HENRY FORD HEALTH


Department of Ophthalmology
Detroit Institute of Ophthalmology


# 10th World Research Congress on vision, cognition and driving and the impact of autonomous vehicle technology on healthcare

The Eye, The Brain & The Auto
World Research Congress

October 30 – November 1, 2022
Hybrid Event
Dearborn Inn
Dearborn, Michigan

henryford.com/TheEyeAndTheAuto

Department of Ophthalmology
Detroit Institute of Ophthalmology

# Thank you to **Macular Degeneration Foundation** for your **Leadership Level** support of The Eye, The Brain and The Auto World Research Congress

HENRY FORD HEALTH®

**Department of Ophthalmology**
Detroit Institute of Ophthalmology

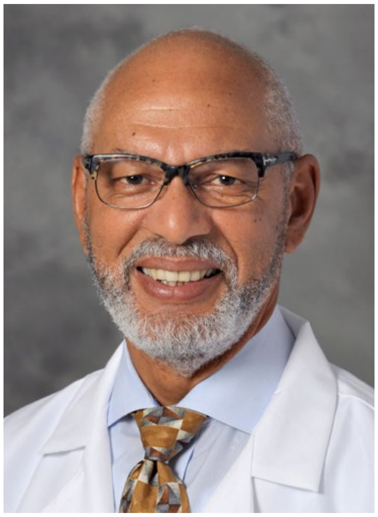
## Table of contents



Audio-visual services provided by

**Dynasty Media Network**

www.Dynastymedianetwork.com



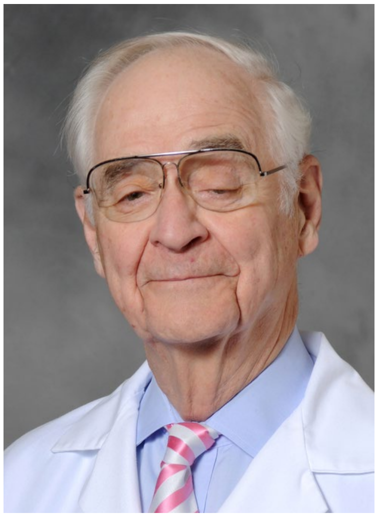
## WELCOME

On behalf of Henry Ford Health and the Department of Ophthalmology, welcome to The Eye, The Brain and The Auto 10th World Research Congress. Philip Hessburg, M.D., Medical Director of the Detroit Institute of Ophthalmology, along with the World Congress planning team, have brought together the world's foremost experts on the relationship between vision and the safe operation of the motor vehicle. This year our focus will also be on advances in the autonomous vehicle and how adoption of this technology will impact health and loss of lives due to auto accidents on the roads and highways in this country.

Thank you to the entire organizing committee for their hard work in helping to organize the Congress. I would like to also take this opportunity to thank our esteemed panel of presenters who have traveled from near and far. Finally, I would also like to thank each of our attendees for participating in this year's Congress. I am delighted that you are joining us and hope that you find the presentations and conversations very valuable and informative.

Sincerely,

Paul A. Edwards, M.D., F.A.C.S.
Chairman
The McCole Chair
Department of Ophthalmology
Henry Ford Health



Welcome to the 10th biennial world research congress, **The Eye, The Brain and the Auto 2022.** We are honored to have you choose to spend three days with us.

In the early decades of the last century thoughtful leaders watched motorized vehicles replace horse driven contrivances and considered who should be licensed to drive. They accepted that the blind should not pilot those newfangled vehicles powered by electric motors, or internal combustion or steam driven engines.

But who should be allowed to drive? What level of vision was to be considered "safe"? It would be reassuring to say hard data existed then to allow full licensure to drivers with best corrected vision of 20/70 or 20/80 but deny such to those with 20/100 or lower acuity levels.

No such data existed then, nor does it exist one hundred years later. Without unassailable data we punish citizens whose vision falls to that level by denying them the independence that comes with driving.

Does cognition play a role? In aviation we know that pilot error is responsible for most aero tragedy. We do not allow cognitively challenged to fly airplanes, but we do let them drive. Few jurisdictions, world-wide, allow testing of levels of intelligence which might allow us to spot those most likely when piloting land vehicles to commit "pilot error".

This congress will address matters such as this and will study the path as well to full autonomous mobility, which just one century later will, finally, allow full freedom of travel to the blind.

Further, on our path to SAE Level Five autonomous mobility we know that many car manufacturers are studying the capture of biometric data from in–cab occupants. This could signal life preserving interventions.

We are truly optimistic about full national autonomous mobility eliminating the over 40,000 lives we now lose annually in the United States with roadway crashes.

Welcome to **The Eye, The Brain and the Auto 2022.**

Philip C. Hessburg M.D.

Philip C. Hessburg, M.D.
Medical Director, Detroit Institute of Ophthalmology
Senior Staff Ophthalmologist, Henry Ford Health

## The Detroit Institute of Ophthalmology

1972- 2022

# Celebrating 50 years

**as a bridge between the sighted and the visually impaired communities**

Imagine having very poor vision or not being able to see at all. Now imagine an organization that helps you and your family – and one that's a world leader in bringing together researchers studying advances in eyesight and vision.

For more than 50 years, that's been the mission of the Detroit Institute of Ophthalmology, the research education arm of the Henry Ford Health Department of Ophthalmology (DIO). The DIO exists to assist and educate the visually impaired helping them maintain independence and dignity and live satisfying lives in a sighted world. The DIO also sponsors international research congresses that annually bring together the world's leading vision-related scientists.

To help the blind and visually impaired maintain the highest quality of life, the DIO offers a comprehensive range of support services. These include:

### Support groups

For more than four decades, the DIO has sought to help those who suffer from vision loss by managing support groups for the visually impaired. These groups are offered at various locations in southeast Michigan. All groups offer hope, joy, compassion, understanding and interaction with others who are similarly challenged. Thanks to Edward T. and Ellen K. Dryer Charitable Foundation and The Mary Thompson Foundation for their support.

