current member of the State Board of Optometry.

I appear before you this morning in opposition of SB 2123. The language that is of concern is on page 3, number 9.

> 9. A noncommercial applicant may apply by mail or electronically for renewal of a license during every other renewal cycle. The director may waive vision requirements for applicants under the age of sixty-five and adopt procedures necessary to implement this subsection.

The current renewal cycle for a non-commercial driver's license is 6 years. Being able to renew electronically every other renewal cycle would mean drivers would essentially be exempt from a vision screening for 12 years! Waiving the vision requirements for drivers under the age of 65 is irresponsible.

From my experience, patients undergo many vision changes from the age of 16 to 65. In the earlier years, patients are still going through puberty and the prescription typically can change quite drastically in a year's time let alone 6 or 12 years. Many vision changes also happen in the 20's and 30's due to pregnancy, changes in visual demand due to school and work changes, and many new health issues arise. In the 40's, 50's, and 60's patients typically start presbyopia which affects near vision. This causes changes in distance vision also because the entire visual system relaxes causing a shift in prescription. Often, these changes can be subtle, but compounding over 6 or 12 years, they become quite significant. Typically, in this age range, diabetes is most often diagnosed. Many Type 2 diabetics are diabetic for several years before they are formally diagnosed. I have seen many patients over the years who come in for blurry vision and have large prescription changes from undiagnosed diabetes.

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Assuming that people will seek out eye care if their vision is blurry is naïve. If that were the case, my colleagues and I wouldn't see as many patients in for eye exams with the chief complaint of "failing the vision test when trying to get their driver's license renewed." I also have many patients who come in for an eye exam when they need to renew their driver's license and tell me they know their vision is so poor they won't pass at the DMV, so they need to get glasses before they fail at their renewal. Many of these patients are aware of their poor vision for many years, but procrastinate until the last possible moment to take care of the problem. The only reason they take care of it is because of the vision screening at the renewal.

Routine vision care is typically not covered under medical insurance and glasses can be expensive, so to assume that all drivers are going to be responsible in maintaining their vision care is unrealistic. Good vision can be variable depending on a person's perception. Many patients feel that they have very good vision at 20/60, 20/80, or worse; the minimum acuity for driving without correction is 20/40. I have had patients in my chair who have 20/200 vision (20/100 best corrected is legally blind), and know they need glasses for driving, but use the excuse of they only drive during the day. Their typical reason for not coming in sooner is that there is not enough time and the expense. There are complacent people now with strict driving requirements, I can't imagine the problems we will see if this is extended for 12 years.

I feel that this proposed change takes a large step backwards in road safety. The increased traffic that we have seen in Bismarck, the Bakken, and around the state, along with the number of young drivers, and the distraction of cell phones, poor vision is a risk factor that can be greatly reduced.

I realize that new technology is constantly emerging and stream lining the process is necessary. However, I do not feel that this bill offers enough detail to address these issues and concerns for driver's as well as pedestrian safety. I have concerns with the language of "The director may…adopt procedures necessary to implement this subsection." I would like to know, in detail, what these procedures would entail. Is adopting a procedure complex, like implementing a new website or registry, or as simple as clarifying a definition, or checking a box that a recent eye exam had been performed. Would this checking of a box be on the honor system? I asked a patient this question last week and his response was "who wouldn't check the box if it meant you wouldn't get your license?" There is discussion that needs to happen before changes are made that jeopardize the safety of the citizens of North Dakota.

This concludes my testimony. I strongly encourage a DO NOT PASS on Senate Bill 2123. I would be happy to answer any questions you may have. Thank you.

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State by State Drivers' License Vision Requirements

State	Initial	Renewal	Notes
Alabama	No	No	Renew every 4 yrs.; IP, M, OL
Alaska	Yes	Yes	Renew every 5 yrs.; IP#, M
Arizona	Yes	Yes	Every 12 yrs. must pass a vision exam; IP#
Arkansas	Yes	Yes	Renew every 8 yrs.; IP#
California	Yes	Maybe	Renew every 5 yrs.; IP# (70+), M, OL, Ph
Colorado	Yes	Maybe[i]	Renew: under age 61, 10 yrs.; 61+, 5 yrs.[ii]; IP, M, OL
Connecticut	Yes	No	Renew every 6 yrs.; 65+ every 2; IP, M
D.C.	Yes	No[iii]	Renew every 8 yrs.; IP (70+), M, OL
Delaware	Yes	Yes	Renew every 5 to 8 yrs.; IP only
Florida	Yes	Yes*[iv]	Renew every 8 yrs.; 80+, 6 yrs.; IP, M (active military only), OL
Georgia	Yes	Maybe[v]	Renew: short-term, 5 yrs.; long-term, 8 yrs.; 59+, 5 yrs.; IP, M, OL
Hawaii	Yes	Yes	Renew based on age and county of residence; IP, M
Idaho	Yes	Yes	Renew: ages 21-69, 8 yrs.; IP, M
Illinois	Yes	No	Renew: ages 21-80, 4 yrs.; 81-86, 2 yrs.; 87+ annual; IP, M, OL, Ph
Indiana	Yes	No[vi]	Renew: under 75, 6 yrs.; 75-84, 3 yrs.; 85+, 2 yrs.; IP, OL
Iowa	Yes	Yes	Renew: under 72, 5-8 yrs[vii].; 72+, 2 yrs.; IP, OL (18-69)
Kansas	Yes	No	Renew: ages 21-65, 6 yrs.; 65+, 4 yrs.; IP, M (limitations)
Kentucky	Yes	No	Renew every 4 yrs.; IP, M (active military only)
Louisiana	Yes	Yes	Renew every 6 yrs.; IP, M (under 70), OL
Maine	Yes	Maybe[viii]	Renew: ages up to 65, 6 yrs.; 65+, 4 yrs.; IP, OL
Maryland	Yes	Maybe*[ix]	Renew every 8 yrs.; IP, M, OL, self-service kiosk
Massachusetts	Yes	Maybe[x]	Renew every 5 yrs.; IP, OL, M (active military only)
Michigan	Yes	Yes	Renew every 4 yrs.; IP[xi], OL, M*
Minnesota	Yes	Yes	Renew every 4 yrs.; IP only; M* (out of state only)
Mississippi	Yes	No	Renew every 4 or 8 yrs. based on fee paid; IP[xii], OL, M[xiii]
Missouri	Yes	Yes	Renew: ages 21-69, 6 yrs.; 70+, 3 yrs.; IP, M (active military only)
Montana	Yes	Yes	Renew: ages 21-67, 8 yrs.; 68, 7 yrs.; 69, 6 yrs.; 70, 5 yrs.; 71, 4 yrs.; 72, 3 yrs.; 73, 2 yrs.; 74, 1 yr.; 75+, 1 yr.; IP, M[xiv]
Nebraska	Yes	Yes	Renew every 5 yrs.; IP, OL[xv], M (active military, out-of-state)
Nevada	Yes	Maybe[xvi]	Renew every 4 to 8 yrs.[xvii]; IP, OL, M (active military, out-of-state), self-serve kiosk
New Hampshire	Yes	Yes	Renew *usually* every 5 yrs.; IP, OL, M (active military)
New Jersey	Yes	Yes	Renew every 5 yrs.; IP, M (out-of-state)
New Mexico	Yes	Yes	Renew every 4 to 8 yrs.[xviii]; 75+ annual; IP, OL[xix]
New York	Yes	Yes[xx]	Renew every 8 yrs.; IP, OL, M
North Carolina	Yes	Yes	Renew: ages 18-65 yrs., 8 yrs.; 66+, 5 yrs.; IP, OL, M (active military, out-of-state)
North Dakota	Yes	Yes	Renew every 6 years; IP, M (active military, out-of-state)
Ohio	Yes	Yes	Renew every 4 yrs.; IP, M (active military, out-of-state)
Oklahoma	Yes	No	Renew every 4 yrs.; IP, M (active military, out-of-state)
Oregon	Yes	Maybe[xxi]	Renew every 8 yrs.; IP, M (active military, out-of-state)
Pennsylvania	Yes	No	Renew every 4 yrs.; 65+ option to renew every 2 yrs.; IP, OL, M (active military, out-of-state)

Rhode Island	Yes*	Yes[xxii]	Renew every 5 yrs.; 75+ every 2 yrs.; IP, OL, M (active military, out-of-state)
South Carolina	Yes	Yes[xxiii]	Renew every 5 (65+ or by mail) or 10 yrs. (in person); IP, M*
South Dakota	Yes	Yes[xxiv]	Renew every 5 yrs.; IP*, OL*, M*
Tennessee	Yes	No	Renew every 5 yrs.; IP, OL, M
Texas	No	Maybe[xxv]	Renew: ages 18-84, 6 yrs.; 85+, 2 yrs.; IP, OL, M, Ph[xxvi]
Utah	Yes	Yes[xxvii]	Renew every 2 yrs.; IP, OL[xxviii]
Vermont	Yes	No	Renew every 4 yrs. $51, every 2 yrs. $32; IP, M
Virginia	Yes	Yes[xxix]	Renew every 8 yrs.; IP, OL, M (out-of-state)
Washington	Yes	Yes	Renew every 6 yrs.; IP, OL (24-70 yrs. old, M
West Virginia	Yes	No	Renew every 5 yrs.; IP only
Wisconsin	Yes	Yes	Renew every 8 yrs.; IP, OL, M*
Wyoming	Yes	Yes	Renew every 4 yrs.; IP, M

Renewal of license may be completed by: IP – in-person; M – mail; OL – on-line; Ph – phone
*Requires vision certification from optometrist or ophthalmologist
#vision screening

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[i] Renew online if eye exam by OD in last 3 years.
[ii] Starting at age 66 drivers can renew by mail only with a doctor's or optometrist's certification they passed an eye exam within six months.
[iii] To renew online, must self-report any vision changes.
[iv] 80+ Mature Driver Vision Test form (OD or MD) or Report of Eye Exam from a vision specialist
[v] 64+ yrs. Only.
[vi] Renewal with 6 points or more, or any points if under 21 years old, must pass vision exam.
[vii] Transition from 5 years to 8 years. By 12/31/2018 all renewals under age 72 will be 8 yrs.
[viii] Vision screenings required every other renewal at 40 years old and older.
[ix] 40+ needs completed vision certification from eye doctor.
[x] 75+ must pass vision test or submit completed vision screening certificate
[xi] Must renew IP if you did not last renewal.
[xii] Only if you renewed in person last time.
[xiii] active military and out-of-state college students only
[xiv] if you are a resident of Montana who is temporarily living outside of MT AND who will not return to MT before their driver's license will expire or if you live in Carter, Garfield, Golden Valley, Jefferson, Judith Basin, Madison, Petroleum, Prairie, Treasure, or Wibaux counties. However, your next renewal MUST be completed in person.
[xv] You can renew your NE driver's license online as long as you meet the following requirements: U.S. citizen; license is expiring before 72nd birthday; 21 years old or older; have NOT renewed online more than once in the last 10 years; have NOT changed your name or address since the issuance of your last driver's license; NE DMV has NOT requested a re-examination; do NOT need to submit medical or vision information to the DMV; Your physical description has not significantly changed; do NOT have G, V, or X restriction(s).
[xvi] If renewing by mail.
[xvii] currently transitioning 8-year renewal. Those born in an even-numbered year, a renewed driver's license is valid for 8 years. Those born in an odd-numbered year, a driver's license is valid for 4 years, and all renewals through 2017. After 2017, a driver's license will be valid for 8 years at a time.
[xviii] The fee is $18.00 for a four-year license or $34.00 for an eight-year license. Drivers who are 75 years old or older must renew their licenses yearly, but they are not charged renewal fees.
[xix] To be eligible for online renewal, you must: Be 18 to 75 years old; conducted your last renewal in person; non-commercial driver's license; have Social Security number (SSN) on file with the NM Motor Vehicle Division; No changes to your vision or medical condition since your last renewal; No outstanding traffic tickets or arrest warrants; driver's license expiring within 1 year or has been expired for less than 1 year; active duty military.
[xx] Whether renewing a NY driver's license online, by mail, or in person, applicant must provide proof of a vision test. If the optometrist is registered in the DMV Online Vision Registry, the NY DMV will be notified automatically.
[xxi] Licensees over 50 yrs. old will need to vision screen or have a certificate from a doctor.
[xxii] Eye exam card
[xxiii] Must pass a vision exam or have a certificate from an eye doctor in the past 12 months.
[xxiv] Must have a completed vision statement no older than 6 months.
[xxv] Ages 79+ need to pass a vision test.
[xxvi] Must meet state requirements for OL, M, and Ph.

#5 1-6-17

SB2123

NDMA

Est.1887 NORTH DAKOTA MEDICAL ASSOCIATION

Senate Transportation Committee
SB 2123 - January 6, 2017

CHAIRMAN LAFFEN AND COMMITTEE MEMBERS:

My name is Jack McDonald. I'm appearing here today on behalf of the North Dakota Medical Association (NDMA). The NDMA is the professional membership organization for North Dakota physicians, residents, and medical students.

The NDMA opposes SB 2123 because, in Subsection 9, it practically eliminates eye exams. North Dakota ophthalmologists have reviewed the bill and they would not recommend reducing the frequency of the eye exam requirements.

From a public safety point of view, people should be able to prove they can see well enough to drive more than just once every 12 years. License renewals were recently lengthened from 4 to 6 years. This bill now extends the eye exam requirement from 6 to 12 years. Many serious vision problems develop prior to age 65, such as cataracts, which is the most common, and also macular degeneration and glaucoma, just to mention a few common ailments.

Vision requirements can and do change throughout the lifetime of every individual. Even people under the age of 30 can have drastic changes in vision correction requirements.

Now that individuals are going to be driving at least 80mph on the NASCAR circuit commonly known as I-94 and I-29, it is more important than ever, for public safety purposes, that they have eye exams more than once every 12 years.

Additionally, we have no idea how this will actually be implemented. Subsection 9 says the Department of Transportation director may waive the vision requirements and adopt procedures to implement this. He may do what? We don't know.

Therefore, the North Dakota Medical Association respectfully requests that you give a DO NOT PASS to SB 2123.

Thank you for your time and consideration. I would be happy to answer any questions.

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A Roadmap for Interpreting the Literature on Vision and Driving

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Abstract

Over the past several decades there has been a sharp increase in the number of studies focused on the relationship between vision and driving. The intensified scientific attention to this topic has most likely been stimulated by the lack of an evidence-basis for determining vision standards for driving licensure and a poor understanding about how vision impairment impacts driver safety and performance. Clinicians depend on the scientific literature on vision and driving as a resource to appropriately advise visually impaired patients about driving fitness. Policy makers also depend on the scientific literature in order to develop guidelines that are evidence-based and are thus fair to persons who are visually impaired. Thus it is important for clinicians and policy makers alike to understand how various study designs and measurement methods should be appropriately interpreted so that the conclusions and recommendations they make based on this literature are not overly broad, too narrowly constrained, or even misguided. In this overview, based on our 25 years of experience in this field, we offer a methodological framework to guide interpretations of studies on vision and driving, which can also serve as a heuristic for researchers in the area. Here we discuss research designs and general measurement methods for the study of vision as they relate to driver safety, driver performance, and driver-centered (self-reported) outcomes.

Keywords

driving; vision; vision impairment; eye disease; research methods

I. Introduction

Just as in a literate society the ability to read is important for quality of life, the same can be said for driving in a society dependent on the personal vehicle for mobility and transportation. Visual acuity testing is the most common functional method for determining eligibility for licensure world wide, in addition to on-road and knowledge tests. Yet there is little to no evidence that a visual acuity screening test, no matter which pass-fail cut-point is selected, enhances driver safety and performance.[99] The absence of evidence-based vision

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standards for licensure together with the negative health consequences of not being a driver[25, 31, 37, 38, 42, 43, 55, 77, 94, 105] have prompted growing interest in the link between vision and driving by clinicians and researchers alike. For example, the number of literature citations on vision and driving indexed in Pubmed has approximately tripled since the 1980s. In spite of the growth in this literature, there are widespread misunderstandings about the inferences that can be properly made from various types of study designs. These misunderstandings impede construction of a convergent evidence base, have the potential for wasting precious research resources, lead to study conclusions that are erroneous and clinical recommendations that are potentially questionable, and have slowed our ability to provide coherent guidelines for clinicians and government policies. In an attempt to provide a clear conceptual framework for the research field and for clinicians who use this information to counsel patients about driving, this article is our perspective, formulated over our 25 years of experience in vision and driving research, on how different types of study designs and methodologies can be properly utilized to address specific research questions and hypotheses and properly inform conclusions.

"Driving" can be measured using several different methods that may not produce consistent findings due to the fact that each method is designed to measure a unique aspect of driving or its component skills. As a result, the types of inferences that can be made from each type of method are distinct, although theoretically related because they all address aspects of driving behavior, albeit from different perspectives. Below we discuss these various constructs, the approaches used to measure them, and inferences that can be made in studies that use them.

II. Safety

Safety in the context of driving is typically defined by motor vehicle collisions (MVCs). The US Department of Transportation's National Highway Traffic Safety Administration (NHTSA) characterizes driver safety this way as do most countries throughout the world.[90] From the standpoint of understanding the impact of vision on driving, MVCs in which the driver is at-fault[13, 79, 96] are of greater interest than those where the driver played no role other than being on the road (e.g., hit from behind when stopped at a red-light). Associations between vision impairment in older drivers and MVCs tend to be stronger when at-fault MVCs are the outcome measure compared to when all MVCs are used.[26, 79] However, the vision and driving literature is replete with studies using all MVCs, regardless of fault, as the outcome measure.[13, 32, 51, 97, 98, 111] This is the preference of many investigators since MVCs are rare events and thus utilizing all MVCs instead of at-fault MVCs increases the number of outcome events. In our research the proportion of MVCs that are determined to be the fault of the older driver is between 35% and 50%. The increase in statistical power often associated with an increase in the number of outcomes is potentially offset in this context because the effect size is diminished. Objective information on the occurrence of MVCs, including attribution of fault, for an individual driver can be acquired from motor vehicle administrations in the form of "accident" reports (electronically or on paper), although the availability and reliability of these reports is subject to laws and regulations regarding public access to such information.

Information on the occurrence of MVCs can also be obtained by self-report (i.e., reported by the driver being studied).[60, 76, 128] This approach is easier and cheaper when compared to acquiring MVC data from a jurisdiction's motor vehicle administration. However, the convenience of self-report may be offset by a number of factors, including the inability to obtain an objective assessment of fault. Even when accident reports are available and are obtained, collecting self-reported information is valuable as several studies have shown that there is a poor association between self-reported collisions and accident reports.[8, 11, 76, 81, 116] There are many possible reasons for this lack of agreement including faulty memory, social desirability, and privacy concerns. Critics of the reliance on police-reported MVCs observe that accident reports do not exist for all MVCs (e.g., those on private property, when the driver and any other involved drivers do not choose to report to police, those in jurisdictions where police do not routinely submit reports).[6, 76] Thus, while neither source captures 100% of all collisions that a driver incurs, this is not necessarily the primary goal; rather, if the goal is to obtain an unbiased measure of MVC occurrence, police-reported MVCs are more desirable. Collecting information via both mechanisms is also valuable in that it aids in the conduct of sensitivity analyses, i.e., conducting two sets of analyses, one using self-reported, the other using state-recorded MVCs as the dependent variable. If both sets of analyses yield consistent results, the validity of the findings is enhanced. But, for a given risk factor (e.g., vision impairment), the association may be different when using self-report versus police-reported MVCs, as McGwin et al. have demonstrated.[81] This discrepancy is partly attributable to the fact that any lack of agreement between self- and police-reported MVCs is associated with the risk factor in question. An example would be if cognitive impairment is associated with MVC occurrence and drivers with cognitive impairment are more (or less) likely to report MVCs accurately. This issue not only has important implications for the internal validity of a single study, but also sheds light on why the results of independent studies on the same topic may yield differing results if the dependent variables are not identical. Thus, researchers and readers need to be aware of differences in MVC variables when designing, conducting and comparing studies.

In general, cohort-based studies have the ability to estimate a number of measures of disease occurrence, the most common being risks and rates, the latter most frequently expressed as MVCs per miles driven. Research suggests that drivers can validly estimate the miles they drive per year, which is perhaps the most common measure of driving exposure.[15, 56, 67, 89] It should be noted however that, unlike the ubiquitous epidemiologic metric of person-years used as a uniform measure of time at risk, person-miles of travel may not be constant. This is due to the fact that MVC risk varies geographically and chronologically; for example, MVC risk is higher at night compared to during the day. To date, there has been little work on methods to "discount" mileage for differences in the underlying MVC risk. Just as studies using police-recorded and self-reported MVCs can yield differing results, studies estimating risks and rates may reveal different associations, partly attributable to the failure to account for driving exposure. This can occur when one of the groups being compared, despite having a similar MVC risk, drives less and thus will have a higher MVC rate. This problem can be obviated with the use of a randomized (i.e., randomized controlled trials) rather than an observational cohort-based study design. The main difference between these designs is the use of randomization to assign study participants to two or more treatment

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(i.e., "exposure") groups in randomized designs versus simply characterizing behaviors or characteristics in observational designs. Randomized studies focused on driving safety are rare, partly reflecting a lack of consensus regarding modifiable risk factors that are amenable to intervention development and evaluation. Randomized designs have a number of other advantages over observational designs including less concern regarding the role of confounding factors though concern regarding other issues is equivocal, e.g., loss to follow-up. For example, a recent observational cohort study compared MVC involvement among drivers with homonymous hemianopia and quadrantanopia with that of age-matched drivers with normal visual fields. The MVC risk and rate ratios were 1.19 and 2.45, respectively, reflecting the fact that drivers with homonymous hemianopia and quadrantanopia were, on a per person basis, 1.19-times more likely to be involved in an MVC but, on a per mile basis, 2.45-times more likely. This also reflects the fact that the homonymous hemianopia and quadrantanopia patients drove approximately half as much as the comparison group.[85] In comparison, Owsley et al. conducted a randomized, control, single masked study to determine whether an individualized educational program designed to promote strategies to enhance driver safety reduced MVC occurrence in high-risk, visually-impaired older drivers.[98] In this study the two comparison groups were equivalent in all measures of driving exposure (i.e., miles, days, trips and places driven) and as a consequence the MVC risk and rate ratios were also nearly equivalent. The comparison of these studies brings up two important points. First, risk and rate ratios may differ despite the groups being compared having equivalent measures of driving exposure. This is attributable to the fact that the risk factor or intervention may not have an impact on the risk or likelihood of an MVC but does have an impact on the timing at which such events occur. Second, any inconsistency in risk and rate ratios does not call into question the validity of a study's results. Rather, it reflects the very important point that risks and rates are two related but distinct outcomes and properly interpreting the results of studies using one versus the other relies upon the reader, and often the investigator, understanding their differences. The benefit of being able to calculate both risks and rates is offset by the requirement in cohort studies for large numbers of drivers. These large numbers are needed to have adequate statistical power to detect differences, say, between a visually impaired group of drivers and normally sighted drivers. Adequately powered cohort-based studies can be very costly, since in addition to characterizing the visual or ocular characteristics of interest, it is also necessary to determine driving exposure levels for a large sample of drivers at baseline and pay for the police-reported crash data from the governmental jurisdiction. Additionally, follow-up visits or telephone contacts must take place over the prospective period during which accident report data are also collected (usually multiple years) in order to track driving exposure and other changes in health and functioning.[97, 111]

There are other non-experimental, observational study designs used to study driver safety including case-control and cross-sectional designs. The distinct advantage of these designs over a cohort study is the fact that the investigator does not have to wait for the events to occur. To quantify the effect of risk factors on MVC occurrence, cases and controls are compared with respect to risk factors and other characteristics of interest.[47, 78] Because at the time the study is conducted both the MVC and risk factors have already occurred, there is opportunity for bias, although bias can be minimized using objective measurements and with proper case and control selection. Using pre-existing measurements of risk factors, e.g., from medical records, is particularly advantageous in that these measurements were taken prior to MVC occurrence and generally represent a bias-free source of information. For example, a case-control study was used to evaluate the association between visual field defects and the risk of MVC among patients with glaucoma.[83] In this study cases were patients who sustained a police-reported MVC between January 1994 and June 2000; controls were those patients who did not experience an MVC. Then, for each patient, a visual field loss score was calculated based on automated visual fields already collected and pre-existing in the medical records of enrollees. In a case-control study it is reasonable to identify and enroll drivers who have sustained MVCs and *then* measure or assess their visual function. This approach can produce valid results assuming that the visual function measurements were not affected by the MVC and were stable over time. The latter can be solved by selecting a short time period for MVC occurrence, i.e., in the prior year.

Briefly, cross-sectional study designs are those where the study population is not selected with regard to either the primary exposure or outcome of interest; rather, they are selected at random or by convenience from a larger population of individuals. Once the sample is selected, information on exposures and outcomes is assessed simultaneously. For example, a recently published study enrolled 2,000 adults aged 70 and older who were licensed drivers obtained from the state's licensing agency.[46] Among other things, the investigators measured visual function, asked participants about their driving habits and obtained information on MVCs in the prior five years via police accident reports, respectively. Cross-sectional studies are more efficient than most other designs in that they do not have the financial and logistical burdens of long periods of follow-up, however, they retain the need for large sample sizes and are subject to a number of significant methodological limitations. For example, one of the well-known limitations of cross-sectional studies is the difficulty establishing temporality; i.e., did the outcome occur before or after the exposure. In the aforementioned study, for the observed association between visual acuity impairment and reduced driving exposure (e.g., lower mileage), it is not possible to know whether those with reduced driving exposure changed their driving habits in response to changes in their visual function.

Finally, ecologic study designs which, rather than measuring risk factors and measures of safety in individuals, measure these characteristics in the aggregate, typically geographically or temporally. These designs have been used to compare the impact of licensure laws as they relate to older drivers and vision re-screening policies.[45, 84, 92, 115] For example, Grabowski et al. compared state driver's license renewal policies with respect to older driver fatality rates and observed that states requiring in-person renewal had lower rates compared to those states that did not have such policies.[45] In another study McGwin et al. also compared fatality rates in a single state, Florida, before and after the implementation of a new licensure renewal law targeting older drivers.[84] The results indicated that following the implementation of a law requiring that license applicants pass a visual acuity test, the MVC fatality rate decreased. In both of these studies, the unit of observation/analysis was not the individual; rather it was the state or chronological time. While the limitations of ecologic designs are extensive and well-known,[86] they are valuable for exploring novel hypotheses as well as the impact of policies.

The main limitation of safety studies is that they tell us little about the mechanisms by which vision impairment impacts driving performance, i.e. how vision affects driver behaviors behind the wheel and vehicle control kinematics. An accident report has a wealth of information such as demographic information about the drivers involved and many details about the circumstances of the collision. Yet also vital are mechanistic questions such as how the driver's visual capacities impact lane control, speed, gaze, recognition of roadway obstacles, obeying traffic control devices and signage, navigation of a route, as well as what behaviors ensued before and during a vehicle crash.

III. Performance

Performance refers to driver behaviors and vehicle kinematics when a person is operating a motor vehicle on a roadway. Driver behaviors include the driver's use of vehicle controls (e.g., steering, directional signal, shifting gears), visual behaviors (e.g., eye and head movements, gaze direction), and secondary task behaviors (e.g., eating, smoking, cell phone use, conversations with passengers). Vehicle kinematics refer to physical variables such as speed, changes in speed and the smoothness with which these changes are adopted (e.g., smooth or jerky deceleration, acceleration), cornering and lane keeping. While there has been an abundance of epidemiologic research on the relationship between specific driver behaviors (e.g., cell phone use, the presence of passengers) and MVC occurrence, the relationship between both behaviors and kinematics and MVC occurrence has not been explored outside of controlled settings. The vast majority of driving performance studies to date, as summarized in this section, have utilized cross-sectional designs where driving performance was measured on a given day, and performance variables were then analyzed in terms of their relationships to various aspects of drivers' vision as measured on or near the date that driving performance was measured. A limitation of the literature is that longitudinal designs addressing vision and driving, where change in driving performance variables are tracked over multiple assessments over a period of months or years as a function of any vision changes, have not yet been conducted. Intervention evaluations where driving performance is assessed before and after an intervention to improve vision or visual skills have appeared in the literature yet are uncommon.[66, 126, 139]

Performance studies take place in two types of roadway environments – either on the open-road or on a closed-road circuit. There are also several different types of measurement tools that have been developed to measure driving performance. These issues will be discussed in the following sections.

A. Open-Road and Closed-Road Designs

Open-road studies take place on actual public roadways (for example [16, 39, 50, 74]). Closed-road studies take place on a series of roads or circuits created especially for research investigations that are closed to public access; any obstacles or events along the closed route (e.g., vehicles, pedestrians, road signs) are "staged" by the investigator (for example [54, 143, 148, 150, 153]). The main advantage of an open-road design is that driving takes place amidst a natural traffic environment where vehicles, pedestrians, and other types of obstacles and events unfold during the course of everyday driving. The roadway and its environment are not created for the purpose of the study but rather are what the driver would normally encounter in daily driving along that roadway. Thus the open-road design has very high validity as a stimulus environment for assessing driving performance. The closed road does not have these naturally occurring events, but rather, the investigator creates test events (e.g., approaching vehicles, road signs, pedestrians) where the driver's behavior is assessed. The main advantage of the closed road design is that test "trials" can be standardized across research participants, where the same or very similar stimulus conditions can be presented to all drivers in the study and comparisons can be made, for example between drivers with vision impairment and those who are normally sighted.[146] Closed road courses can also be viewed as less risky from a collision perspective since the traffic environment and potential hazards are created by the researcher and thus predictable. The main limitation of closed road studies is that the roadway environment is much simpler than the open road; the lack of other naturally occurring vehicles and events along the roadway reduces the validity of testing and could potentially over-estimate driving skills. However, on balance, one of the main limitations of the open-road design is that tight stimulus control is impossible. However, investigators standardize the assessment as much as possible by selecting a route with, for example, a specified number of traffic control devices or curves in the road, although the number and pathways of other vehicles, pedestrians and other obstacles cannot be controlled.[149] In addition, the same route is typically used for all participants unless the study involves previously conducted on-road assessments for clinical purposes by a driving rehabilitation specialist where route standardization is not the norm.[104]

It is also possible to simulate the effects of various types and degrees of vision impairment in participant drivers, and then assess how impairment impacts closed-road driving performance using a repeated measures design.[53, 142] Simulating vision impairment in drivers (e.g., introducing blur through optical lenses, recreating the effects of cataracts through filters that reduce contrast and increase glare, restricting peripheral vision through occluders) and then introducing them to the open-road would not be legally possible in most jurisdictions. However, while simulated visual impairment in a repeated measures design provides the opportunity to partial out the effects of vision alone, the negative impact of simulated impairment on driving performance may be greater than for drivers with true vision impairment who have had the opportunity to adapt to their visual deficits and develop compensatory strategies.

Both open-road and closed-road designs have generated substantive advances in our understanding of how vision impacts driving. For example a series of studies on a closed-road circuit in Queensland, Australia in the 1990s were the first to document the association between vision impairment and road sign recognition and obstacle detection during driving.[141, 142, 144, 145] More recently, open-road designs have examined the relationship between vision impairment and driving performance. For example, studies have shown that in spite of having significant visual acuity loss (20/70 to 20/200) or field loss (homonymous hemianopia or quadrantanopia), some visually impaired drivers are capable of skilled driving performance that is indistinguishable from that of normally sighted drivers.[149, 155]

The kinds of conclusions that can be made from closed- versus open-road designs are somewhat different. Because closed road studies allow for the repetition of orchestrated stimulus events and trials, they provide good estimates about specific driver competences as a function of visual status; for example, they can establish the distance at which a pedestrian or cyclist can be detected or a road-sign can be read.[20, 127, 152, 153] Closed-road designs can be viewed as "proof-of-concept" studies in that they demonstrate under near-laboratory, highly controlled conditions, how vision impacts performance while the participant drives and controls a real vehicle. On the other hand, closed road studies do not allow for confident generalizations to the open road where the driving environment is highly complex and often chaotic. A reasonable research strategy is that the proof-of-concept closed road studies with interesting findings should stimulate open road studies as a next investigative step. Open-road studies can thus establish the relationship between vision and driving under an everyday roadway environment with all its complexity and spontaneity.[149]

B. Measuring Driving Performance

Thus far we have focused on driving performance study design in terms of the roadway. Also critically important to performance studies are the measurement tools used to assess driving performance, of which there are several.