### Martha F. Gorey Resource Center

Named for a long-time benefactor and housed within the DIO, the Center offers a large selection of low-vision aids. These include closed-circuit magnifying machines, hand-held and stand magnifiers up to 3x, large-print calendars, talking watches, clocks and calculators.

### Education

The DIO provides a variety of educational resources to both the visually impaired and sighted communities, including:

- **Professional Education:** DIO is closely affiliated with the ophthalmic technician training program at Henry Ford College, Dearborn, and the Henry Ford Health Department of Ophthalmology's Residency Training program. One of the physicians of the DIO serves as both the Medical Director for the Henry Ford College Ophthalmic Technician Training Program and as the Residency Program Director and Vice Chair of Education for the Department of Ophthalmology at Henry Ford Hospital. Throughout the year, various workshops for training physicians in internal medicine and emergency medicine are conducted at the DIO.

- **Public Education:** Each year the DIO participates at the Assumption Senior Expo providing information and resources for visually impaired seniors and their families.

## Research Congress

The DIO sponsors two international vision-related research congresses that each assemble more than 30 of the world's top vision-related scientists for two or three days of meetings and seminars in Detroit. Alternating each year, these congresses are: The Eye, The Brain & The Auto, and The Eye and The Chip. Find more information at: **henryford.com/TheEyeAndTheChip**.

## Friends of Vision

Many DIO programs rely on support from its volunteer arm, the Friends of Vision. They provide support to the visually impaired in several ways, including helping to set up and provide transportation to meetings and events; escorting them on field trips; staffing the Martha F. Gorey Resource Center store; and participating in such events as managing the cash raffle at the EyesOn Design Car Show. Volunteers receive necessary training and choose the activities that best match their schedules and interests.

## DIO support

In addition to the EyesOn Design events, DIO programs are supported by generous donations from individuals, foundations and businesses. The many ways you can help include:

- Bequests
- Fundraisers / special events
- Donations of time and/or money
- Honorary / memorial gifts
- Endowments
- Matching funds

Through the commitment of several very generous donors, DIO has established the Philip C. Hessburg, M.D. Detroit Institute of Ophthalmology Endowed Lectureship: Progress in the Eradication of Blindness and the Philip C. Hessburg, M.D. – Art Van Elslander Endowed Chair in Ophthalmic Research. Each honors Dr. Hessburg and ensures that the vital work of the Detroit Institute of Ophthalmology endures.

For more information, please call the DIO at (313) 824-4710 or visit **henryford.com/DIO**

HENRY FORD HEALTH

Department of Ophthalmology
Detroit Institute of Ophthalmology

Thank you to
**GM Research and Development**
for your **Leadership Level** support of
The Eye, The Brain and The Auto
World Research Congress

### At the Henry Ford Health Department of Ophthalmology, patients will find:

- Board-certified physicians, with leaders in comprehensive ophthalmology and ophthalmic sub-specialties, including surgical care
- Advanced treatment options, led by continuous research
- One of the largest practices in the United States, providing convenient, high-quality and compassionate care for over 75 years

**At Henry Ford the patients come first**
A leader in Michigan, as well as one of the largest ophthalmology practices in the United States, the Henry Ford Department of Ophthalmology treats more than 55,000 patients per year at 15 locations throughout southeast Michigan.

**Coordinated care**
Our ophthalmologists also work closely with Henry Ford Medical Group physicians in other departments, providing multidisciplinary, coordinated care for those patients who need it.

**Pioneering vision research**
In addition, we are dedicated to vision research, helping to increase our understanding of disease processes and the most effective ways to detect, diagnose, treat and prevent these conditions. Ultimately, our extensive research program helps to break new ground in critical areas of vision research, keeping us at the forefront of innovation while advancing the level of eye care that we provide to our patients.

# The Eye, The Brain and The Auto Organizing Committee 2022

## Co-organizers:

**Philip C. Hessburg, M.D.**
Medical Director
Detroit Institute of Ophthalmology
Department of Ophthalmology, Henry Ford Health
Detroit, MI
Philiphessburg@gmail.com

**Cynthia Owsley, Ph.D.**
Professor of Ophthalmology
Vice Chair for Clinical Research
Department of Ophthalmology
School of Medicine, University of Alabama at Birmingham
Birmingham, AL
Cynthiaowsley@uabmc.edu

## The planning committee:

**Thomas G. Dennehy, M.S., B.S.**
Smart Mobility and Connected Vehicle Analytics
Ford Motor Company
Dearborn, MI
Tdenneh2@ford.com

**Jennifer Dukarski, J.D.**
Butzel Long Law
Ann Arbor, Michigan
dukarski@butzel.com

**Paul A. Edwards, M.D., F.A.C.S.**
Chairman, The McCole Chair
Department of Ophthalmology, Henry Ford Health
Detroit, MI
Pedward2@hfhs.org

**David J. Goldman, M.D.**
Assistant Medical Director
Detroit Institute of Ophthalmology
Department of Ophthalmology, Henry Ford Health
Detroit, MI
dgoldman@hfhs.org

**Roseanne Horne**
Program Coordinator
World Research Congresses
Detroit Institute of Ophthalmology
Department of Ophthalmology, Henry Ford Health
Rhorne1@hfhs.org,

**Kathleen Pecar Lightbody**
Marketing Consultant
Chairman – Eyes On Design at Ford House Car Show
Detroit Institute of Ophthalmology
Grosse Pointe Park, MI
kathylightbody@hotmail.com

**Gerald McGwin, Jr., M.S., Ph.D.**
Professor, Vice Chairman
Department of Epidemiology
University of Alabama at Birmingham
Birmingham, AL
gmcgwin@uabmc.edu

**Lylas Mogk, M.D.**
Center for Vision Rehabilitation and Research
Department of Ophthalmology, Henry Ford Health
Detroit, MI
Lmogk1@hfhs.org

**Anne Nachazel, M.D.**
Ophthalmologist
Eastside Eye Physicians
St. Clair Shores, MI
toalhome@comcast.net

**Edward R. O'Malley, M.D.**
Detroit Institute of Ophthalmology
Department of Ophthalmology, Henry Ford Health
Detroit, MI
eromalley@comcast.net

**Daniel Rathbun, Ph.D.**
Director of Research
Bionics and Vision Lab
Department of Ophthalmology, Henry Ford Health
Detroit, MI
Drathbu2@hfhs.org

**Joseph Rizzo, M.D.**
Director, Neuro-Ophthalmology Service
Massachusetts Eye & Ear Infirmary
Professor of Ophthalmology Harvard Medical School
Massachusetts Eye and Ear
Boston, MA
Joseph_Rizzo@meei.harvard.edu

**Thomas Seder, Ph.D.**
GM Technical Fellow
Chief Technologist, HMI
GM Technical Center
Warren, MI
Thomas.Seder@gm.com

# Program schedule

## Sunday, October 30, 2022

(Presentations are 20-minutes long, plus a 10-minute Q & A period)
All times are Eastern Standard

| | |
|---|---|
| 12:15 – 1:00 p.m. | **Lunch/ Welcome and introduction**<br>Paul Edwards, M.D., Chair, Department of Ophthalmology, Henry Ford Health, Detroit, Michigan |

### Session one: Three to Energize the Congress

**Moderator:** Cynthia Owsley, Ph.D., University of Alabama, Birmingham, Alabama

| | |
|---|---|
| 1:00 – 1:30 p.m. | **TREYESCAN: An Eye Tracking and Hazard Viewing Test for Driving with Visual Field Defects**<br>Yasmin Faraji, M.D., Amsterdam University Medical School, Amsterdam, Netherlands |
| 1:30 – 2:15 p.m. | **Keynote address:**<br>**An Introduction to Artificial Intelligence and its Impact on Mobility and Healthcare**<br>Jacob Bond, Ph.D., General Motors, Warren, Michigan<br>Alok Warey, Ph.D., General Motors, Warren, Michigan |
| 2:15 – 2:45 p.m. | **Volatolomics of Breath as an Emerging Frontier for Wellness Screening in Autonomous Vehicles**<br>Philip Olla, Ph.D., Audacia Bioscience, Windsor, Canada<br>Arezoo Emadi Ph.D., University of Windsor, Canada |
| 2:45 – 3:15 p.m. | **Break** |

### Session two: The Driver

**Moderator:** Timo Tervo, M.D., Ph.D., Helsinki University Eye Hospital, Finnish Crash Data Institute, Helsinki, Finland

| | |
|---|---|
| 3:15 – 3:45 p.m. | **Bioptic Driver Training and Testing: Similarities and Differences Across the United States**<br>Charles Huss, M.A., Retired, Dunbar, West Virginia |
| 3:45 – 4:15 p.m. | **Windshields as an Electronic Device for Perception, Comfort, and Communication**<br>Sameh Saad, Ph.D., Betterfrost and Asahi Glass, Oakville, Ontario, Canada<br>Terence Yim, Asahi Glass, Oakville, Ontario, Canada |
| 4:15 – 4:45 p.m. | **Global Human Body Modeling: Vision and Opportunities**<br>Paul Krajewski, Ph.D., General Motors, Warren, Michigan |
| 4:45 – 5:15 p.m. | **Naturalistic Driving Metrics for Predicting Rheumatoid Arthritis Disease Status**<br>Jun Ha Chang, Ph.D., University of Nebraska Medical Center, Nebraska |
| 5:15 – 5:45 p.m. | **Panel discussion:**<br>Moderators: Cynthia Owsley, Ph.D. and Timo Tervo, M.D., Ph.D.<br>Panelists: Jacob Bond, Ph.D., Jun Ha Chang, Ph.D., Patrick Droste, M.D., Yasmin Faraji, M.D., Charles Huss, M.A., Paul Krajewski, Ph.D., Sameh Saad, Ph.D., and Alok Warey, Ph.D. |
| 5:45 – 6:00 p.m. | **Break** |
| 6:00 – 9:00 p.m. | **Bartimaeus Award reception and dinner**<br>Reservations required: Contact **rhorne1@hfhs.org** |

# Program schedule (continued)

## Monday, October 31, 2022

(Presentations are 20-minutes long, plus a 10-minute Q & A period)
All times are Eastern Standard

7:25 – 7:30 a.m. **Welcome and introduction**
Paul Edwards, M.D., Chair, Department of Ophthalmology, Henry Ford Health, Detroit, Michigan

### Session three: Night Driving

**Moderator:** Cynthia Owsley, Ph.D., University of Alabama, Birmingham, Alabama

7:30 – 8:00 a.m. **Night-time Driving in Older People: Quantifying the Relation Between Visual Acuity, Contrast Sensitivity, and Hazard Detection Distance in a Driving Simulator**
Ulrich Schiefer, M.D., University of Applied Science Aalen/Tuebingen University, Aalen, Germany

8:00 – 8:45 a.m. **Keynote address:**
**Night Vision Driving Research**
Joanne Wood, Ph.D. Queensland University of Technology, Brisbane, Australia

8:45 – 9:15 a.m. **Correlations Between Intra-Ocular Stray-light perception and Contrast Sensitivity, Halo Size, and Hazard Recognition Distance with and without Glare - Results from a Nighttime Driving Simulator Study**
Judith Ungewiss, Ph.D., Aalen University of Applied Sciences, Aalen, Germany

9:15 – 9:45 a.m. **Break**

### Session four: Matters Automotive

**Moderator:** Joseph Rizzo, M.D., Harvard Medical School, Boston, Massachusetts

9:45 – 10:15 a.m. **Imaging Through Scattering Media for Automotive Applications**
Manoj Sharma, Ph.D., General Motors, Warren, Michigan

10:15 – 11:00 a.m. **Keynote address:**
**What You Don't See Makes the Difference in Auto!**
Tim Cavanaugh, M.B.A., Cavanaugh Consulting Group, South Lyon, Michigan

11:00 – 11:30 a.m. **The Eye and The Brain vs. The Automated Auto**
Richard Young, Driving Safety Consulting, Troy, Michigan