A general point to make at the outset is that when studying vision and driving performance, participants should be currently active drivers; investigators typically define current driving as engaging in some minimum amount of "behind the wheel" exposure (miles or days per week). Just because someone has a driver's license does not mean that he/she is a current driver; some, particularly older adults, even though they no longer drive, choose to renew their license for identification purposes or because it potentially represents a "badge" of independence.[99] The reason that studies aiming to examine the relationship between visual abilities and driving should refrain from including non-drivers (or persons who have not been behind the wheel for an extended period of time, e.g., a year or more) is that such persons cannot be expected to be as skilled as normally sighted drivers who habitually drive, which is the primary comparison group with which the visually impaired drivers are compared. If one were to compare non-current drivers who are visually impaired to normally sighted drivers, one could erroneously attribute driving performance problems to vision impairment, when in fact driving problems may be more appropriately attributable to a lack of recent driving experience. It is well established that novice drivers display different on-road visual and vehicle control behaviors as compared to experienced drivers.[87, 114, 132] It is of course appropriate, however, to study non-current visually impaired drivers (e.g., those with learner's permits) if the aim of the study is to understand the process by which visually impaired persons learn to drive.[9, 134]

1. Clinical Gold Standard—The clinical gold standard for assessing on-road driving performance by persons who are functionally or medically compromised is an evaluation by a certified driving rehabilitation specialist (CDRS),[9] who is often also an occupational therapist. These clinical gold standard assessments typically occur on the open road, although some evaluations may begin in areas away from public roadways such as empty parking lots or private roads before the driver is asked to embark on the open road. Driving assessments usually take place in a specially equipped vehicle with a side front-passenger brake and, in some cases, an auxiliary gas pedal (positioned where the CDRS sits) and up-to-date safety equipment (e.g., air-bags and modern seat-belt designs). When the assessments are done for research purposes, they are typically conducted along the same route to ensure standardization across participants. The CDRS evaluates specific elements of the driver's performance as well as making an overall rating of driving fitness. While there are many rating scales in use by CDRSs,[39, 58, 61, 62, 74] most have common elements including assessing interaction-communication with other road users and pedestrians, driving style (margin of anticipation), vehicle control skills, adjustment to traffic speed conditions, responses to traffic control devices, reaction to unanticipated events, and unusually bad driving maneuvers (e.g., turning wrong way on one-way street). The CDRS makes ratings of driving quality typically using a 3 to 5 item Likert-type scoring system. Even though CDRS ratings are the gold standard for making judgments about driving fitness in a clinical care setting, they do have limitations as the sole measurement tool in research on the visual mechanisms underlying driving problems. The CDRS is generally familiar with the driver's medical and functional status and driving history and may also have predispositions toward certain driving fitness judgments based on prior clinical experience. This has strong potential for introducing bias into their ratings, which could be exacerbated in studies that include assessments performed by several different CDRS evaluators.[24, 104]

2. Backseat evaluators—Some researchers have used an alternative approach to generating ratings of driving performance by using "backseat" evaluators.[16, 57, 110, 147, 149, 155] These are generally research personnel, or in some cases occupational therapists, trained to use rating scales to make judgments about the quality of driving, who sit in the backseat while the driver and the CDRS or a driving instructor sit in the front seat. Since the backseat evaluators are not responsible for monitoring safety (unlike the CDRS), they can concentrate on making continuous judgments about driving throughout the route. Under ideal study conditions, the backseat evaluators are masked with respect to which drivers are visually impaired versus normally sighted, however, valid masking is easier for some visual disorders than others. For example, for drivers with hemianopic field loss back seat evaluators can be successfully masked,[149] whereas in studies on bioptic drivers it is obvious who is wearing a telescope and who is not.[155] In addition, high inter-rater agreement should be established with a second rater since judgments on rating scales are fundamentally subjective. The rating scales used by backseat evaluators are usually different from those used by the CDRS. While the CDRS rates general skill levels displayed during driving (as discussed previously), a backseat evaluator uses a rating scale that assesses the quality of specific elements of driving at a series of pre-determined places during the route.[16, 110, 147, 149, 155] For example, a location such as driving through a specific intersection is rated with respect to behaviors such as lane position, steering steadiness, gap judgment, braking, use of the directional signals, and obeying traffic control devices. The advantages of ratings provided by backseat evaluators, as compared to the CDRS, is that they can be relatively free of bias since they are masked to the clinical history of the driver. Yet, in the end, backseat evaluators make subjective judgments; the dependent measures they generate do not provide actual vehicle kinematics or objective records of driver performance. In addition, drivers are aware of their presence in the vehicle and may modify their driving behaviors as a result.

3. Instrumented Vehicles—Instrumented vehicles are a potentially major step forward in measurement techniques in vision and driving research. Multiple sensors and video cameras are placed in the vehicle and record vehicle kinematics, GPS location, nearby objects, driver behavior, and the roadway environment. The data streams from these recordings can then be analyzed to generate many types of objective measures such as speed, braking, rapid acceleration or stopping, steadiness, and cornering. Video cameras strategically positioned in the vehicle can capture videos of the driver's upper body including head, arms, as well as foot movement, which can later be analyzed for features of interest (e.g., gaze direction, using cell phone). Video recordings can also be made of the roadway environment around the vehicle in order to capture other events and objects in the roadway environment (e.g., vehicles, pedestrians, signs, traffic control devices). Currently the most common way that instrumented vehicles are implemented in vision and driving studies[3, 27, 30, 69, 108, 130, 131, 149, 151, 155] is to install instrumentation in the study's vehicle and then all study participants drive that vehicle, usually on a standardized route for about an hour. Study personnel are in the vehicle; for example, a CDRS often sits in the front passenger seat to monitor safety, and personnel are often in the backseat as raters and/or to monitor instrumentation installed in the vehicle via a laptop computer. Variables as mentioned above can be extracted from the data streams and analyzed in light of the drivers' visual or other functional characteristics.

The considerable advantage of installing instrumentation in the study vehicle is that, rather than subjective judgments from a rater, it provides objective data on vehicle kinematics and also video of driver behaviors and the roadway around the vehicle. The video can be later scored by a human observer who rates features such as vehicle excursions over the center-line or head turns to the left or right; this observer needs to establish good agreement with another rater, or be reviewed by a CDRS after the drive.[4, 5, 28, 151] An additional advantage of this approach is that the video of the driver's face can be occluded for judgments about vehicle kinematics (e.g., lane-keeping); thus if there is some physical feature of the driver (e.g., driver is wearing a bioptic telescope) that relays whether the person is visually impaired, the observer is masked to it. Image processing algorithms can be also used to discern behaviors from the vehicle kinematic variables and video, for example to assess lane-keeping and detect the driver's gaze direction,[29, 65] However, the development and widespread application of these algorithms is a relatively new field, yet a field that is rapidly growing. Initiatives are also underway to develop computer algorithms to automate the identification of safety critical events and near-crashes from vehicle kinematic variables.[10, 34, 65, 156] However, the data generated by the vehicle's instrumentation over many miles of driving will be of limited scientific value unless user-friendly automated analysis procedures can be implemented.

There are disadvantages to using an instrumented study vehicle in the manner described above. First, driving behaviors are likely influenced by the presence of study personnel in the vehicle. Second, the driver does not choose the route as one would do during the course of everyday driving, nor is the vehicle the driver's own vehicle. The latter is particularly relevant since previous research has shown that older drivers perform better in their own vehicle than in an unfamiliar research vehicle.[72] Third, the drive is relatively short, usually no more than one hour of driving time, which is a brief snapshot of driving when one considers the many miles most drivers cover over weeks and months. Thus, while the instrumentation adds a great deal of measurement power, the driving experience from the driver's perspective is unnatural and the epoch being studied is short.

4. Naturalistic Driving—The above-mentioned downsides have recently given rise to what is referred to as *naturalistic driving* methodology.[70, 133] Naturalistic driving techniques objectively measure driver performance over extended periods (weeks or months) in the driver's own vehicle, where the individual drives as they would normally during the course of everyday life. Study personnel are not in the vehicle. The vehicle is instrumented, similar to that described above, but in a more miniaturized and/or hidden way. The ability to practically place these measuring devices in a person's private vehicle unobtrusively has been facilitated by technological advances and miniaturization of computer, sensor, data storage, communications, and video technologies. Naturalistic driving techniques avoid the short snapshot of on-road driving evaluations, the staged analogues of the closed course, the standardized driving route, and the intrusiveness of study personnel riding in the vehicle. Naturalistic driving also allows for the study of driver behaviors and vehicle kinematics as related to vehicle crashes and near-crashes. Admittedly, crashes are rare events so a naturalistic driving study is likely to have very few of these events, if any. However, near-crashes occur at a rate 10 times higher than the rate of actual crashes yet are similar to crashes in terms of driver behavior and vehicle kinematics.[48] Thus they are a rich source of material for study. It is worth highlighting that a major advantage of these numerous video and vehicle kinematic data streams could also be viewed as a disadvantage, or at least a serious challenge. The data streams must be reduced into variables that can be used to test hypotheses about the relationship of vision and driving. As mentioned earlier, there is growing activity in developing computer algorithms to automate data reduction,[10, 29, 34, 65, 156] but the field has far to go in developing data reduction and analysis strategies for the data streams. Furthermore at present there is little, if anything, known about the relationship between variables collected through naturalistic driving by visually impaired drivers and assessments of their on-road driving by backseat evaluators or a CDRS, or the relationship between naturalistic driving variables relationship and the drivers' own impression of the quality of their driving. This is not surprising since, as mentioned, research using naturalistic driving techniques to study vision and driving is in its infancy.

There have been several large initiatives using naturalistic driving methods,[32, 52, 64, 91, 117, 129] most funded by the U.S. Department of Transportation, and also subsequent publications that make use of these databases. However there have only been a handful of publications to date using naturalistic driving data to focus on the relationship between vision, vision impairment, and driving.[7, 19, 64, 71, 73, 90, 135, 138] Yet with the continuing technological advances in the design and miniaturization of recording instruments and the advantages of naturalistic methods for understanding the visual mechanisms underlying driving, this field is expected to blossom over the next decade.

IV. DRIVER-REPORTED OUTCOMES

In addition to driver safety and performance research methods, a third method for measuring driving is a driver's self-report on his/her own perspectives about driving experiences. In the medical literature, these measures based on patient reports are referred to as patient-reported outcomes (PRO), so it is fitting in our context to call them driver-reported outcomes (DRO). DROs play an important role in understanding the relationship between vision and driving since they provide insights into drivers' attitudes and beliefs about their own skill-sets and driving behaviors, including how their vision and other medical/functional issues impact their driving and what compensatory strategies they implement when driving (if any). DROs are typically elicited through questionnaires that are specially designed for this purpose.[2, 23, 95] However, a limitation of many DRO instruments is that they have not been developed using item-response theory. Common domains that are addressed by these questionnaires are driving difficulties in or avoidance of general or specific situations, driving habits (e.g., where, when, how much one drives), driving errors (e.g., "close-calls" or near-crashes), and adverse events (e.g., moving violations, collisions). DRO questionnaires also have addressed drivers' attitudes and beliefs about changes in vision re-screening policies[80] and have been developed as "self-assessment" tools designed to stimulate self-awareness by the driver regarding how visual and other functional limitations could impact their driving.[35]

The published literature on vision and driving using self-report measures is extensive, as summarized recently.[99] The vast majority of studies examine the cross-sectional relationships between DROs and the visual function or eye disease status of drivers. There is widespread evidence that compared to drivers who are normally sighted, drivers with vision impairment and eye conditions are more likely to report driving difficulty (particularly under reduced visibility conditions or unfamiliar areas), avoidance of challenging driving situations, and driving cessation.[1, 12, 43, 63, 82, 100, 103, 106, 113, 121] DRO research has the advantage of being less costly to conduct as compared to driver performance and safety studies, and it is also relatively straightforward since there is great flexibility in how DRO data is collected (e.g., in person, by phone, mail-out, web-based). When DROs are used appropriately in research to understand the driver's perspective, they can add a great deal to our understanding of vision and driving. For example, DRO data strongly suggest that many visually impaired drivers and drivers with eye conditions are aware of driving challenges and self-regulate their driving by limiting their driving exposure (e.g., limiting or stopping night driving).[1, 12, 43, 63, 82, 103, 106, 113, 121] However, it is highly problematic when DRO measures are used as surrogates for driver safety and performance measures. Some drivers with reduced contrast sensitivity secondary to cataract may report driving difficulties, which is verifiable by closed-road driving performance measures such as reduced hazard detection.[139] However, some drivers with reduced contrast sensitivity report no driving difficulties, when in fact they do have elevated MVC rates.[97] The capacity of some drivers to validly self-rate their own driving is limited; those with the greatest mismatch between actual and self-reported driving abilities tend to be those most at risk.[154] It is therefore important that investigators and readers are aware that DROs are the driver's opinion, by definition; and, they cannot be used to make conclusions about performance or safety. A

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similar case can be made for self-reported collisions, as discussed earlier with reference to safety measures.

Proxy reports from family members or other caregivers about a patient's driving performance have also been used in research,[22, 93, 136] although studies have mostly focused on cognitively impaired drivers. Agreement among the patient's assessment of his/her driving, a caregiver's assessment, and a professional driving evaluator's assessment has been evaluated; there may be moderate agreement between proxy reports and driving evaluators, however their agreement with the patient's report is not typically good. In addition, these relationships may be different for drivers who are cognitively impaired, versus those drivers from the general driving population including visually impaired drivers.

V. DRIVING SIMULATORS

Interactive driving simulators are becoming more commonly used to measure the relationship between vision and performance in driving tasks given the increased availability of off-the-shelf, commercial systems.[41] For example, simulator studies have examined the impact of vision impairment on vehicle control such as lane-keeping in drivers with retinal degenerations,[123, 124] near-crashes in drivers with slow visual processing speed,[110] and pedestrian or vehicle detection in drivers with homonymous hemianopia.[17, 101, 102] Simulator studies typically adopt a cross-sectional design. There are wide differences in the sophistication of various simulators, ranging from desktop PC-controlled displays with steering wheel controls and gas/brake pedals to those using the cab of a real vehicle situated on a moving base, to virtual reality systems.[17, 101, 107, 120, 122, 137] Driving simulators offer the advantages of standardizing testing conditions and driving scenarios for all participants and allow the safe assessment of task performance in potentially dangerous roadway scenarios since the environment is pretend, not real. Simulators are also useful in studying persons whose functional impairments are so severe that taking them on the road would be too dangerous and/or illegal. Compared to on-road studies, simulator studies may be more practically convenient for the investigator since they are based in the laboratory rather than out amidst the complexity and challenges of the real-world driving situation. Simulators are also particularly well-suited for eye movement studies using currently available systems since the physical environment (e.g., lighting) can be controlled and the vehicle is not actually moving, which facilitates valid and reliable eye movement recording.

A major disadvantage of simulators in the context of vision and driving studies is that the visual displays are obvious visual oversimplifications of the roadway, often looking cartoon-like; no matter how sophisticated they are, they can have questionable fidelity in terms of representing the visual complexity and variable lighting conditions of the actual road, including glare and variations in ambient lighting (e.g., sunny versus shaded, night, dusk, precipitation).[40, 112, 140] In addition, the participant is well aware that he/she is not having a real driving experience with all its associated risks, and thus there is an obvious recognition on the part of the participant that questionable driving behaviors have no adverse, real-world consequences. A collision in a simulator has no personal safety, vehicle, or environmental consequences. These factors can influence response contingencies in how one behaves in the simulator. For example, studies have demonstrated that drivers tend to adopt higher speeds in a simulator compared to the real road for some driving scenarios, implying that these differences could stem from differential risk perception on the simulated road as opposed to that on the real road.[14] Similar differences have been found for lane deviations.[128]

Another disadvantage is that "poor" or "unsafe" simulator performance (however that might be defined) does not automatically signify a driver would have impaired performance on the road or has an increased crash risk. Some investigators take their simulator studies to the next step by enhancing their results through companion on-road driving studies,[109] which is important when investigators seek to use their simulator results to make generalizations about actual driving ability. Although some researchers have reported a positive correlation between components of an on-road assessment and driving simulator performance measures,[49, 68] the best validity occurs when studying drivers who have no difficulties on the actual road; the validity is reduced when persons who have driving problems are studied. Thus, while there is evidence that drivers perform well in a simulator if they are good drivers, there is some question as to whether simulator performance corresponds to on-road driving performance when drivers have functional impairments (e.g., vision loss) that engender driving difficulties.

Simulator sickness is a further challenge that investigators routinely deal with when they use driving simulators to study driving in the laboratory. Simulator sickness is a syndrome with a range of possible symptoms, some more severe than others, such as sweating, dizziness, head ache, eye strain, nausea, vomiting, among others.[18, 21] The literature is clear that older adults and women are more prone to simulator sickness than other demographic groups.[18, 21, 36, 118] The stimulus characteristics of scenarios and the environment where testing takes place can influence the likelihood of symptoms so investigators need to be keenly aware of this literature in order to reduce these adverse complications in their simulator scenarios and study protocols.[119] Since vision impairment is more prevalent among older adults, the fact that advanced age increases risk for sickness is practically concerning since it suggests that some older enrollees will be unable to complete the protocol. This also potentially strikes at the generalizability of findings if a substantial segment of the population cannot provide usable data. Reports of simulator studies on vision and driving should always report the number of subjects who could not complete testing due to simulator sickness.

As for closed road driving studies, interactive driving simulators are useful for generating hypotheses regarding the role of vision and visual impairment in driving. The ultimate goal should be to subsequently test these hypotheses on the road whenever possible. Importantly, driving simulator results, by themselves, must not be the sole basis of driver safety and licensing policies without on-road confirmation of the findings and the consideration of safety data.