11:30 – 12:15 p.m. **Panel discussion**
**Moderators:** Joseph Rizzo, M.D., and Matthew Rizzo, M.D.
**Panelists:** Daniel Rathbun, Ph.D., Ulrich Schiefer, Ph.D., Manoj Sharma, Ph.D., Judith Ungewiss, Ph.D., Joanne Wood, Ph.D., and Richard Young

12:15 – 1:00 p.m. Lunch

## **Program schedule** (continued)

### Session five: Naturalistic Driving

**Moderator:** Joanne Wood, Ph.D., Queensland University of Technology, Brisbane, Australia

| | |
|---|---|
| 1:00 – 1:30 p.m. | **How Bus Drivers Keep Distance from Obstacles when Braking: A One-year Naturalistic Driving Study**<br>Gang Luo, Ph.D., Harvard Medical School, Boston, Massachusetts |
| 1:30 – 2:15 p.m. | **Keynote address:**<br>**Naturalistic Driving and Attribution of Crash Causation**<br>Matt Rizzo, M.D., University of Nebraska, Omaha, Nebraska |
| 2:15 – 2:45 p.m. | **Older Adults' Person Abilities about Vehicle Dashboard Designs and Their Association with Vision**<br>Cynthia Owsley, Ph.D., University of Alabama, Birmingham, Alabama |
| 2:45 – 3:15 p.m. | **Break** |

### Session six: Autonomous Driving

**Moderator:** David Goldman, M.D., M.B.A., Department of Ophthalmology, Henry Ford Health, Detroit, Michigan

| | |
|---|---|
| 3:15 – 3:45 p.m. | **Comparing Motion Sickness in a High-fidelity Driving Simulator During Manual and Automated Driving in Older Adults**<br>Behrang Keshavarz, Ph.D., KITE Research Institute, University Health Network, Toronto, Canada |
| 3:45 – 4:15 p.m. | **Selling Technology: Influencing Perceptions of Autonomous Vehicles**<br>Cornelius Darcy, Ph.D., Flint, Michigan |
| 4:15 – 4:45 p.m. | **Passenger Emotional State Assessment using Physiological Sensors in Autonomous Vehicles**<br>Mia Levy, M.S., HRL Laboratories, Agoura Hills, California |
| 4:45 – 5:15 p.m. | **Resolution to American Medical Academy on Driver's License Restrictions for Visually Impaired Citizens**<br>Patrick Droste, M.D., Grand Rapids, Michigan |
| 5:15 – 5:45 p.m. | **Panel discussion**<br>**Moderators:** Joanne Wood, Ph.D., David Goldman, M.D., M.B.A<br>**Panelists:** Cornelius Darcy, Ph.D., Arezoo Emadi Ph.D., Behrang Keshavarz, Ph.D., Gang Luo, Ph.D., Phillip Olla, Ph.D., Cynthia Owlsey, Ph.D., and Matt Rizzo, M.D. |
| 5:45 – 6:00 p.m. | **Break** |
| 6:00 – 8:00 p.m. | **Poster session and cocktail reception** |

# **Program schedule** (continued)

## Tuesday, November 1, 2022

(Presentations are 20-minutes long, plus a 10-minute Q & A period)
All times are Eastern Standard

### Session seven: Driving with Reduced Vision

**Moderator:** Cynthia Owsley, Ph.D., University of Alabama, Birmingham, Alabama

| | |
|---|---|
| 7:30 – 8:00 a.m. | Vision Screening for Motor Vehicle Collision Involvement among Older Drivers<br>Gerald McGwin, Ph.D., University of Alabama, Birmingham, Alabama |
| 8:00 – 8:45 a.m. | **Keynote address:**<br>**Medical Condition as a Risk Factor in Fatal Motor Vehicle Crashes**<br>Timo Tervo, M.D., Ph.D., Helsinki University Eye Hospital, Finnish Crash Data Institute, Helsinki, Finland |
| 8:45 – 9:15 a.m. | **Uncovering the Hidden Population in Low Vision: A 10-Year Look at a Student-Parent Program on Driving with Low Vision and Its Multiple Benefits**<br>Cynthia Bachofer, Ph.D., TSBVI, Austin, Texas |
| 9:15 – 9:45 a.m. | **Break** |

### Session eight: More on the Drivers

**Moderator:** Gerald McGwin, Ph.D., University of Alabama, Birmingham, Alabama

| | |
|---|---|
| 9:45 – 10:15 a.m. | **Driver Engagement Support for Commercial Trucking**<br>Derrick Redding, M.S., Betterfrost Technologies, Oakville, Ontario, Canada |
| 10:15 – 10:45 a.m. | **Preferences of Individuals with Different Levels of Visual Impairment for Autonomous Vehicles**<br>Robert Beran, M.S., Wichita State University, Wichita, Kansas |
| 10:45 - 11:15 a.m. | **Pilot Study of a Tactile Hazard Warning Device for Drivers with Impaired Vision**<br>Alex Bowers, Ph.D., Harvard Medical School, Boston, Massachusetts |
| 11:15 – 12:00 p.m. | **Panel discussion**<br>**Moderators:** Daniel Rathbun, Ph.D. and Joanne Wood, Ph.D.<br>**Panelists:** Cynthia Bachofer, Ph.D., Robert Beran, M.S., Alex Bowers, Ph.D., Gerald McGwin, Ph.D., M.A., Derrick Redding, M.S., and Timo Tervo, M.D., Ph.D. |
| 12:00 – 1:00 p.m. | **Lunch** |