VI. CONCLUSION

Although the clinical gold standard for assessing driving performance is an evaluation by a CDRS, in research there is no one type of study design, study setting, or measurement tool that is patently superior to others for the study of vision and driving. All the methodologies discussed in this overview have scientific relevance in studying the relationship between vision and driving, and how impaired vision impacts driving. As ophthalmologists, optometrists and other health care providers read this literature in order to provide guidance about driving fitness to their visually impaired patients, it is important for them to recognize that study design, settings, and measurement tools will impact how studies can be properly interpreted. Similarly, policy makers depend on this literature in developing guidelines that are evidence-based and fair to drivers who are visually impaired. All methods have strengths and limitations, and some are more costly to implement than others. Some measurement methods are objective; some are derived from trained observers; and some are patient-centered. The challenge for the clinician, researcher, or policy maker is to understand whether the selected methodology is most appropriate for examining the question being asked and then to make conclusions that are consistent with the constructs that the methodology is designed to measure. Observational studies based on police-reported MVCs are the optimal approach for generating evidence to inform vision-related driver safety policies; different types of study designs, as discussed above, provide different levels of evidence. Closed-road, simulator and on-road studies are optimal for understanding the visual mechanisms underlying driver behaviors and vehicle kinematics, though closed-road and simulator studies are contrived environments; on-road studies are not contrived, but research personnel are in the vehicle. Naturalistic studies provide an opportunity to inform visual mechanisms in real-world settings, and if their samples are sufficiently large, naturalistic studies can also inform policy. Driver-reported measures can be implemented in all study designs. With the methodological framework presented in this article as a guide, it is our hope that we have offered a useful framework for researchers in this field, facilitated ophthalmologists and optometrists in evidenced-based clinical interpretations, and enhanced the appropriate use of vision and driving research for policy making. The ultimate public health aim is an improved understanding of vision and driving that best serves patients with visual impairment and other road users.

VII. METHODS OF LITERATURE SEARCH

In preparing this article we used the following methods for identifying relevant articles. We searched PubMed using the key words "driving", "vision", "vision impairment", and "eye disease". There was no constraint placed on publication date. Based on the reference sections of the articles that were generated in this PubMed search, we identified additional articles that addressed vision and driving, which did not arise in the original search. Many of these latter articles were government publications or conference proceedings that are not indexed in PubMed. Only full-length articles in English are cited. It was not our goal to review and cite all articles on vision and driving in this article; rather our focus was on those articles that shed light on the research designs and measurement tools used in the study of vision.

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Review

Vision and driving

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ABSTRACT

Driving is the primary means of personal travel in many countries and relies heavily on vision for its successful execution. Research over the past few decades has addressed the role of vision in driver safety (motor vehicle collision involvement) and in driver performance (both on-road and using interactive simulators in the laboratory). Here we critically review what is currently known about the role of various aspects of visual function in driving. We also discuss translational research issues on vision screening for licensure and re-licensure and rehabilitation of visually impaired persons who want to drive.

1. Introduction

Driving is inarguably a highly visual task. Even though visual acuity is the ubiquitous screening test during application for a driver's license, many other aspects of visual function and visual processing are undoubtedly involved in supporting the effective control of a vehicle. During the last two decades there has been a burst of research activity focused on the role of vision in driving, much of which has been centered on what types and degrees of vision impairment hamper driver safety and performance. This body of work is largely motivated by society's need to preserve public safety on the roadways. The larger question emerging from this research is, what should be the visual requirements for obtaining or maintaining a driver's license? There is widespread agreement that vision standards for driver licensure need to be evidence-based so as not to unfairly prohibit individuals from driving who have the visual skills necessary to do so, in spite of being visually impaired. Even though the field does not yet have the evidence accumulated to define those standards, the research over the past two decades has gone far in contributing to this evidence base. This article will critically summarize these findings.

Before doing so, however, it is important to acknowledge that driving is not simply just a way to "get around", but in fact is the primary and preferred mode of travel for adults in the US and many other countries (Hu & Reuscher, 2004). Being a driver has a profound impact on health and well-being. Driving cessation, regardless of whether it is voluntary or involuntary (i.e., license revocation), can have a number of adverse consequences. Cessation of driving has been associated with decreased health-related quality of life (DeCarlo, Scilley, Wells, & Owsley, 2003), increased likelihood of depression and social isolation (Fonda, Wallace, & Herzog, 2001; Marottoli et al., 1997; Ragland, Satariano, & MacLeod, 2005), reduced access to healthcare services (Owsley et al., 2006, 2008), and increased likelihood of placement in long-term-care (Freeman, Gange, Munoz, & West, 2006). It also creates a need for alternative transportation options at both the societal and individual level that are potentially expensive (e.g., public transportation and paratransit systems, taxi) (Rosenbloom, 1993; Transportation Research Board, 1988) and are unavailable in many geographic areas, especially rural areas. Just as reading in a literate society is important to quality of life, so is driving in a society that depends on the personal vehicle for transportation.

Because vision impairment is much more prevalent in later adulthood, many studies on vision and driver safety and performance focus on adults ⩾50 years old. Because of this focus on the older adult population, other medical and functional co-morbidities common in late adulthood are potential confounders in understanding the relationship between vision and driving. In particular, cognitive impairment elevates crash risk and impairs driving performance (Ball et al., 2006; Wood, Anstey, Kerr, Lacherez, & Lord, 2008). Thus, study designs that make use of older adult populations to study associations between vision and driving must consider cognitive co-morbidities whenever possible.

In research on driving, there are two major outcomes (dependent variables) – driver safety and driver performance. They are not synonymous in that they assess different constructs and use different types of methodology in doing so. *Safety* is defined by adverse driving events, typically motor vehicle collision involvement (e.g., at-fault crashes, injurious crashes). Information on these adverse events is typically provided by a state's motor vehicle administration in the form of accident reports. The US Department of

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Transportation's National Highway Traffic Safety Administration (NHTSA) characterizes driver safety this way (National Highway Traffic Safety Administration., 2009), as do countries throughout the world. Safety measures are often expressed as rates – crashes per miles driven or per person-years of driving. The numerator of these rates can vary with respect to severity (e.g., property damage vs. fatalities) and attribution (e.g., all collisions vs. at-fault). These distinctions are not inconsequential as certain risk factors may be more strongly associated with some types of collisions than others. From an etiologic perspective collisions in which the driver was at-fault are of greater interest than those wherein the driver played no role while from a public health perspective injury-producing collisions may be more relevant. When computing crashes per miles driven, the denominator (miles driven) is based on the driver's estimate of how many miles per year they have driven in the past year. Drivers of all ages can validly estimate the miles they drive per year (Hu & Reuscher, 2004; Leaf, Simons-Morton, Hartos, & Northrup, 2008; Murakami & Wagner, 1997). For crash rate computed as crashes per person-years of driving, the denominator is the number of years the person was a driver during the observation period. These denominators are referred to as "driving exposure". For inferential purposes crash rates (or risks) in a subgroup of drivers of special interest is compared to a reference group (e.g., drivers with visual acuity worse than 20/40 compared to those with 20/40 or better) using risk, rate or odds ratios. It should be noted that these two safety measures may yield different results, particularly if one group tends to drive less than another yet accumulates a disproportionate number of collisions.

It is not advisable to use self-report of crash involvement in computing crash rate. This issue has been discussed at length elsewhere (Arthur et al., 2005; Ball & Owsley, 1991; McGwin, Owsley, & Ball, 1998; Smith, 1976). Self-report measures of driver safety come from questionnaires that ask drivers about the number of crashes they have had for some previous period. However, there is a poor association between self-reported crashes and crashes where the police came to the scene and an accident report was filed. Drivers who have been crash free over the past 5 years are very likely to validly report that they have not had crashes; however, those who have crashed, especially those with >1 on record, are less likely to validly report their crash histories. Many reasons undoubtedly underlie this mismatch, including recall problems, social desirability, and unwillingness to share this type of potentially embarrassing information. Rather, the state accident report is typically viewed as the gold standard for measuring safety. It should be noted that police reported crashes may not capture a 100% of the crashes a driver incurs (e.g., minor collisions, those on private property). However, police reported crashes are highly likely to reflect more serious crashes involving property damage and/or personal injury on public roads. From public health and safety perspectives, these are the most relevant crashes.

Performance refers to driver behaviors when operating a motor vehicle. Performance can be measured in two general ways. One is by physical measures of driving behavior (e.g., speed, braking, latency, scanning behavior, position in the lane). These measures are accomplished through the use of an instrumented vehicle having sensors or measuring devices that record elements of vehicle movement or driver behaviors directly (Munro et al., 2010; Neale et al., 2002; Uc et al., 2006; West et al., 2010; Wood et al., 2009). A second way of measuring performance is by ratings given by a trained evaluator who rides in the vehicle and uses a standard rating scale (Bowers, Peli, Elgin, McGwin, & Owsley, 2005; Haymes, LeBlanc, Nicolela, Chiasson, & Chauhan, 2008; Wood et al., 2008, 2009). Ratings are given for quality and effectiveness of overall ("global") driving behavior and for specific skills (e.g., lane control). The rater should also have good inter-rater reliability established with a second rater, with both raters masked to driver functional and health characteristics and history.

Although driving performance should be theoretically linked to driver safety, there is little empirical evidence for this link. More specifically, no on-road driving performance assessment has been designed whose results are associated with motor vehicle collision rates (Ratz, 1978a, 1978b). Practically speaking what this means is that persons who demonstrate impaired driving performance according to some metric are not necessarily at high risk for future crash involvement, or vice versa. The difficulty in establishing a link between driver performance and safety is probably due to many factors, including the fact that performance is assessed during a brief snapshot of driving time whereas safety is estimated over many person-miles or person-years of driving.

Use of interactive driving simulators to provide information about the relationship between vision and driver performance is becoming more popular, spurred on by the increased design sophistication and commercial availability of off-the-shelf systems. Interactive driving simulators fill a research niche by providing a laboratory environment for the study of the complex behaviors that comprise driving. The primary advantage offered by simulators is stimulus control, that is various types of driving scenarios can be standardized for each participant and can be repeated in "trials" as many times as deemed useful for measuring a particular behavior. Also, it is sometimes impractical or impossible for a researcher to take research participants on the road for driving performance measurements because of limited technical or financial resources, legal reasons, and/or ethical concerns. Prior research has demonstrated that interactive driving simulators can be useful in studying visual capabilities and driving, including older drivers or drivers with vision impairment (Alexander, Barham, & Balck, 2002; Bowers, Mandel, Goldstein, & Peli, 2009; Donmez, Boyle, & Lee, 2006; Gray & Regan, 2007; Lee, Lee Cameron, & Li-Tsang, 2003; Rizzo, Reinach, McGehee, & Dawson, 1997; Staplin, 1995). Yet it is also important to understand the noteworthy limitations of the simulator approach for understanding real-world driving performance. The visual displays of many simulators are relatively crude and have poor fidelity in terms of representing the visual complexity and different lighting conditions of common driving situations. Many simulator scenarios have not undergone the appropriate validation process necessary for generalizing the results of simulator performance measures to actual on-road driving, or if they have undergone validation, the validation study has been limited to certain driver populations. While it is tempting to conclude that impaired performance in the simulator means impaired performance on the road, this should be avoided unless a thorough validation of the simulator has been conducted, and much more convincing on-road studies are done subsequently (e.g., with an instrumented vehicle). Nevertheless, interactive driving simulators are useful laboratory tools that can assist in generating hypotheses about vision-driving relationships that then can be tested on the open road or on closed-road courses in an actual vehicle. Another potential use of interactive simulators that could be more fully exploited in the future is their serving as a training intervention for drivers with visual impairments in order to improve skills critical to driving before the drivers are exposed to actual on-road traffic situations (Ivancic & Hesketh, 2000; Romoser, Fisher, Mourant, Wachtel, & Sizov, 2005).

2. Visual function and driving

Below we review what is currently known about the role of different aspects of vision in driver safety and performance. For additional and historical perspectives the reader is referred to previous

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reviews of and commentaries on this topic (Brody, 1954; Charman, 1997; Committee on Medical Aspects of Automotive Safety, 1969; Owsley, 2004; Owsley & McGwin, 1999; Panek, Barrett, Sterns, & Alexander, 1977; Subzwari et al., 2009).

2.1. Visual acuity

The ability to resolve detail, or visual acuity, is the ubiquitous visual screening test used by licensing agencies for the determination of driving fitness. The use of visual acuity screening for initial and periodic re-licensure for driving has face validity. It is the choice of ophthalmologists and optometrists when assessing the integrity and health of the visual system and is the primary visual function evaluated during a comprehensive eye examination. In addition, road signs in the US are designed based on sight-distances assuming that drivers have at least 20/30 binocular visual acuity (Federal Highway Administration, 2003). Drivers with acuity worse than that level are likely to have difficulty reading highway signage (e.g., speed limit signs, stop signs, exit signs on the interstate) at distances deemed safe for making vehicle control decisions (e.g. lane changes, turns, exiting) (summarized in Schieber (2004)). Thus, requiring that licensed drivers have visual acuity at the 20/30 level or better enhances the likelihood that drivers can read highway signs well in advance of the time they need to make decisions and execute motor responses.

However, in the United States, visual acuity requirements are highly variable from state to state (American Association of Motor Vehicle Administrators, 2006; American Medical Association, 2003; Peli & Peli, 2002). The following examples illustrate the diversity of visual acuity standards among the states. In Florida, drivers must have 20/70 in either eye with or without corrective lenses whereas drivers in Connecticut must have 20/40 in the better eye, with or without corrective lenses. In a proportion of states, drivers who do not meet the vision requirement may be eligible for a restricted driver license. For example, Iowa drivers with visual acuity of worse than 20/50 but not worse than 20/70, in addition to being restricted to daytime driving, must also drive no faster than 35 miles per hour. Some states (e.g., Maryland) allow for licensure even though the applicant does not meet the state's acuity requirement if, after reviewing the case, the Medical Advisory Board decides that there is potential for safe driving and a driving specialist determines the person is fit to drive based on a detailed on-road evaluation.

The earliest large-scale research examining the association between visual acuity and driver safety is that of Burg (1967, 1968) and subsequently Hills and Burg (1977) who demonstrated that for young and middle-aged California drivers, there was no relationship between poor visual acuity and motor vehicle collision involvement; however, significant, albeit weak, associations were observed among older drivers. This pattern of results (i.e., significant yet weak associations) has been observed in other studies (Davison, 1985; Hofstetter, 1976; Humphriss, 1987; Ivers, Mitchell, & Cumming, 1999; Marottoli et al., 1998); these findings are counterbalanced by other studies reporting no significant association (Decina & Staplin, 1993; Gresset & Meyer, 1994; Johansson et al., 1996; Marottoli, Cooney, Wagner, Doucette, & Tinetti, 1994; McCloskey, Koepsell, Wolf, & Buchner, 1994; Owsley, Stalvey, Wells, Sloane, & McGwin, 2001; Owsley et al., 1998). If there is a true yet small association between visual acuity and motor vehicle collisions, the lack of significant findings in some studies may be partly attributable to inadequate sample size (i.e., low statistical power) and/or failure to account for driving exposure. However, two recent well-designed cohort studies with 1801 participants (Rubin et al., 2007) and 3158 participants (Cross et al., 2009) did not find a significant relationship between visual acuity and motor vehicle collision involvement rates. It has been argued (and research supports) that visually impaired drivers tend to drive less and in more familiar surroundings (Ball et al., 1998; Freeman, Munoz, Turano, & West, 2005, 2006; Lyman, McGwin, & Sims, 2001); thus any excess risk they pose on a per capita basis is diminished once accounting for driving patterns.

Research regarding visual acuity and driver performance, actual or simulated, has been less extensive than that regarding driver safety. Higgins, Wood, and Tait (1998) used simulated acuity impairment (from induced optical blur) to evaluate its relationship with different components of the driving task on a closed-road course. Results suggested that road sign recognition and road hazard avoidance were impaired but the ability to navigate the vehicle through a road course was not. Further research confirmed these findings (Higgins & Wood, 2005). In addition to simulated visual acuity impairment, studies have also evaluated the driving performance of those with acuity-impairing conditions such as age-related macular degeneration (AMD). Szlyk et al. (1995) compared the driving performance of older drivers with AMD to an age-matched group of drivers with normal vision and observed that the AMD drivers performed significantly worse on nearly all on-road and driving simulator measures. However, such performance decrements should not be wholly attributed to visual acuity impairment as a number of other factors (e.g., contrast sensitivity) may also play a role.

Based upon the research to date, it is clear that if there is an association between visual acuity and driver safety, it is at best weak, a conclusion expressed by others (Charman, 1997; Hu, Trumble, & Lu, 1997). How does one rectify this conclusion in light of the significant findings from performance-based studies? One important consideration in this regard is that visual acuity-related performance decrements do not translate into reduced safety. That is, visual acuity-related driving skills (e.g., sign recognition) may not be crucial to the safe operation of a vehicle. Reading signage may be important for route planning or maintaining regulatory compliance with the "rules of the road", but it may not be critical for collision avoidance. Another consideration is that visual acuity testing does not measure the visual skills necessary for the safe operation of a motor vehicle. Visual acuity tests were originally designed for the clinical diagnosis and monitoring of eye disease, and do not by themselves reflect the visual complexity of the driving task. Guiding a vehicle along a roadway and through intersections involves the simultaneous use of central and peripheral vision and requires monitoring of primary and secondary tasks, all in the midst of a visually cluttered environment where critical events occur with little or no advance warning. Visual acuity tests do not generally include these stimulus features, and in fact seek to minimize distractions and secondary task demands. Acuity is typically evaluated under high contrast and luminance conditions, whereas driving encompasses wide ranging contrast and luminance levels. Another consideration is the fact that stationary visual acuity test targets do not represent the motion-based driving environment. Studies which have included both static and dynamic acuity measurements have generally found relatively stronger, yet still weak, associations for dynamic rather than for static acuity (Burg, 1966, 1967, 1968; Hu et al., 1997; Shinar, 1977).