## Program schedule (continued)

### Session nine: Matters to Consider on the Way Home!

**Moderator:** Daniel Rathbun, Ph.D., Henry Ford Health, Detroit, Michigan

| | |
|---|---|
| 1:00 – 1:30 p.m. | **Experiences of Drivers with Vision Impairment When Using Tesla Cars: A One-year Follow-up Study**<br>Jing Xu, Ph.D., Envision Research Institute, Wichita, Kansas |
| 1:30 – 2:15 p.m. | **Keynote address:**<br>**Beyond "HIPAA in the Car": The Real Impact of the Law on Automotive Biometric Data**<br>Jennifer Dukarski, J.D., Butzel Long, Ann Arbor, Michigan |
| 2:15 - 2:45 p.m. | **Impact of Glare and Other Interference Factors on Visual Exploration and Nighttime Driving in a Simulator**<br>Michael Woerner, Ph.D., Aalen University of Applied Sciences, Aalen, Germany |
| 2:45 - 3:30 p.m. | **Final panel discussion**<br>**Moderator:** Daniel Rathbun, Ph.D.<br>**Panelists:** Jennifer Dukarski, J.D., Michael Woerner, Ph.D., and Jing Xu, Ph.D. |
| 3:30 p.m. | **Congress adjournment and bon voyage!** |

HENRY FORD HEALTH®

**Department of Ophthalmology**
Detroit Institute of Ophthalmology

Thank you to **ALCON**
for your **Leadership Level** support of
The Eye, The Brain and The Auto
World Research Congress

# The Eye, The Brain and The Auto Presenters 2022


**Cynthia Bachofer, Ph.D.**
TSBVI
Austin, Texas
bachoferc@tsbvi.edu

**Robert Beran, M.S.**
Wichita State University
Wichita, Kansas
RPBeran@shockers.wichita.edu

**Jacob Bond, Ph.D.**
General Motors
Warren, Michigan
Jacob.bond@gmail.com

**Alex Bowers, Ph.D.**
Schepens Eye Research Institute
Boston, Massachusetts
Alex_bowers@meei.harvard.edu

**Tim Cavanaugh, M.B.A.**
Cavanaugh Consulting Group
South Lyon, Michigan
Cavanaughconsulting.tim@gmail.com

**Jun Ha Chang, Ph.D.**
University of Nebraska Medical Center
Omaha, Nebraska
juchang@unmc.edu

**Cornelius Darcy, Ph.D.**
Flint, Michigan
Kip.darcy@gmail.com

**Patrick Droste, M.D.**
Ophthalmologist
Grand Rapids, Michigan
drdroste@comcast.net

**Jennifer Dukarski, J.D.**
Butzel Long Law
Ann Arbor, Michigan
dukarski@butzel.com

**Arezoo Emadi, Ph.D.**
University of Windsor
Windsor, Canada
Arezoo.Emadi@uwindsor.ca

**Yasmin Faraji, M.D.**
Amsterdam University Medical School
Amsterdam, Netherlands
y.faraji@amsterdamamumc.nl

**Charles "Chuck" Huss, M.A.**
Retired
Dunbar, West Virginia
Chuck_huss@hotmail.com

**Behrang Keshavarz, Ph.D.**
KITE Research Institue, University Health Network
Toronto, Canada
Behrang.keshavarz@uhn.ca

**Paul Krajewski, Ph.D.**
General Motors
Warren, Michigan
Paul.E.Krajewski@gm.com

**Mia Levy, M.S.**
HRL Laboratories
Agoura Hills, California
mmlevy@hrl.com

**Gang Luo, Ph.D.**
Harvard Medical School
Boston, Massachusetts
Gang_luo@meei.harvard.edu

**Gerald McGwin, Ph.D.**
University of Alabama, Birmingham
Birmingham, Alabama
gmcgwin@uabmc.edu

**Phillip Olla**
Audacia Bioscience
Windsor, Canada
phillip@audaciabio.com

**Cynthia Owsley, Ph.D.**
University of Alabama, Birmingham
Birmingham, Alabama
cynthiaowsley@uabmc.edu

**Derrick Redding, M.S.**
Betterfrost Technologies
Oakville, Ontario, Canada
derrick@automotivetechnologies.com

## The Eye, The Brain and The Auto Presenters 2022 (continued)

**Matt Rizzo, M.D.**
University of Nebraska Medical Center
Omaha, Nebraska
Matthew.rizzo@unmc.edu

**Sameh Saad, Ph.D.**
Betterfrost and Asahi Glass
Oakville, Ontario, Canada
Sameh.saad@betterfrost.com

**Ulrich Schiefer, M.D.**
Tuebingen University
Aalen, Germany
Ulrich.schiefer@hs-aalen.de

**Manoj Sharma, Ph.D.**
General Motors
Warren, Michigan
Manoj.sharma@gm.com

**Timo Tervo, Ph.D.**
Helsinki Eye Hospital
Finnish Crash Data Institute
Timo.Tervo@kolumbus.fi

**Judith Ungewiss, M.Sc.**
Aalen University of Applied Sciences
Aalen, Germany
Judith.ungewiss@hs-aalen.de

**Alok Warey, Ph.D.**
General Motors
Warren, Michigan
Alok.warey@gm.com

**Michael Woerner, Ph.D.**
Aalen University of Applied Sciences
Aalen, Germany
Michael.woerner@hs-aalen.de

**Joanne Wood, Ph.D.**
Queensland Univeristy of Technology
Brisbane, Australia
j.wood@qut.edu.au

**Jing Xu, Ph.D.**
Envision Research Institute
Wichita, Kansas
Jing.xu@envisionus.com

**Terence Yim,**
Asahi Glass
Ypsilanti, Michigan
Terence.yim@agc.com

**Richard Young, Ph.D.**
Driving Safety Consulting
Troy, Michigan
Richardyoung9@gmail.com

## The Eye, The Brain and The Auto Moderators 2022

**David Goldman, M.D.**
Department of Ophthalmolgy
Henry Ford Health System
Detroit, Michigan
dgoldman@hfhs.org

**Cynthia Owlsey, Ph.D.**
University of Alabama, Birmingham
Birmingham, Alabama
cynthiaowsley@uabmc.edu

**Gerald McGwin, Ph.D.**
University of Alabama at Birmingham
Birmingham, Alabama
gmcgwin@uabmc.edu

**Daniel Rathbun, Ph.D.**
Henry Ford Health System
Detroit, Michigan
Drathbu2@hfhs.org

**Joseph Rizzo, M.D.**
Massachusetts Eye and Ear
Harvard Medical School
Boston, Massachusetts
joseph_rizzo@meei.harvard.edu