There are other factors that must be considered when rectifying the seemingly illogical conclusion that visual acuity, the widespread measure for granting driving privileges, is not associated with driving safety. One such factor is directly related to state licensing restrictions. That is, it is possible that drivers with severe visual acuity impairment have simply been removed from the road; this would be particularly true in states that require vision re-screening at the time of license renewal. A related issue is the fact that drivers with vision impairment may voluntarily restrict or stop driving. A population-based cohort study in Maryland reported that reduced visual acuity was associated with reduced mileage and cessation of driving in unfamiliar places (Freeman, Munoz et al., 2006). Results from the same study failed to observe an association between visual acuity impairment and overall driving cessation after adjustment for contrast sensitivity and visual field impairment, both of which showed significant associations (Freeman et al., 2005). These seemingly contradictory results point to the fact that while visual acuity may be associated with modifications in driving habits, it may play less of a role when ultimately deciding to stop driving altogether. Though current research supports the relationship between driving cessation or restriction and vision impairment, particularly among older drivers (Ball et al., 1998; Campbell, Bush, & Hale, 1993; Marottoli et al., 1993; Stutts, 1998), there is less consistency regarding specific changes in driving habits and specific visual impairments. And as a result, observational studies (as opposed to simulator or on-road studies) may fail to observe an association between visual acuity impairment and motor vehicle collision involvement.

Another consideration is that the relationship between visual acuity and driving safety and performance cannot be appropriately considered without taking into account other aspects of visual functioning. This has two important implications. First, vision screening protocols that address several domains of visual function may prove more useful in discriminating high and low risk drivers. For example, Decina and Staplin (1993) reported that Pennsylvania drivers who did not meet a combined vision screening criterion (including visual fields, acuity, and contrast sensitivity) had higher motor vehicle collision rates, whereas visual acuity by itself was not predictive. Another implication is that reported associations between visual acuity and motor vehicle collision involvement may truly reflect other, correlated, measures of visual function (e.g., contrast sensitivity). Freeman et al. (2005) observed that older drivers with visual acuity impairment had higher driving cessation rates, yet once the joint effect of contrast sensitivity was considered the relationship disappeared. The authors concluded that contrast sensitivity plays a more prominent role in driving cessation compared to visual acuity.

2.2. Visual field

While not universal, visual field testing is used by many states for licensing purposes and like visual acuity, the specific visual field requirements are highly variable and the rationale for one requirement over another is often not clear. For example, in Arizona, the field of vision must be 60 degrees, plus 35 degrees on the opposite side of the nose in at least one eye. The field of vision for Connecticut drivers must be 140 degrees for a person with two eyes, and 100 degrees for a person with one eye.

The first large-scale population-based assessment of visual field impairment and driver safety was conducted by Johnson and Keltner (1983). They reported that drivers with severe binocular field loss had significantly higher motor vehicle collision and violation rates compared to those without any loss. This study is noteworthy for its large sample size (i.e., 10,000 drivers) and the use of mileage-based motor vehicle collision rates. However, several other studies (Burg, 1967, 1968; Decina & Staplin, 1993; Hu et al., 1997; Owsley, Ball et al., 1998) have also accounted for driving exposure and have not reported elevated motor vehicle collision rates for those with visual field impairments. Moreover, studies that did not account for driving exposure have also failed to observe a significant association (Council & Allen, 1974; Danielson, 1957).

This is in contrast to other studies that have reported elevated rates for those with such impairments (Haymes, LeBlanc, Nicolela, Chiasson, & Chauhan, 2007; McGwin et al., 2005; Rubin et al., 2007). In the case of Rubin et al. (2007) as with Johnson and Keltner (1983), the association was specific to those with binocular field loss. McGwin et al. (2005) observed that the association was stronger when considering the extent of impairment in the worse eye. Haymes et al. (2007) observed that among glaucoma patients, those with visual field impairment in the worse eye had a nearly fivefold increase in motor vehicle collisions though this association was not statistically significant. This highlights an important consideration in comparing results across studies, perhaps more so than for visual acuity, namely that the definition of visual field impairment differs across the studies. Johnson and Keltner (1983) defined impairment as very significant binocular field loss (however it was not quantitatively defined), whereas most other studies have used less stringent definitions of impairment. And perhaps in the broadest sense, several studies have simply compared drivers with and without glaucoma, a disease whose hallmark is visual field impairment, and observed elevated motor vehicle collision risks (or rates) for drivers with glaucoma (Haymes et al., 2007; Hu, Trumble, Foley, et al., 1998; Owsley, McGwin, & Ball, 1998) However, such findings have not been universal; in a study by McGwin et al. (2004), simply because persons were diagnosed with glaucoma did not transfer to an increase crash risk. Furthermore, in those studies where glaucoma was associated with an increased crash risk, it would be inappropriate to conclude that the elevated risk among glaucoma patients is solely attributed to their visual field impairment. In the study by Haymes et al. (2007) the glaucoma patients had higher motor vehicle collision rates compared to non-glaucoma patients after adjustment for visual field impairment suggesting that some other factor was responsible for the elevated rates. This underscores the problem with using an eye disease diagnosis as a surrogate for a visual functional loss in research on driving in that the disease can functionally manifest itself in very diverse ways, from very minor visual impairment to severe impairment.

The aforementioned studies have largely focused on driving safety as measured by real-world motor vehicle collisions. There have also been a number of studies evaluating the association between visual field impairment and on- and off-road driving performance. In a series of papers, Wood and colleagues (Wood, Dique, & Troutbeck, 1993; Wood & Troutbeck, 1992, 1995) used simulated visual field restriction to evaluate its impact on driving performance on a closed course. Collectively the results of this body of work suggest that simulated visual field impairment compromised some (e.g., identification of road signs, avoid obstacles, reaction time) but not all (e.g., speed estimation, stopping distance) aspects of driving performance. The relevance of the findings from these studies to real-world driving is unclear. It is likely that the impact of sudden, simulated visual field restriction is different from that of naturally occurring restriction from eye disease, such that the persons with the latter may develop compensatory mechanisms over time. Despite the largely consistent observation that drivers with visual field defects have impaired driving performance, a number of authors have cautioned that large individual differences exist and that some drivers with such impairments may pose no more of a safety risk than normally sighted drivers (Elgin et al., 2010; Racette & Casson, 2005; Wood et al., 2009). As a result, individualized assessments of driving skill rather than comprehensive prohibitions are recommended. However, closed course or simulator driving is less complex and less demanding than actual driving and may not allow for the identification of drivers that pose a true safety (i.e., collision) threat. Thus, whether closed course and simulator driving are valid and reliable measures of driving safety remains an important issue.

When interpreting the literature on visual field impairment and driving safety and performance, there are several important issues to consider. The first relates to visual field measurement. For example, in some studies only the extreme limits of the visual field were determined. Such screening techniques provide little information

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about the type or severity of visual field impairment (e.g., scotomas, central field defects). Another important issue is adaptation and compensatory strategies. Drivers with visual field defects may partly overcome them by eye and head movement, restricted driving, or both. There is little research regarding eye and head movements but that which does exist suggests that drivers with field defects deemed to be safe drivers tended to engage in more scanning behavior compared to unsafe drivers having field defects (Coeckelbergh, Brouwer, Cornelissen, van Wolffelaar, & Kooijman, 2002; Elgin et al., 2010; Wood et al., 2009). Additional research is needed to explore these findings. A related consideration is the extent to which drivers with visual field defects modify their driving behaviors in an attempt to moderate crash risks. It has been suggested that failure to account for such methodological issues may account for the lack of a relationship observed in some studies (North, 1985). However, research regarding this issue has produced mixed results. While some studies have reported that drivers with visual field impairment or related eye diseases (e.g., glaucoma) limit or cease their driving (Adler, Bauer, Rottunda, & Kuskowski, 2005; Ramulu, West, Munoz, Jampel, & Friedman, 2009), others have not (Keay et al., 2009). Given that some drivers self-regulate, it is interesting that most of the studies examining the relationship between visual field impairment or related diseases and motor vehicle collision involvement that have taken driving exposure into account have produced null results (Burg, 1967, 1968; Decina & Staplin, 1993; Hu et al., 1997; Owsley, Ball et al., 1998).

2.3. Contrast sensitivity

To our knowledge, contrast sensitivity is not currently used as a licensing requirement in any state in the US While the literature regarding contrast sensitivity and driving safety and performance is less extensive than that for visual acuity, it is no less divergent. In population-based studies on older drivers, contrast sensitivity impairment was associated with a recent history of crash involvement (Ball, Owsley, Sloane, Roenker, & Bruni, 1993), but was not associated with future crash involvement (Cross et al., 2009; Owsley, Ball et al., 1998; Rubin et al., 2007). However, in an evaluation of contrast sensitivity as a screening test at licensure renewal in California, those who failed the screening test were more likely to incur future crashes as compared to those who passed (Hennessy, 1995; Hennessy & Janke, 2009). Contrast sensitivity deficits are common in older adults with cataract; Owsley et al. (2001) found that for older drivers with clinically significant cataract, contrast sensitivity impairment was strongly associated with a recent crash history. The association was twice as strong when both eyes were impaired compared to when only one eye was impaired. Furthermore, they found that cataract surgery and intraocular lens insertion in this same cohort (which improved their vision) reduced their risk of future crash involvement by 50%, as compared to those in the cohort who did not elect cataract surgery (Owsley et al., 2002).

The significant association between contrast sensitivity deficits and crash risk observed by Owsley et al. (2001) may reflect the increased representation of drivers with significant contrast sensitivity impairments (since the study focused on cataractous drivers) compared to the population-based samples used in other studies finding no association (Cross et al., 2009; Owsley, Ball et al., 1998; Rubin et al., 2007). Rubin et al. (2007) suggest that the lack of an association in most prospective studies may reflect state licensing laws (where persons with vision impairment are less likely to get their licenses renewed) or self-regulation. Drivers with severely impaired contrast sensitivity (i.e., those with the highest risk) may reduce or eliminate their driving. Along these lines, numerous studies (Ball et al., 1998; Freeman, Munoz et al., 2006; Freeman et al., 2005; Keay et al., 2009; Lyman et al., 2001; McGwin, Chapman, & Owsley, 2000; Rubin, Roche, Prasada-Rao, & Fried, 1994) have reported significant associations between impaired contrast sensitivity and driving modification and difficulty.

As with visual acuity, the literature regarding contrast sensitivity and driving performance is more consistent than the driving safety literature. For example, Wood and colleagues (Wood & Troutbeck, 1995; Wood et al., 1993) used simulated contrast sensitivity impairment and assessed its relationship with driving performance on a closed-road circuit. The results indicated that higher (i.e., better) overall driving scores were correlated with better contrast sensitivity. Contrast sensitivity measured under photopic conditions was a better predictor of the recognition of road signs, obstacles and pedestrians while driving at night than was photopic visual acuity (Anderson & Holliday, 1995; Wood & Owens, 2005). Wood and Carberry (2004, 2006) also demonstrated that for older drivers with cataract, cataract surgery improves driving performance, an effect that is mediated by improvement in contrast sensitivity following surgery. These driving performance results parallel the driver safety benefits of cataract surgery demonstrated by Owsley et al. (2002). Further evidence supporting the key role of contrast sensitivity in driving performance comes from both on-road and simulator studies on drivers with Parkinson disease (Amick, Grace, & Ott, 2007; Uc et al., 2009, 2009; Worringham, Wood, Kerr, & Silburn, 2006) and from on-road research on drivers with hemianopia and quadrantanopia (Elgin et al., 2010; Wood et al., 2009).

2.4. Visual processing speed and divided attention

Visual sensory abilities, such as measures of spatial resolution, contrast sensitivity, and light sensitivity throughout the visual field, are useful for understanding the visibility of objects and events during driving, yet by themselves they are insufficient for understanding the visual complexity of the driving task. The visual demands of driving are intricate. Controlling a vehicle takes place in a visually cluttered environment and involves the simultaneous use of central and peripheral vision and the execution of primary and secondary tasks (both visual and non-visual). As the vehicle moves through the environment, the visual world is rapidly changing. The driver is often uncertain as to when and where a critical visual event will occur. These task demands have prompted researchers to examine relationships between driver safety and performance and attentional skills.

The earliest studies on attention and driving were from the 1970s and focused on commercial drivers. Kahneman, Ben-Ishai, and Lotan (1973) reported that bus drivers in Israel with worse scores on an auditory selective attention task had a higher crash rate over the previous years. This finding was further confirmed for utility company drivers in the United States (Barrett, Mihal, Panek, Sterns, & Alexander, 1977; Mihal & Barrett, 1976). Also around this time Shinar (1978) reported the results of a detailed analysis of accident report documents from a large sample of Indiana drivers, finding that "driver inattention" appeared to be the most common operator cause of motor vehicle collisions.

The role of visual attention in driver safety was largely ignored until the 1990s when there was increasing interest in the mechanisms underlying older drivers' elevated rate of crash involvement; it is about double that of middle-aged drivers (National Highway Traffic Safety Administration., 1993). By this time there was considerable evidence that many older adults, even when free of dementia, had impairments in visual divided attention abilities under brief target durations, as compared to younger adults (Allen, Weber, & Madden, 1994; Ball, Beard, Roenker, Miller, & Griggs, 1988; Hoyer & Plude, 1982; Madden, 1990a, 1990b; Plude & Doussard-Roosevelt, 1989; Sekuler & Ball, 1986). The potential for these divided attention deficits to contribute to older adults driving problems was first suggested in a study by Ball, Owsley, and Beard (1990). Using a task called the useful field of view (UFOV) (Ball, Roenker, & Bruni, 1990), they found that older adults with impaired divided attention abilities under brief target durations were more likely to report driving problems, as compared to those without this deficit. The UFOV estimates the minimum target duration needed by an observer to detect or discriminate targets presented in central vision, while localizing a simultaneously presented peripheral target. In some conditions the targets are embedded in distractors. This finding prompted Ball, Owsley and colleagues (Ball et al., 1993; Owsley, Ball, Sloane, Roenker, & Bruni, 1991) to examine whether slowed visual processing speed under divided attention conditions as assessed by the UFOV task elevated crash risk in older drivers. They demonstrated that poor performance in the UFOV task by older drivers was associated with a history of an increased number of motor vehicle collision in recent years. Furthermore, a prospective study showed that older drivers with slowed visual processing speed, particularly under divided attention conditions, were 2.2 times more likely to incur a crash in the subsequent two years, as compared to those without this impairment (Owsley, Ball et al., 1998). This association was independent of other factors that can impact crash involvement (e.g., visual sensory abilities, medical co-morbidities, cognitive status); further, in this study no other visual functional test (e.g., acuity, contrast sensitivity, visual field sensitivity) was associated with increased crash involvement in future years.

Since the initial reports, these findings have been replicated and extended (Ball et al., 2006; Clay et al., 2005; Cross et al., 2009; Owsley, McGwin et al., 1998; Rubin et al., 2007; Sims, McGwin, Allman, Ball, & Owsley, 2000; Sims, Owsley, Allman, Ball, & Smoot, 1998). Collectively this literature has prompted several jurisdictions to examine the feasibility of using a speed of processing/divided attention task as a way to screen older drivers when applying for routine re-licensure (Ball et al., 2006; Hennessy & Janke, 2009). These studies imply that visual attention and visual processing speed are critical considerations in the evaluation of safe driving skills and may be better screening tests than visual sensory tests (e.g., visual acuity) for identifying crash-prone older drivers.

Visual processing speed and divided attention have also been associated with driving performance problems on the road. When evaluated on a closed-road course, those older drivers with divided attention deficits as assessed by a modified perimeter were less likely to detect and recognize signs and pedestrians and needed more time to complete the course (Wood et al., 1993). In a recent study on drivers with brain injuries causing hemianopia or quadrantanopia, those who exhibited slowed visual processing speed in a divided attention task (Trails B) (Retan, 1955) were rated as having vehicle control problems by trained backseat evaluators masked to driver health and functional characteristics (Wood et al., 2009). Several studies have shown that drivers seen at rehabilitation clinics because of dementia (e.g., Alzheimer's disease) or brain injury (stroke) were at higher risk of failing an on-road driving test administered by a driving rehabilitation specialist if they performed poorly on the UFOV test (Cushman, 1996; Duchek, Hunt, Ball, Buckles, & Morris, 1998; Mazer, Korner-Bitensky, & Sofer, 1998; Myers, Ball, Kalina, Roth, & Goode, 2000).

With the widespread popularity of cell phones, there is concern about their impact on driver safety and performance since they are commonly used while people drive. Using a cell phone while driving is basically a dual-task situation, and thus raises questions about how the performance of the primary task (driving) is impacted by the secondary task (conversing on the phone). A 2004 study in the US estimated that at any given time of day, 5% of drivers are using cell phones (Glassbrenner, 2005). Research has clearly demonstrated that cell phone use impairs both driver safety and performance (for recent overviews, see Caird, Willness, Steel, & Scialfa, 2008; McCartt, Hellinga, & Braitman, 2006). Drivers conversing on cell phones have about a fourfold increase in the risk of motor vehicle collision involvement, compared to those not using phones, and this increased risk applies to the use of hands-free devices as well (McEvoy et al., 2005; Redelmeier & Tibschirani, 1997). Studies using interactive driving simulators indicate that drivers conversing on cell phones tend to take longer to react to relevant targets or events in the driving environment, take longer to recover their speed after braking, increase their following distance, reduce their overall speed, miss traffic signals and incur simulator crashes (Consiglio, Driscoll, Witte, & Berg, 2003; Laberge, Scialfa, White, & Caird, 2004; Strayer & Drews, 2004; Strayer & Johnston, 2001; Woo & Lin, 2001). On-road studies conducted with closed courses, tracks, and the open road reveal similar findings (summarized by McCartt et al. (2006)). Many studies show that the negative impact of cell phone use is just as strong even when a hands-free device was used (Consiglio et al., 2003; Strayer & Drews, 2004, 2007; Strayer & Johnston, 2001), but a few find problems worse for hand-held phones (Haigney & Westerman, 2001; Törnros & Bolling, 2005). Some studies suggest that younger and older drivers are equally vulnerable to the negative effects (Strayer & Drews, 2004), while others suggest older drivers are more vulnerable (Hancock, Lesch, & Simmons, 2003; Shinar, Tractinsky, & Compton, 2005). Furthermore, there is disagreement about whether practice driving while conversing on a cell phone mitigates the adverse effects of cell phone use (Cooper & Strayer, 2008; Shinar et al., 2005). Text-messaging on cell phones is also very popular; recently Drews, Yazdani, Godfrey, Cooper, and Strayer (2009) reported that the negative impact of text-messaging on a cell phone while driving exceeds that of conversing on a cell phone.

Inattention blindness has been suggested as a mechanism underlying failure to detect relevant targets (e.g., traffic signals, pedestrians, other vehicles) during driving while using a cell phone (Strayer & Drews, 2007). In their studies Strayer and Drews (2007) showed that even though the driver's gaze was fixated on the target, the driver was less likely to remember the target when conversing on a cell phone compared to when not conversing. Rather than being a problem of retrieval, event-related potential (ERP) studies imply that the problem was a failure to adequately encode the target (Strayer & Drews, 2007; Strayer, Drews, & Johnston, 2003). It is interesting that the driving performance decrements found with cell phones do not appear to extend to conversations with passengers (Charlton, 2009; Drews, Pasupathi, & Strayer, 2008). These studies suggest that conversations with passengers differ from conversations on a cell phone in at least two ways. First, the surrounding traffic is sometimes a topic of conversation between driver and passenger that may help the driver's situational awareness of the roadway environment, and second, the language complexity and the speech production rate of both driver and passenger decreased as the surrounding traffic demands increase.

2.5. Eye movements

Land (2006) has recently provided a comprehensive overview of research on eye movements and driving, and thus here we briefly summarize some of the main findings from this research area. Beginning in the 1970s with the development of eye movement recording systems that could be deployed in-vehicles, there were a series of now seminal studies by Mourant and Rockwell (1970) addressing the impact of route familiarity on drivers' visual scanning behaviors (see also summary by Shinar (2008)). They found that when learning a new route, drivers' fixations are dispersed widely in the roadway environment, with the modal fixation above and to the right of the road (where there was signage). As drivers

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became more familiar with the route on repeated drives, fixations were confined to a smaller area with the modal point moving to the left, centering on the lane in front of them, far down the road. Lane markers (e.g., lines on the road) were rarely fixated implying that lane control is achieve largely through peripheral vision. Thus, practically speaking, it is critical that the angular subtense of lane markings, which fall on peripheral retina, be large enough to support this function.

Mourant and Rockwell (1972) also examined the visual processing mechanisms of novice drivers as compared to experienced drivers. In contrast to experienced drivers, novice drivers had eye fixation patterns distributed over a small area of the roadway environment, and fixations were mostly distributed on the road immediately in front of the vehicle, to the right of the road, and on lane markings. They infrequently used side- and rear-view mirrors. Novice drivers exhibited pursuit movements on expressways, whereas experienced drivers did not. More recent work has extended these findings to show that novice drivers have longer fixation durations in many situations, are relatively inflexible in search strategies in the face of varying roadway environments, have problems both engaging and disengaging attention to hazards, and often fail to scan elements of the roadway relevant to assessing potential risk (Chapman & Underwood, 1998; Crundall & Underwood, 1998; Crundall, Underwood, & Chapman, 1999, 2002; Pradhan et al., 2005; Underwood, Chapman, Bowden, & Crundall, 2002).

The novice drivers in Mourant and Rockwell's study (1972) had completed a driver education course. However, research has shown that driver education courses do not enhance safety (i.e., reduce the rate of motor vehicle collisions) (Insurance Institute for Highway Safety, 2001). The visual skills needed for safe driving come with practice, prompting some to suggest that interactive driving simulators and/or PC-based training programs may be useful tools for novice drivers in learning scanning strategies and visual search skills without exposure to the open road (AAA Foundation for Traffic Safety; Chapman, Underwood, & Roberts, 2002; Fisher, Narayanaan, Pollatsek, & Pradhan, 2004; Pradhan et al., 2005).

Effective steering requires that the arms and hands be guided by visual information so they can turn the wheel the appropriate direction and amount in order to stay in the vehicle's lane. Land and Lee (1994) determined that when on a curvy road, drivers spent a lot of time looking at the "tangent point" on the up-coming bend, where the tangent point is defined as the moving point on the inside of each bend where the driver's line of sight is tangential to the road edge. This point is conspicuous because it is the point that protrudes most into the road. Drivers search for this point 1–2 s before a bend, and then return fixation to it many times as they drive through the bend. Their data suggest that the visual information that drivers use as they steer through a curve is the direction of the tangent point relative to the car's heading, which essentially predicts the curvature of the road (see also Underwood, Chapman, Crundall, Cooper, & Wallén, 1999).

For drivers with extensive binocular visual field loss due to ocular or neurological conditions, research implies that eye movements can serve as a compensatory strategy so that more areas in the visual world can be seen. Drivers with hemianopia or quadrantanopia were videotaped as they drove in real-traffic situations (Wood et al., submitted for publication). Backseat evaluators, masked to drivers' visual and other medical characteristics, rated the quality of their driving using a standard assessment tool. Those hemianopia and quadrantanopic drivers who received good driving performance ratings made more excursive eye movements as revealed in the videotapes, as compared to those who received poor driving ratings. Further research with quantitative eye movement recordings is needed to examine this issue in greater depth. Along similar lines, Coeckelbergh et al. (2002) using an interactive driving simulator observed that drivers with binocular visual field loss from retinal conditions who passed the on-road test displayed more scanning behavior as indicated by eye and head movements, as compared to those who failed the on-road test. These findings raise the possibility that scanning training could be used successfully in driver rehabilitation of at least some drivers with binocular field loss.

2.6. Monocularity

A question that arises is whether one needs two eyes to drive. Two eyes provide for a wider visual field than a single eye and also make possible binocular summation (and thus improved visibility by lowering the threshold) (Blake, Sloane, & Fox, 1981). The operational definition of "monocularlity" varies widely in the literature, ranging from denoting a total absence of function in one eye to one eye having impaired vision below some cutpoint with respect to some aspect of visual function (usually visual acuity). The literature on the safety and performance of monocular drivers is largely devoted to studies on commercial drivers (e.g., truck, delivery vehicle, taxi, bus). With respect to drivers of personal vehicles, most jurisdictions visually screen drivers using both eyes, or only consider the better seeing eye when persons apply for licensure. Thus, the question of licensure of monocular drivers for personal drivers does not practically arise that often. However, in the US interstate truck drivers must have visual acuity of 20/40 or better in each eye, which has stimulated research examining whether requiring good acuity in both eyes is really supported by data.

A study in California (Roger, Ratz, & Janke, 1987) examined the 2-year crash and conviction rates of 16,465 heavy-vehicle operators, including a subgroup of 1202 drivers who were visually impaired. Visually impaired drivers (those with 20/40 visual acuity or worse in the worse eye) had significantly more total crashes and convictions than did non-impaired drivers. Driving exposure did not differ in the two groups. On the other hand, another study examined the visual and driving performances of monocular and binocular commercial drivers and found no differences with respect to visual search, lane placement, clearance judgment, gap judgment, hazard detection, and information recognition (McKnight, Shinar, & Hilburn, 1991). Monocular drivers were less adept than binocular drivers in sign-reading distance in both daytime and nighttime driving, which is consistent with what is known about binocular summation and binocular inhibition (Blake et al., 1981; Pardhan, Gilchrist, & Douthwaite, 1989). The authors concluded that although monocular drivers have some reductions in certain driving functions compared with binocular drivers, differences in the performance of most day-to-day driving functions were not apparent. A limitation with this study is that the definitions of monocular versus binocular drivers were not clearly stated.

The importance of good vision in both eyes for commercial drivers of heavy trucks may also be called into question by a study of commercial vehicle drivers who received waivers of the federal vision requirements (Federal Highway Administration, 1996), i.e. the waiver allowed for drivers that had worse than 20/40 visual acuity in one or both eyes. The severity of the vision impairment and the extent to which it involved both eyes or a single eye was not described in the report. The crash rates of the 2234 drivers in the waiver program as of 1995, adjusted for self-reported miles traveled, were compared to the crash rates of heavy trucks provided by the 1994 General Estimates System of the National Highway Traffic Safety Administration. The waiver group's crash rates was not higher than the national reference group, nor were their crashes more severe.

Caution is needed in generalizing the results of studies on commercial drivers to drivers of personal vehicles. Commercial drivers have very high levels of driving exposure compared to non-commercial drivers of personal vehicles since they are on the road almost continuously during their workday, logging in more miles per day than many drivers of personal vehicles cover in a week. Routes routinely involve traffic congestion, multiple stops, parking, and back-up maneuvers. The visual challenges of commercial driving are arguably more intense than personal use driving, the point being that the visual requirements for commercial driving may not be wholly transferrable to personal driving.

2.7. Other aspects of vision

Here we consider several aspects of vision that play prominent roles in our theories and models of visual processing, which on face validity would appear to be important to the driving task. Yet the research to date has not strongly established their relevance to driving performance (vehicle control) or to driver safety (crash risk).

With respect to stereoacuity, several studies on commercial drivers have reported that commercial motor vehicle drivers with impaired stereoacuity were at elevated risk for motor vehicle collisions (Maag, Vanasse, Dionne, & Laberge-Nadeua, 1997), or once in a crash, their crashes tended to be more severe (as measured by the total number of crash-related victims) as compared to drivers who had normal stereoacuity (Dionne, Desjardins, Laberge-Nadeau, & Maag, 1995; Laberge-Nadeau et al., 1996). As mentioned earlier, studies on commercial drivers may not be generalizable to drivers of personal vehicles since the former have very high driving exposure often under dense traffic conditions. Large sample studies on older drivers that have examined deficits in stereoacuity as a risk factor for future motor vehicle collision involvement have found no association (Owsley, Ball et al., 1998; Rubin et al., 2007). Stereoacuity may be more relevant for the driver's interactions with the dashboard (e.g., seeing controls or gauges), than for understanding crash risk. In general the impact of binocular vision disorders on driving has not been comprehensively addressed.

Color vision is tested at license application in over 40 states in the US, and the ability to respond properly to color traffic signals is a requirement for a commercial vehicle license in the US (Decina, Breton, & Staplin, 1991). The reason for testing color vision in both personal and commercial licensing is not because it is widely held that color vision deficiency is a major risk factor for crash involvement; rather, color vision screening is meant to ensure that drivers can obey color traffic control devices and other color signals on the road (e.g., tail-lights) (Heath & Schmmidt, 1959). Laboratory and field studies have confirmed that drivers with color deficiencies have longer reaction times to traffic control devices with color signals and are also likely to make more color confusions, than persons with normal color vision (Atchison, Pendersen, Dain, & Wood, 2003; Vingrys & Cole, 1988). However, in naturalistic driving, the critical cues on the road can typically be obtained through multiple sources of information (e.g., luminance, position, pattern). Thus, it is not surprising that the literature largely supports no link between color deficiencies and vehicle crash involvement (Atchison et al., 2003; Vingrys & Cole, 1988). It is also important to emphasize that most drivers with color deficiency are not color blind, rather, they have a reduced ability to discriminate color. One study (Verriest, Naubauer, Marre, & Uvijls, 1980) supporting an association reported that drivers with color vision defects were more likely to have rear-end collisions. However, because of the overwhelming wealth of evidence to the contrary, it is reasonable to conclude that color vision deficiency by itself does not increase crash risk in personal or commercial drivers, although in some circumstances it may impact performance of interpreting traffic control devices and other color coded signals if other cues (luminance, position, pattern) are not sufficiently informative.

Motion perception has a great deal of face validity to the driving task since the vehicle and thus the driver is moving through the roadway environment, but only a few studies have addressed how impairments in motion processing may affect driving performance and safety. When driving on a closed-road course, older drivers with an elevated minimum displacement threshold in a coherent motion task had difficulties in detecting signs and hazards and took longer to complete the course (Wood, 2002). In addition, when evaluated on the open road in natural in-traffic conditions, older drivers with elevated thresholds in a coherent motion task had worse performance evaluations as assessed by raters specialized in on-road evaluation (Wood et al., 2008). Older adults with Alzheimer disease were evaluated in a driving simulator, and reduction in performance in a structure-from-motion task was a strong predictor of collisions in the simulator (Rizzo et al., 1997). Research has not linked motion perception to increased crash risk on the road, except for a study that collected self-reported collision data, not state-recorded collisions (Shinar, 1977).

Disability glare (increased glare sensitivity), particularly among older adults, is discussed as a serious threat to the safety of older drivers (e.g., Wolbarsht, 1977) but studies have not scientifically supported this notion (Ball et al., 1993; Owsley, Ball et al., 1998; Owsley et al., 2001). This failure to find an association between glare and road safety may be attributed to methodological difficulties in defining "glare" and in measuring a multifaceted phenomenon (e.g., discomfort glare, disability glare), as well as to a poor understanding of what people mean when they say they have "glare" problems. Rubin et al. (2007) reported a seemingly paradoxical relationship between disability glare and motor vehicle collisions. They found that disability glare reduced crash risk in older drivers with good vision, which could not be attributed to changes in driving habits (e.g., reduced exposure).

3. Translational research issues

Because driving is a task integral to daily life for many people around the world, research on the role of vision in driving has implications beyond basic research. For example, research on vision and driving can serve as a basis for policies that set rules for determining who can be licensed to drive and for developing rehabilitation strategies that help visually impaired persons acquire skills so that they can drive as long as it safely possible for them to do so. These translational research issues are discussed below.

3.1. Policies for vision screening for licensure and renewal of licensure

As mentioned previously, visual acuity testing, under high contrast and luminance conditions, is the ubiquitous screening test for driver licensure. This is true not only in all 50 US states and the District of Columbia but in Canada, Australia, and the countries of the European Economic Community (American Medical Association, 2003; Peli & Peli, 2002; Transportation Research Board., 1988). Of all the various visual, cognitive, and physical abilities that are relevant for driving a vehicle, visual acuity testing stands out as the one aspect of function that is consistently viewed by policy makers and the public as important for licensure. Besides the knowledge test about the "rules of the road" and a brief on-road driving performance evaluation, visual acuity is often times the only ability evaluated when one applies for a driver's license or for license renewal. Some jurisdictions do have visual field and color discrim nation screening tests as mentioned above, but these are le common as compared to the universal use of visual acuity screening (American Association of Motor Vehicle Administrators, 2006; Peli & Peli, 2002).