**Timo Tervo, M.D., Ph.D.**
Helsinki Eye Hospital
Finnish Crash Data Institute
Timo.Tervo@kolumbus.fi

**Joanne Wood, Ph.D.**
Queensland Universitry of Technology
Brisbane, Australia
j.wood@qut.edu.au

# Thank you to **Bill and Happy Rands** for your support of the **Poster Session** The Eye, The Brain and The Auto World Research Congress

## The Eye, The Brain and The Auto Poster Presenters

**What You Don't See Makes the Difference in an Auto!**

**Tim Cavanaugh, M.B.A.**
Cavanaugh Consulting Group
South Lyon, Michigan
Cavanaughconsulting.tim@gmail.com

**Using Physiological Measures in Combination with Machine Learning to Detect Motion Sickness**

**Behrang Keshavarz, Ph.D.**
KITE Research Institute, University Health Network
Toronto, Canada
Behrang.keshavarz@uhn.ca

**Effects of Different Hazard Warning Modalities and Timings for Older Drivers with Impaired Vision**

**Jing Xu, Ph.D.**
Envision Research Institute
Wichita, Kansas
Jing.xu@envisionus.com

**Will Automated Vehicles be Safer Than Conventional Vehicles?**

**Richard Young, Ph.D.**
Driving Safety Consulting
Troy, Michigan
Righardyoung9@gmail.com

**Biomotion Triggering Driver (In) Attention for Cyclists at Night**

**Paul Hemeren, Ph.D.**
School of Informatics,
University of Skovde, Sweden

**Cynthia Bachofer, Ph.D.**
Texas School For the Blind and Visually Impaired
Austin, Texas

## Uncovering the Hidden Population in Low Vision: A 10-year Look at a Student-parent Program on Driving with Low Vision and its Multiple Benefits

**Purpose:** What personal characteristics suggest a likelihood to pursue a driver's license as a person with low vision? What are the most common reasons given for not pursuing a driver's license? What outcomes not related to driving did participants report through attending the program?

**Methods:** A 15-item instrument was used to collect quantitative and qualitative data on a second cohort of attendees (2017-2022) including characteristics of participants who are pursuing or are not pursuing a driver's license and their perception of positive outcomes in program attendance. Contact information from the sponsoring program database was used to identify respondents (young adult with low vision or a parent) who consented to complete the phone interview. Quantitative and qualitative data was analyzed using excel software for statistical analysis.

**Results:** Over a five-year period (2017-2022) 74 students with low vision (accompanied by a parent) who met state visual criteria to drive attended a three-day workshop sponsored by a specialized school for students who are blind or visually impaired. Year 2021 was excluded due to COVID. Eighty percent (n=59) of the total attendees completed a phone interview. Males were slightly more represented than females in the group. Over twenty different eye conditions were reported and the most prevalent eye condition was oculocutaneous albinism. Acuity levels reported by those who had or were actively pursuing a driver's license were at the best and worst extremes (e.g., 20/50 vs. 20/200) of the visual range for low vision drivers. Nineteen percent (n=14) had acquired their license and 27% (n=20) were in the process (e.g., obtaining bioptic, driving with permit) of seeking a license. Attendees from cohort 1 (2012-2016) who then identified as not driving were again contacted for a final follow-up of six questions. Thirty-one percent (n=20) of this cohort responded. Twenty percent (n=4) of these adults had acquired their driver's license while seven or 35% were pursuing their license.

**Conclusions:** Young adults with low vision face an emotionally complex decision in deciding whether to become a driver or to not drive. Determining personal characteristics of eligible candidates who want to become drivers and positive outcomes noted across participants is necessary to support effective program development. Identifying critical program content most needed to make the driving decision is imperative in designing a quality program.

**Biography:** Cindy Bachofer, Ph.D., CLVT, is the low vision consultant at the Texas School for the Blind and Visually Impaired, Austin, Texas. She completed her doctorate at Vanderbilt University in 2013. The title of her dissertation is Long-Term Use of Optical Devices by Young Adults with Low Vision. She is also a Certified Low Vision Therapist. Her teaching interests include use of optical devices, print reading strategies, and psychosocial issues for students with low vision. She previously served as a teacher of students with visual impairments and as a consultant with Project Providing Access to the Visual Environment (PAVE).

## Presenters

**Robert Beran, M.S.**
Wichita State University,
Wichita, Nebraska

### Preferences of Individuals with Different Levels of Visual Impairment for Autonomous Vehicles

**Purpose:** Autonomous vehicles hold great potential for enabling independent travel for individuals with visual impairment. Preferences and accessibility needs for autonomous vehicles might vary depending on the severity of one's visual impairment. This ongoing study was aimed to investigate the relationship between the severity of visual impairment and the preferences for two aspects of autonomous vehicles: level of automation and mode of interaction.

**Method:** Individuals with visual impairment will participate and complete an online Qualtrics-based survey. The participants will answer questions about their visual impairment, including visual acuity and visual field status. They will then be presented with scenarios depicting vehicles of different automation levels. For each scenario, the participants will be asked about their trust for the depicted vehicle, their comfort level and perceived ability to safely operate the vehicle. The participants will also be asked questions regarding their preferences for different modes (visual, auditory, tactile, etc.) of interaction with the vehicle. For data analysis, participants will be divided into groups based on reported severity of visual impairment (mild, moderate, and profound), and the preferences for automation level and interaction mode will be compared between groups.

**Results:** Data collection is ongoing and will be completed by September. We have a few expectations: 1. Individuals with profound visual impairment will prefer the highest level of automation, while individuals with mild visual impairment will prefer a lower level of automation so that they still retain some control over the vehicle; 2. Individuals with profound visual impairment will prefer non-visual modes of interaction, while individuals with mild visual impairment will prefer the visual mode.

**Conclusion:** The study will reveal what people with different levels of visual impairment prefer when it comes to adopting autonomous vehicles. It will guide future lab studies that assess the safety and user experience consequences of accessibility features in autonomous vehicles and inform the industry on the design of customizable vehicles to suit the needs of individuals with different visual capabilities.