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Most states in the US require visual acuity screening when applying for renewal of a license, although the interval and age group these policies apply to varies by state (American Association of Motor Vehicle Administrators, 2006; American Medical Association, 2003). Ten states do not require visual acuity re-screening after initial licensure. In these states, the visual acuity screening test is administered only when applying for the driver's license for the first time, for most people typically when one is a teenager or young adult. When the license comes up for renewal, even in the later decades of life where functional problems like visual impairment are relatively prevalent, the visual acuity screening test is not re-administered. License renewal is accomplished by mail or by visiting the licensing office and paying a renewal fee without any functional evaluation. Therefore, in these states, drivers with visual acuity impairment could maintain a license and continue driving. While prevailing views among the public may lead one to question the appropriateness of not having a visual acuity re-screening policy, it is important to point out that there is no clear evidence supporting the benefits of visual acuity re-screening laws. Epidemiological studies using ecologic designs compared states with re-screening laws to states without these laws, reporting that the fatality rate for older drivers was lower in states that have re-screening laws (McGwin, Sarrels, Griffin, Owsley, & Rue, 2008; Nelson, Sacks, & Chorba, 1992; Shipp, 1998). However, because ecologic studies are based upon population-level rather than individual-level data, the results from such studies must be interpreted with caution and cannot be considered definitive. In addition, these studies did not separate out the effect of visual acuity re-screening from in-person renewal, and thus it is unknown to what extent the lower fatality rate was due to visual acuity testing itself. Another ecologic study (Grabowski, Campbell, & Morrisey, 2004) found that when vision re-screening was evaluated as an independent contribution, it had no impact on fatality rates in adults age ⩾65 years. Thus, owing to the methodological shortcomings of the literature, the question remains unanswered as to whether visual acuity screening at re-licensure for older drivers is a policy that has a safety benefit. Furthermore, a recent cost-benefit analysis of current vision screening approaches at driver licensing offices suggested that they have no economic benefit to society (Viamonte, Ball, & Kilgore, 2006). At present, government motor vehicle departments and legislative bodies essentially have a poor evidence-basis upon which to formulate their re-licensure-screening policies, even though these very agencies are asking for guidance from the research community about how to modify existing laws. Yet without a sound evidence-basis, there is little to offer except personal perspective.

3.2. *Rehabilitation of drivers with vision impairment*

Since driving is so critical for maintaining a high quality of life in many societies, persons with irreversible vision impairment, most often those with moderate as opposed to severe deficits, sometimes want to be drivers even though they do not meet their jurisdictions' visual acuity or visual field standards for licensure. Many view this desire as reasonable given the lack of evidence that establishes a visual acuity or visual field cutpoint beyond which driving is unsafe.

Driving assessment and rehabilitation clinics, usually based in rehabilitation services at medical centers, provide rehabilitation interventions designed to assist functionally impaired drivers to remain behind the wheel, if it is safely possible for them to do so. Bioptic telescopic spectacles (BTS) are an option for persons with visual acuity impairment who want to drive in 35 states in the US, although individual states differ widely in the specific requirements and provisions in the law. BTS consist of telescopes mounted in the superior portion of a regular lens (referred to as a "carrier lens"), which incorporates the refractive correction as does the telescope. In most cases they are prescribed for one eye, although some drivers may prefer a binocular BTS depending on individual characteristics and preferences. The most common telescope magnifications are between 2× and 4× and provide a field of view between 6° and 16°. While driving the BTS user views the world through the carrier lens and then dips the head down to use the BTS to view signs, traffic control devices, and potential obstacles. A number of authors have discussed the use of BTS and training programs for drivers who wish to use such devices (Barron, 1991; Feinbloom, 1977; Jose, Carter, & Carter, 1983).

Although most would agree that severely visually impaired individuals (e.g., those having visual acuity worse than 20/200, or less than a 20 degree visual field in the better eye) should not drive, controversy remains regarding drivers with visual acuity between 20/60 and 20/200. It has been recommended that the use of BTS for drivers with visual acuity impairment should be considered on an individual basis and the BTS should not be mandatory for persons with moderate visual acuity impairment in order to obtain a driver's license if they can demonstrate driving fitness without a BTS (Barron, 1991). In fact some jurisdictions are now licensing persons with visual acuity as low as 20/200 if they can demonstrate safe driving skills in a detailed on-road evaluation even if they do not use a BTS. Other recommendations include drivers using BTS must complete a mandatory training program plus annual vision examinations by an ophthalmologist or optometrist to ensure their visual acuity impairment is not progressive. Fonda (1983, 1988) has opined that the use of a BTS while driving by persons with visual acuity impairment may, in fact, increase rather than reduce crash risk, and that they may be safer drivers without BTS. However, quantitative evidence to support such an opinion is lacking. A BTS occludes part of the visual field, an under-appreciated deleterious aspect of BTS.

As we have commented elsewhere (Owsley & McGwin, 1999), previous research on crash risk among drivers who use BTS has methodological problems, thus making it difficult to make firm conclusions. Studies have generated a wide array of findings. Four studies from California (Janke, 1983), New York (Vehicles, 1989), Maine (Department of State, 1983), and Texas (Lippman, 1979; Lippman, Corn, & Lewis, 1988) have reported that users of BTS have higher crash rates than control groups. An additional study from Texas found crash rates of visually impaired drivers to be similar to those of drivers with cardiovascular and neurologic impairments (Lippman, 1979). A study of drivers using BTS in Massachusetts reported crash rates lower than those of the general population (Korb, 1970). Methodological problems with the prior work include the following. Several of the studies used the general population of drivers as the control group. It is not clear whether the BTS itself and its "side effects" (e.g., reduced field of view) or visual acuity impairment or both are responsible for the elevated crash rates. Furthermore, it is likely that drivers using BTS restrict their driving (e.g., avoid night driving), and failure to account for such self-regulation in etiologic studies may lead to invalid results.

Most BTS drivers are young and middle-aged adults (Bowers, Apfelbaum, & Peli, 2005; Park, Unatin, & Park, 1995). Even though central vision impairment due to age-related macular degeneration (AMD) is a relatively common cause of vision impairment in the US, drivers who use BTS are infrequently elderly. It remains to be determined why this is the case. Possible reasons are that clinicians may not be presenting BTS as an option for older drivers with AMD, older drivers are not interested in using BTS to drive and/or they in fact try BTS, but do not feel that it helps. Many older adults have medical co-morbidities (e.g., cognitive impairment) that may make the training programs more challenging.

Some have argued that BTS are not primarily used by visually impaired persons for on-road driving but are principally used to

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pass visual acuity screening when applying for licensure, and then not used once the driver is licensed and on the road (Fonda, 1983; Keeney, 1974). There is no definitive evidence that can refute this claim. Essentially we do not know to what extent and under what conditions drivers with BTS actually use BTS when driving. Survey research has suggested that many bioptic drivers report that BTS is helpful (Bowers, Apfelbaum et al., 2005; Park et al., 1995; Taylor, 1990); however there is no objective verification of these self-reports. Users may be particularly motivated to state how useful they are given that their licensure depends on their use of BTS when driving. Slightly over half report they wear BTS when driving (Bowers, Apfelbaum et al., 2005), but once again there are no objective data to confirm self-reports. It remains to be determined to what extent BTS drivers actually wear and use BTS when driving and in what driving scenarios BTS are helpful from driver performance and safety perspectives.

Persons with hemianopia are sometimes prescribed spectacles that provide a prismatic correction to re-locate or expand the field (Bowers, Keeney, & Peli, 2008; Perez & Jose, 2003; Smith, Weiner, & Lucero, 1982). At present there is no evidence that such optical devices improve on-road driving performance or driver safety in-persons with homonymous hemianopia (Szlyk, Seiple, Stelmack, & McMahon, 2005). One study observed that 2/3 of hemianopic drivers evaluated on the road drove flawlessly or had only minor errors, yet none of these drivers wore prismatic devices while driving (Elgin et al., 2010). This suggests that hemianopic drivers have strategies that they use to compensate for their field loss during driving, and that a prismatic correction is not a necessary condition for safe driving for all individuals in this population.

It has been estimated that on a population-basis that up to one-third of older drivers have slowed visual processing speed under divided attention conditions (Rubin et al., 2007). A training intervention has been developed that increases visual processing speed in older adults (Ball, Edwards, & Ross, 2007; Ball et al., 2002). This training involves trainer-guided practice of computer-based non-verbal exercises that are presented briefly and involve visual target detection, identification, discrimination, and localization. Recent findings from the ACTIVE clinical trial (Jobe et al., 2001) indicate that this speed of processing training program reduces the risk of future motor vehicle collision involvement among older drivers (Ball, Edwards, Ross, & McGwin, in press).

4. Conclusions

Many studies have converged in indicating that visual acuity is, at best, very weakly linked to driver safety (i.e., collision involvement) and thus is a poor screening test for identifying drivers who are at-risk for future crash involvement. In contrast, it is clear that visual acuity is related to certain aspects of driving performance (e.g., road sign recognition). As summarized above, there are undoubtedly many reasons for the lack of relationship between acuity and safety. Licensing authorities and policy makers are unlikely to give up visual acuity screening tests for driver applicants because of their high face validity, public acceptance, and association with highway sign legibility. A more practical approach to improving the efficacy of vision screening at licensure is to examine how visual acuity screening tests could be supplemented by other types of screening approaches, like contrast sensitivity, visual field, processing speed, and divided attention tests, some of which have a large evidence-basis for their relevance to driver safety. Well-designed population-based prospective studies on drivers are needed to identify the effectiveness of these vision screening tests both singly and in combination, in terms of their ability to identify the drivers who experience at-fault crashes in the future. This research could also inform the best pass-fail cut-points for these tests.

Basic research on eye and head movements, scanning, visual search and attention during the driving task has high relevance to the rehabilitation of drivers with vision impairments. This research can contribute to developing interventions and training strategies for drivers with visual impairments in the range of 20/40–20/200 so that they can remain behind the wheel as long as it is safely possible for them to do so. The effectiveness of these interventions will need to be rigorously evaluated with respect to both driving performance and safety outcomes. This also applies to BTS devices and training programs, especially since BTS studies to date have been inconclusive with respect to both safety and performance, and many of these studies have methodological problems, as described above. Basic research on vision and driving, especially scanning and visual search, can also inform the design of training interventions for novice drivers (usually teenagers and young adults) who have the highest rate of collision involvement of all age groups.

Automotive manufacturers are interested in meeting the needs of older drivers since older adults are the fastest growing group of drivers in the US both in terms of annual mileage and the number of current drivers (National Highway Traffic Safety Administration., 1989). By 2010 there will be 40 million adults ⩾65 years in the US (United States Census Bureau., 2004); 4 out of 5 will be drivers (32 million) (US Department of Transportation, 2003). Vehicle manufacturers recognize that visual sensory impairments and deficits in the processing of visual information are common among older adults (Rubin et al., 1997; Vitale, Cotch, & Sperduto, 2006). These aging-related visual impairments could impact older adults' ability to control the vehicle, detect relevant events and objects in the roadway environment, and to interact with the dashboard. It is conceivable that certain vehicle technologies could theoretically compensate, at least in part, for vision impairments typical of advanced age, and conversely other designs could exacerbate the negative effects of these visual deficits (Charness, 2008; Lee, 2008). However, little is known about what design options are more likely to facilitate older adults' processing of visual information while driving. Studies are beginning to address these human factors issues for older drivers (Owsley, McGwin Jr., & Seder, submitted for publication; Rokotonirainy & Steinhardt, 2009), although this research area is still in its infancy.

Research methodology for studying vision and driving also needs to move to the next level. As discussed throughout this paper, most studies examining the link between vision and driving rely on either of three outcomes (dependent variables) – motor vehicle collision involvement, performance on-road, and performance in an interactive simulator. However we know little about how measures of performance and safety relate to each other, or how simulated performance from the laboratory relates to on-road driving. There is a tendency to treat all three types of outcomes as equivalent when interpreting the literature even though the nature of their interrelationships is unknown. Furthermore, not until very recently research has examined the role of vision in naturalistic driving where driving performance measurements of drivers are made in a largely unobtrusive yet objective fashion over a period of days. Such research is attractive in that it avoids the artificial analogues of the laboratory, the simulator scenarios that are over-simplifications of the roadway environment, and the relatively short snapshot (e.g., one hour), one-time sampling of on-road driving evaluations. Naturalistic driving captures actual driving behaviors that may shed light on the visual and cognitive mechanisms underlying performance and safety decrements. For example, recent work (Munro et al., 2010; West et al., 2010) has used an in-vehicle monitoring system with older drivers whereby driver behaviors were recorded over a period of several days. The

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visual and cognitive abilities of these drivers were also characterized. Results suggest that visual-motor construction and attentional abilities are associated with lane-changing errors in older drivers (Munro et al., 2010) and that a narrowing of the visual attentional field increases their risk for failure to stop at red lights (West et al., 2010).

With respect to research focused on safety (i.e. crash involvement), there is a need to adopt study designs and to develop screening tests that can be more readily translated into licensing policies. However, this research cannot proceed without well-designed etiologic studies that shed light on those characteristics that both place drivers at risk for collision involvement but are also amenable to interventions to reduce those risks that have potential for widespread implementation.

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Glenn Jackson # 3 Pg1
Amendment 1-26-17
SB 2123

PROPOSED AMENDMENTS TO SENATE BILL NO. 2123

Page 3, line 6, after "may" insert "use"

Page 3, line 6, remove "waive"

Page 3, line 6, after "waive" insert "vision information provided by applicants to meet"

Renumber accordingly.

NANCY Kopp #4 pg1
Amendment

1-26-17 SB 2123

PROPOSED AMENDMENTS TO SB 2123

39-06-19. Expiration of license – Renewal

9. A noncommercial applicant may apply by mail or electronically for renewal of a license during every other renewal cycle. The director may use ~~waive~~ vision information verified by an eye specialist, provided by applicants to meet vision requirements under the age of sixty-five and adopt procedures necessary to implement this subsection.

Submitted by North Dakota Optometric Association and North Dakota Medical Association

SB 2123
2-2-17

Attachment #1
Pg. 1

Proposed amendments to SB 2123

Page 3 Line 6 replace "waive" with "use vision information provided by the applicants to meet"

New section 9 would read:

9: A non commercial applicant may apply by mail or electronically for renewal of a license during every other renewal cycle. The director may use vision information provided by applicants to meet vision requirements for applicants under the age of sixty-five and adopt procedures necessary to implement this subsection.

Submitted by the North Dakota Optometric Association, ND Medical Association and the ND Society of Eye Physicians and Surgeons.

SB2123
3-9-17
#1
Page 1

HOUSE TRANSPORTATION COMMITTEE
March 9, 2017; 9:00 AM, Ft. Totten Room

North Dakota Department of Transportation
Glenn Jackson, Director, Driver's License Division
Senate Bill 2123

Mr. Chairman, members of the committee, I am Glenn Jackson, Director of the Driver's License Division at the North Dakota Department of Transportation (DOT). Thank you for giving me the opportunity to address you today.

The business process for renewing an operator's license is the same process as for issuance of an original operator's license. The applicant completes the application, provides any necessary documentation, completes a vision screening, pays a fee, takes a photo, and gets the license. In order to provide this service online, there are two parts of the business process that must change.

The first part of the business process to change is the photo. Current technology does not allow an applicant to update the photo stored in the database. However, there are technology applications close to completion that will allow an applicant to take a 3D photo and send it in as an attachment that can be used for an upgraded photo. Once that technology is operational, it will become a requirement for conducting an online renewal. As a side note, this technology is also used for the MobileDL, which we will introduce as soon as we hear the final implementation results in Iowa.

The second part of the business process to change is the vision screening. The applicant does not complete a vision screening to complete an online renewal. In proposing this change to the business process we use to license individuals, we carefully reviewed driver safety issues from various states to validate we were not proposing a solution that generated problems.

- Several states allow online renewal of driver licenses. These states vary from requiring some form of vision results to no requirement.
- Several states have no vision screening requirements for issuance of a license at all.
- Some states require vision results at certain ages, others do not.
- A study conducted by the Department of Ophthalmology at the University of Alabama was completed in May 2016 and posted on the US Dept. of Health & Human Services webpage that stated there was "little to no evidence that a visual acuity screening test, no matter which pass-fail cut-point is selected, enhances driver safety and performance."

In short, there is no specific evidence that the requirement for the vision screening conducted by the driver licensing authority provides a higher level of driver safety, nor does the lack of a vision screening increase a safety concern. Drivers with vision concerns are expected to take the necessary steps to correct their vision. Also, it is important to remember that the expected number of people who will utilize this service is relatively low. It is also important to remember that everyone still must complete a vision screening at initial permitting, and at all renewals completed in the driver license office. This is NOT eliminating the screening in all renewal cases. Additional information on both the vision screening and photo are attached.

The process proposed in SB2123 is for every other renewal to be available for those who desire to use the service online. In this case, these individuals would go online and complete an application, provide vision information, pay a fee, and receive their license. The process is unavailable if any information differs from that currently in the record.

The major goal of this process change is to provide necessary flexibility in the process, gain efficiencies within the process, and provide an improved flexible service to our citizens.

It was proposed that we provide this service but still require individuals to complete a vision test and have those results sent in to our office prior to the renewal process. This step could be completed, but with the following impact.

- An individual that has a choice of paying for an eye examination or getting a free screening will most likely take the free screening, in which case they will not use the online process, but will require staff time to complete the process in the office.
- Receiving and processing vision examinations and attaching them to records is a manual task and would require additional staff to process these documents, return those that were unreadable, provide follow-up for applicants whose records were not updated, etc.

Either of these actions cancel out the expected gains in efficiency and staff utilization, and prevent the department from providing improved service flexibility through implementation of technological and process change solutions available today.

At this time, I would like to review the changes to the bill and the attached information.

Mr. Chairman that concludes my testimony, I would be happy to answer any questions.

Attachment 1, SB2123 Online Renewal Information

In 2014 we conducted 169,812 vision screenings. Of these, 988 failed the screening. This represents a .005% failure rate, which is insignificant.
In 2015 we conducted 121,465 vision screenings. Of these, 836 failed the screening. This represents a .006 failure rate, which is insignificant.

- Some of these were first time permit seekers
- Some of these were renewals
- Some of these were individuals who just couldn't figure out how to read the numbers
- Only 33 states still require vision screening
- All of these individuals walked in the door, filled out an application, and were then asked to take the vision screening. All of these individuals had demonstrated the ability to function visually. None of these individuals were blind or hazardous to others.

There is no empirical evidence or data that associates any safety concern with the use or disuse of the vision screening process. If there were, all states would conduct screening and there would be established guidelines for this process. It is not a safety issue.

In a recent review of 50 states and D.C., the following information was provided:

- 13 states have a 4 year license
- 11 states have a 5 year license
- 8 states have a 6 year license
- 16 states have a 8 year license
- 2 states have a 10 year license
- 1 state has no time limit up to age 65
- A significant number of driver photos currently exceed 6 years

In review of on-line renewals of the above states and D.C.:

- 14 states have online renewal
- 12 states only allow renewal every other cycle online
- 4 of those states with online renewal are 8 year licensed states, equating to 16 years between required visits
- 1 of those is Florida
  - Approximately 11% of renewals are online
- 1 of those states is Georgia
  - A number was not available, but the state reports disappointment with the low numbers of drivers who take advantage of the process

In North Dakota, if we get 10% of drivers to renew online every other cycle, it should equate to roughly 10,000 online renewals a year.

- This equates to 5,000 class D skill tests (20 minutes per test)
- This equates to 1,500 commercial skill tests (90 – 120 minutes per test)
- Gaining this much capacity should enable us to improve current wait times and maintain them for the foreseeable future, without the need for additional staff, thus controlling growth in government and costs

The federal passport photo is valid for ten years; Federal Real ID guidelines allow up to 16 years between photos on identification documents

If law enforcement has a problem immediately associating a photo with an individual they have access, through BCI, to the facial recognition software for identity verification. The points used by the software to track the identity of the face do not change significantly over time.

Attachment 2, SB2123 Steps in Online Renewal

Online renewals will not be processed with any changes to the current record. If at any time an individual selects a response that ends the process, the system will not allow an additional attempt, and the individual will be required to go to a Driver's License Division office to process the renewal.

Additionally:

- The photo will be the latest photo in the system.
- The signature will be the latest signature on file.
- The first possible online renewal period, for those initially licensed between 15 – 20 years of age, will not be the first renewal, as some younger individuals may not have updated their license information by this time. The first renewal will be physical presence in an office. Thereafter, every other may be online.

FEDERAL PRIVACY ACT OF 1974

Disclosure of the individual's social security number in this process is mandatory pursuant to NDCC 39-06-07. The individual's social security number is used by the department for file control purposes and record keeping. If your social security number is not disclosed, we will not issue a license.

1. Applicant enters name, DOB, SSN, DL# and address into identification section.
   - The system either recognizes all information as belonging to a record, or process ends and the applicant is directed to go to a Driver's License Division office to renew their license.

2. Once identification is complete and record is recognized, applicant is asked the following questions with corresponding results.

3. Under the provisions of the Uniform Anatomical Gift Act, do you wish to be identified as an organ and tissue donor? Yes/No
   - Neither response stops the process.

4. Have you experienced significant vision changes not reported to the Driver's License Division in the past six years? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
   - If no, the process continues.

5. Regardless of vision changes, attach vision information completed no more than sixteen months before license expiration.
   - If no attachment selected, process ends.
   - If attachment selected, process continues.

6. Do you have a physical or medical condition not reported to the Driver's License Division in the past six years? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.

- If no, the process continues.

7. Do you have a history of epilepsy, blackout attacks, or other lapses of consciousness not reported to the Driver's License Division in the past six years? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
   - If no, the process continues.

8. Have you been adjudged incompetent or been disabled due to a mental illness? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
   - If no, the process continues.

9. Do you habitually use alcoholic beverages or narcotic drugs to excess? Yes/No
   - If yes, the process ends and the applicant is directed to go to a Driver's License Division office to renew their license.
   - If no, the process continues.

10. Protect Yourself: If your application contains any false or fraudulent information, your driving privileges will be revoked or cancelled. You may also be subject to criminal penalties.

I certify, under penalty of perjury, that the information hereon is true and correct, and that I do not possess a license to drive or have an active license record in any other jurisdiction, nor are my driving privileges under suspension, revocation, cancellation or disqualified in any jurisdiction.

Electronic Signature ________________________________

11. Once previous steps complete (and once photo validation tools are available) submit current photo. Photo submitted cannot include wearing of any headgear, unless currently authorized due to specific religion requirements. A photo observed with headgear will result in the process ending prior to issuance.

12. Once all is complete, the individual will click on the SUBMIT button.

13. At this time the system will automatically perform several checks to validate information.
    - If the system detects an error the process stops and the individual is referred to a Driver's License Division office.
    - If all processes without error, continue.

14. Once all checks complete satisfactorily, the individual will be required to submit payment via a credit card.
    - If it processes without error, the system will generate a receipt the individual can print.
    - If it does not process, the process stops and the individual is referred to a Driver's License Division office.

15. At this point, the renewal goes into a work queue. The next business day an examiner will review the information, to include the photo submitted, and print the license, conduct a quality check, and mail the license to the individual. Expected delivery is within 5 business days.

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A Roadmap for Interpreting the Literature on Vision and Driving

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Abstract

Over the past several decades there has been a sharp increase in the number of studies focused on the relationship between vision and driving. The intensified scientific attention to this topic has most likely been stimulated by the lack of an evidence-basis for determining vision standards for driving licensure and a poor understanding about how vision impairment impacts driver safety and performance. Clinicians depend on the scientific literature on vision and driving as a resource to appropriately advise visually impaired patients about driving fitness. Policy makers also depend on the scientific literature in order to develop guidelines that are evidence-based and are thus fair to persons who are visually impaired. Thus it is important for clinicians and policy makers alike to understand how various study designs and measurement methods should be appropriately interpreted so that the conclusions and recommendations they make based on this literature are not overly broad, too narrowly constrained, or even misguided. In this overview, based on our 25 years of experience in this field, we offer a methodological framework to guide interpretations of studies on vision and driving, which can also serve as a heuristic for researchers in the area. Here we discuss research designs and general measurement methods for the study of vision as they relate to driver safety, driver performance, and driver-centered (self-reported) outcomes.

Keywords

driving; vision; vision impairment; eye disease; research methods

I. Introduction

Just as in a literate society the ability to read is important for quality of life, the same can be said for driving in a society dependent on the personal vehicle for mobility and transportation. Visual acuity testing is the most common functional method for determining eligibility for licensure world wide, in addition to on-road and knowledge tests. Yet there is little to no evidence that a visual acuity screening test, no matter which pass-fail cut-point is selected, enhances driver safety and performance.[99] The absence of evidence-based vision

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Review

Vision and driving

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ABSTRACT

Driving is the primary means of personal travel in many countries and relies heavily on vision for its successful execution. Research over the past few decades has addressed the role of vision in driver safety (motor vehicle collision involvement) and in driver performance (both on-road and using interactive simulators in the laboratory). Here we critically review what is currently known about the role of various aspects of visual function in driving. We also discuss translational research issues on vision screening for licensure and re-licensure and rehabilitation of visually impaired persons who want to drive.

1. Introduction

Driving is inarguably a highly visual task. Even though visual acuity is the ubiquitous screening test during application for a driver's license, many other aspects of visual function and visual processing are undoubtedly involved in supporting the effective control of a vehicle. During the last two decades there has been a burst of research activity focused on the role of vision in driving, much of which has been centered on what types and degrees of vision impairment hamper driver safety and performance. This body of work is largely motivated by society's need to preserve public safety on the roadways. The larger question emerging from this research is, what should be the visual requirements for obtaining or maintaining a driver's license? There is widespread agreement that vision standards for driver licensure need to be evidence-based so as not to unfairly prohibit individuals from driving who have the visual skills necessary to do so, in spite of being visually impaired. Even though the field does not yet have the evidence accumulated to define those standards, the research over the past two decades has gone far in contributing to this evidence base. This article will critically summarize these findings.

Before doing so, however, it is important to acknowledge that driving is not simply just a way to "get around", but in fact is the primary and preferred mode of travel for adults in the US and many other countries (Hu & Reuscher, 2004). Being a driver has a profound impact on health and well-being. Driving cessation, regardless of whether it is voluntary or involuntary (i.e., license revocation), can have a number of adverse consequences. Cessation of driving has been associated with decreased health-related quality of life (DeCarlo, Scilley, Wells, & Owsley, 2003), increased likelihood of depression and social isolation (Fonda, Wallace, & Herzog, 2001; Marottoli et al., 1997; Ragland, Satariano, & MacLeod, 2005), reduced access to healthcare services (Owsley et al., 2006, 2008), and increased likelihood of placement in long-term-care (Freeman, Gange, Munoz, & West, 2006). It also creates a need for alternative transportation options at both the societal and individual level that are potentially expensive (e.g., public transportation and paratransit systems, taxi) (Rosenbloom, 1993; Transportation Research Board, 1988) and are unavailable in many geographic areas, especially rural areas. Just as reading in a literate society is important to quality of life, so is driving in a society that depends on the personal vehicle for transportation.

Because vision impairment is much more prevalent in later adulthood, many studies on vision and driver safety and performance focus on adults ⩾50 years old. Because of this focus on the older adult population, other medical and functional co-morbidities common in late adulthood are potential confounders in understanding the relationship between vision and driving. In particular, cognitive impairment elevates crash risk and impairs driving performance (Ball et al., 2006; Wood, Anstey, Kerr, Lacherez, & Lord, 2008). Thus, study designs that make use of older adult populations to study associations between vision and driving must consider cognitive co-morbidities whenever possible.

In research on driving, there are two major outcomes (dependent variables) – driver safety and driver performance. They are not synonymous in that they assess different constructs and use different types of methodology in doing so. *Safety* is defined by adverse driving events, typically motor vehicle collision involvement (e.g., at-fault crashes, injurious crashes). Information on these adverse events is typically provided by a state's motor vehicle administration in the form of accident reports. The US Department of

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NORTH DAKOTA
Optometric Association

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SB 2123

House Transportation Committee

March 9, 2017

Good Morning Mr. Chairman and Members of the Committee.

For the record, my name is Dr. Taya Patzman and I have optometry practices in Bismarck and Jamestown. I am a past president of the North Dakota Optometric Association and am a current member of the State Board of Optometry.

I appear before you this morning in opposition of SB 2123. The current renewal cycle for a non-commercial driver's license is 6 years; being able to renew electronically every other renewal cycle would mean drivers would essentially be exempt from a vision screening for 12 years! Waiving the vision requirements for drivers under the age of 65 is irresponsible. The language amended into this bill that the Director may use vision information provided by the applicant to meet vision requirements is careless. The responsibility of meeting such requirements would lie solely on the honesty of the applicant, and that is a safety risk to the general population.

From my experience, patients undergo many vision changes from the age of 16 to 65. In the earlier years, patients are still going through puberty, and the prescription typically can change quite drastically in a year's time, let alone 6 or 12 years. Many vision changes also happen in the 20's and 30's due to pregnancy, changes in visual demand due to school and work changes, and many new health issues arise; in the 40's, 50's, and 60's patients typically start presbyopia which affects distance and near vision. Often, these changes can be subtle, but compounding over 6 or 12 years, they become quite significant. Typically, in this age range, diabetes is most often diagnosed - many Type 2 diabetics are diabetic for several years before they are formally diagnosed. I have seen many patients over the years who come in for blurry vision and have large prescription changes from undiagnosed diabetes.

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Assuming that people will seek out eye care if their vision is blurry is naïve. If that were the case, my colleagues and I wouldn't see as many patients in for eye exams with the chief complaint of "failing the vision test when trying to get their driver's license renewed." I also have many patients who come in for an eye exam when they need to renew their driver's license and tell me they know their vision is so poor they won't pass at the DMV, so they need to get glasses before they fail at their renewal. Many of these patients are aware of their poor vision for many years but procrastinate until the last possible moment to take care of the problem. The only reason they take care of it is because of the vision screening at the renewal.

Vision care is typically not covered under medical insurance and glasses can be expensive, so to assume that all drivers are going to be responsible in maintaining their vision care is unrealistic. Their typical reason for not coming in sooner is not enough time and expense; there are complacent people now with strict driving requirements, so I can't imagine the problems we will see if this is extended for 12 years.

I feel that this proposed change takes a large step backwards in road safety. The increased traffic that we have seen in Bismarck, the Bakken, and around the state, along with the number of young drivers, and the distraction of cell phones, poor vision is a risk factor that can be greatly reduced.

I realize that new technology is constantly emerging and stream lining the process is necessary. However, I do not feel that this bill offers enough detail to address these issues and concerns for driver's safety. I would like to see the DOT held accountable for verifying that drivers issued renewal licenses, can see the minimum of 20/40 or better. That may be verified by a DOT screening or by verification by an eye care professional, but not by self-attesting. There is discussion that needs to happen before changes are made that jeopardize the safety of the citizens of North Dakota.

This concludes my testimony. I strongly encourage a DO NOT PASS on Senate Bill 2123. I would be happy to answer any questions you may have. Thank you.

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#3

House Transportation Committee
SB 2123
March 9, 2017

Chairman Ruby and Committee members: My name is Courtney Koebele. I'm appearing here today on behalf of the North Dakota Society of Eye Physicians and Surgeons. The NDSEPS is the professional membership organization for North Dakota ophthalmologists.

The NDSEPS opposed SB 2123 in the Senate, because it extended the time between vision screening to 12 years. North Dakota ophthalmologists reviewed the bill and they would not recommend reducing the frequency of the vision screening. The Senate did amend the bill by taking out the word "waive" and inserting the statement that the director "may use vision information provided by the applicant to meet" vision requirements for applicants under the age of sixty-five and adopt procedures necessary to implement this subsection.

License renewals were recently lengthened from 4 to 6 years. HB 1299, which has passed this committee and the House, extended it to 8 years. This bill now extends the vision screening requirement from 6 to 16 years. From a public safety point of view, people should be able to prove they can see well enough to drive more than just once every 16 years. Many serious vision problems develop prior to age 65, such as cataracts, which is the most common, and macular degeneration and glaucoma, just to mention a few common ailments.

Vision requirements can and do change throughout the lifetime of every individual. Even people under the age of 30 can have drastic changes in vision correction requirements.

Therefore, the North Dakota Society of Eye Physicians and Surgeons respectfully requests that you give a DO NOT PASS to SB 2123. Thank you for your time and consideration. I would be happy to answer any questions.

SB2123
3-10-17
#1

17.8094.02001
Title.

Prepared by the Legislative Council staff for
Representative Jones
March 9, 2017

PROPOSED AMENDMENTS TO ENGROSSED SENATE BILL NO. 2123

Page 3, line 6, remove "The director may use vision information provided by"

Page 3, replace line 7 with "To meet the vision requirements for a license renewal, an applicant under the age of sixty-five may submit to the director vision information verified by an eye specialist. The director may"

Renumber accordingly

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Page 1

Impact of Amendment 17.8094.02002 Adopted by Committee 3/10/17 – SB2123

1. Changes the renewal vision screening to a vision test – different and higher standard.
2. Requires individuals to see an optometrist to complete a vision test to get information to submit for use for a renewal.
3. Eliminates the ability for a significant number of drivers to renew online.
4. Extends the time for use of a vision test to 24 months, may cause a change in administrative rule, we currently only use for 6 months per administrative rule, this would possibly extend that.

The change reinforces a belief that the relationship between driver safety and visual acuity is relevant. Research demonstrates exactly the opposite, that there is no relationship between driver safety and visual acuity screening.

The current bill and proposed amendment would only enable or encourage half the driving population to renew online. The remaining half who do not have a vision restriction would not pay to have a vision test so they could renew online. It would be easier and cheaper to walk into an office and get a free screening.

Licensed Drivers: 558,657
Eye Restriction: 278,645
No restriction: 280,012

9. A noncommercial applicant may apply by mail or electronically for renewal of a license during every other renewal cycle. The director may use vision information provided by ~~the~~ an applicant with a vision restriction verified by a vision specialist, and waive vision screening for applicants without a vision restriction, to meet vision requirements for applicants under the age of sixty – five and adopt procedures necessary to implement this subsection.

Page 3

PROPOSED AMENDMENTS TO ENGROSSED SENATE BILL NO. 2123

Page 3, line 7, replace the first "the" with "an"

Page 3, line 7, after "applicant" insert "with a vision restriction verified by a vision specialist, and waive vision screening for applicants without a vision restriction,"

Renumber accordingly