**Biography:** Bob Beran is a graduate student in the Wichita State University Human Factors Psychology program. He is currently working on his master's degree in the program. He received a Master's in Experimental Psychology from Saint Joseph's University. His current research focuses on assistive technology for people with visual impairment with a focus on autonomous vehicles.

Keynote Speaker
**Jacob Bond, Ph.D**
General Motors
Warren, Michigan

Keynote Speaker
**Alok Warey, Ph.D.**
General Motors
Warren, Michigan

## An Introduction to Artificial Intelligence and its Impact on Mobility and Healthcare

Artificial intelligence (AI) has been described as the "New Electricity". It has the power to transform every industry and create huge economic value. AI already powers many of our interactions today – Siri, Alexa, movie recommendations on Netflix, credit card fraud alerts, and many more. These interactions are powered by AI and Machine Learning (ML) using large amounts of data. AI and Machine Learning are also actively being used in the automotive industry for various applications such as Autonomous Vehicles (AVs), engineering simulations, Human Computer Interaction (HCI) and others. Despite the tremendous advancements to AI/ML in the last decade, there remain several challenges to ensuring that AI/ML benefits society at large. It is important to understand the nature of the concerns surrounding ML and how they can arise in practice so that they can be identified and mitigated before they can cause harm. If we are responsible in the way we deploy AI/ML systems, they have the potential to transform many areas of our society, including mobility, accessibility, and healthcare.

**Biography:** Dr. Jacob Bond leads research in trustworthy AI at General Motors R&D. His work aims to ensure AI systems serve to benefit society through robustness, inclusion, and governance. His research focuses on understanding the security and robustness of deep learning models, as well as identifying methods for improving this robustness. In addition, he works to improve the inclusiveness of AI systems for people with disabilities, as well as using ways to use AI to increase accessibility. Finally, Jacob investigates mechanisms for improving accountability and transparency of AI systems.

**Biography:** Dr. Alok Warey is the Lab Group Manager for the Cabin Experience and Safety group at General Motors Global Research and Development. He has published over 50 papers in peer-reviewed journals and conferences. He received his Ph.D. in Mechanical Engineering from The University of Texas at Austin. He was inducted into the Mechanical Engineering Academy of Distinguished Alumni at the University of Texas in 2017.

## Presenters

**Alex Bowers, Ph.D.**
Schepens Eye Research Institute
Boston, Massachusetts

### Pilot Study of a Tactile Hazard Warning Device for Drivers with Impaired Vision

**Purpose:** People with impaired vision are permitted to drive in many states; however, the vision loss may delay responses to hazards. We conducted a pilot driving simulator study to evaluate a prototype hazard warning device as an assistance system for drivers with central vision loss (CVL; reduced visual acuity) and drivers with hemianopic field loss (HFL; loss of half the field of vision), compared to drivers with normal vision (NV).

**Methods:** Subjects included 11 CVL (50 – 66 y; median VA 20/87), 12 HFL (37– 54 y; VA 20/14), and 11 NV (36 – 68 y; VA 20/13). They completed 2 drives with and 2 drives without a custom-designed vibrotactile warning device. In each drive, 10 pedestrian hazards appeared mid-block from either the left or right and crossed the road, requiring a braking response by the driver to avoid a collision. If collision risk (computed continuously) exceeded a pre-defined threshold, the device gave a directional warning of the approaching hazard. Gaze position and driving metrics were recorded at 50 Hz for analysis. The virtual city environment was populated with other distractor pedestrians, crowds, and traffic. Data are reported for events where collision risk exceeded the threshold (80% of all events).

**Results:** Without warnings, CVL subjects were slower to fixate hazards than HFL and NV subjects (CVL 2.4s, HFL 1.3s, NV 0.6s; $p < 0.01$), but HFL subjects had higher collision rates (CVL 11%, HFL 16%, NV 0.4%), especially on the blind side (30% vs. seeing side 1.7%). CVL and HFL subjects received more warnings than NV subjects (86%, 86%, 70%). Warnings had little effect on the time to fixate a hazard, but significantly ($p < 0.001$) reduced the time to the first brake press for both CVL (2.6 to 2.0s) and HFL (2.4 to 2.1s), but not NV subjects (1.8 to 1.7s). For HFL subjects, the reduction was greater ($p = 0.02$) for hazards on the blind (2.9 to 2.3s) than seeing side (2.0 to 1.9s). The warnings significantly reduced collision rates for CVL to 0% for all hazards and HFL subjects to 2% for blind side hazards.

**Conclusions:** Without warnings, CVL subjects were slow to fixate hazards while HFL subjects often failed to see and therefore collided with hazards from the blind side. By reducing the time to initiate a braking response, warnings decreased the collision risk of CVL subjects for all hazards and HFL subjects for blind side hazards. Warnings had no effect on response times for HFL seeing side hazards and NV subjects.

**Biography:** Alex Bowers is an optometrist with a Ph.D. in vision rehabilitation research from Glasgow Caledonian University, Scotland. She is currently Associate Professor of Ophthalmology at Harvard Medical School and Associate Scientist at Schepens Eye Research Institute of Massachusetts Eye and Ear, Boston, Massachusetts, U.S.A. Her research focuses on quantifying the effects of vision impairment on walking and driving in real and virtual environments and evaluating the effects of devices and interventions to assist visually impaired people when walking and driving.

Keynote Speaker

**Tim Cavanaugh, M.B.A.**
Cavanuagh Consulting
South Lyon, Michigan

## What You Don't See Makes the Difference in an Auto

Having just moderated the launch of the Ford Mustang E and Electrify America for Ward's Automotive, I was astonished to learn that the world only has enough Lithium for 15 to 17 years. It's what we don't see that makes the difference in an automobile. If you can wrap your head around the short lifecycle of Lithium with all the infrastructure that will take place with charging stations and used car sales with a battery that doesn't hold a charge, then maybe you'll be ready for the future. If you are a forward thinker, Hydrogen Fuel Cells are the way of the future using "Green Hydrogen." Hyzon Motors out of Australia builds Class 8 Semitrucks. Hyzon uses Compressed Hydrogen Fuel Tanks that use the same space as Diesel Fuel Tanks yet go six times the distance. Refueling the semitrucks takes the same amount of time as filling the diesel tanks. So, who had the foresight to think about Hydrogen? California, Arizona and Nevada in the United States. But it started with Japan, South Korea, Taiwan and China. In 2006, China took over emission leadership of CO2 from the United States of America. Under the Paris climate deal reached in 2015, China pledged that its emissions would peak around 2030. The Chinese Government order all vehicles to be Zero Emission by 2030. Then China bought or leased all the Lithium mines around the world in order to meet the volume they needed by 2030. Japan immediately saw what China was doing and switched their focus onto Hydrogen. The rest of Asia including China, followed suit. Today, Green Hydrogen is popping up everywhere. But what about the United States of America? Our concentration on Lithium has taken our eye off the future market. As an example, BMW has already validated and certified their first Hydrogen Fuel Cell Vehicle. General Motors, Ford and Stellantis are still focused on battery electric vehicles with charging stations. The Asians are currently selling anywhere between 35 – 45 % of the US's vehicles and they are ready to market with Hydrogen Fuel Cell Vehicles that have been tested and certified. The US Manufacturers will lose significant market share. Currently, the Hydrogen Highway is being built across the United States. It has run through California, Arizona and Nevada and will continue across the country to New York. Companies like BayoTech and Cummins have already taken steps to change the way they do business. What are you doing? Watching for gas prices to come down? Or waiting for a full charge?

**Biography:** Tim has an MBA from St. Edward's University in Austin, TX, in Finance and Marketing with a Bachelor's in Business Degree from Northwood University in Midland, MI. He is a sport pilot, a hot-air ballooner, a true car guy, avid downhill skier and a global tech savvy leader.

## Presenters

**Jun Ha Chang, Ph.D.**
University of Nebraska Medical School
Omaha, Nebraska

### Naturalistic Driving Metrics for Predicting Rheumatoid Arthritis Disease Status

**Objectives:** Rheumatoid Arthritis (RA), which affects up to 1% of adults, causes motor dysfunction that may impair driving and quality of life. Drivers may adopt compensatory strategies, like reducing driver mobility, to improve safety. These may reduce road risk exposure yet reduce social engagement and quality of life. Objective indices of driver mobility may provide objective metrics that link to clinical, RA disease severity to inform clinical provider's treatment, as addressed in this pilot analysis.

**Methods:** Study Design: Each driver participated in a longitudinal study for 2, 1-month periods separated by two months. This analysis used cross-sectional data collected during the first period. Drivers: Sixty drivers with RA (N = 32) and controls without RA (N = 28) participated. In-vehicle devices were installed in drivers' own car, collecting driving data for four weeks. RA Disease Severity: RA disease severity was assessed using the Health Assessment Questionnaire (HAQ)-II, which collects self-reported ratings of daily, physical functioning disability (range 0-3, higher scores are worse). Driving Outcomes: Driver mobility was defined as, on average per day, the 1) number of drives (4.30 ± 1.66) and 2) distance driven (29.17 ± 17.53 miles). Models used Poisson regressions and mixed-effect linear regressions adjusting for age, sex, education, employment, and season.

**Results:** Our RA drivers had mild-to-moderate physical difficulty (HAQ-II 0.83 ± 0.56) and drove 4,179 drives (32,009 miles). RA drivers overall drove fewer times per day than controls (IRR = 0.931, p = .015). RA drivers with worse disease impact (higher HAQ-II) drove less often than RA drivers with less disease impact (IRR = 0.928, p < .001). RA did not affect how many miles a person drove, compared to controls (b = 0.255, p = .130). RA disease impact (HAQ-II) did not affect miles driven (b = -0.149, p = .195).

**Conclusions:** These pilot results provide new-to-field, novel data illuminating how RA affects real-world driver mobility. Results suggest that how often an RA patient drives is a more sensitive indicator of RA disease overall and worsening disease impact than distance driven. Pilot results show the feasibility of using driving data as a digital biomarker of disease impact to aid providers in management and track disease progression.

**Biography:** Jun Ha Chang received her Ph.D. in cognitive psychology from the University of Massachusetts Amherst in 2020. She is currently working as a Post-Doctoral Research Associate in the Department of Neurological Sciences at the University of Nebraska Medical Center. Her research focuses on quantifying the real-world driving, health, and daily activity behavior like sleep to measure and predict disease progression and severity in individuals with neurodegenerative diseases like Alzheimer's and Parkinson's.

**Cornelius Howard Darcy, Ph.D.**
Flint, Michigan

## Selling Technology: Influencing Perceptions of Autonomous Vehicles

**Purpose:** Selling Technology is structured around two research questions:
RQ1: What strategies are used by the automotive and tech industries to influence the perceptions of new, disruptive forms of mobility?
RQ2: How do the automotive and tech industries see perceptions of disruptive mobility technologies affecting communities?

Methods: This study of SAE levels four and five vehicles utilized a sequential mixed methods approach comprised of an online survey that generated data for quantitative analysis. The survey and associated data informed the development of an interview guide to support a deep investigation of specific survey topics. Survey respondents were recruited through industry digital channels. Interview participants were recruited through the researcher's personal network.

Results: Survey respondents shared their perceptions of AV benefits associated with perceived usefulness and perceived ease of use and expectations for the technology including anticipated market timing and pricing. Respondents confirmed the strategic need for influence, their in-depth preferences for forms of influence and moderated content, and detailed perceptions of anticipated effects AVs may have on urban, suburban, and rural environments.

The interviews reveal a sense of disillusionment within the industry associated with a series of AV setbacks in 2018, a need to complete the mission of developing functional AVs, and the importance of improved perceptions of AVs. The interview data reveals the existence of industry influencer strategies, specifically, Tesla as a primary influencer both as a brand and in the person of the CEO, Waymo's annual safety report and the formation and ongoing work of Partners for Automated Vehicle Education (PAVE).

**Conclusion:** Industry sees AVs as potentially disruptive, is using strategies to influence perceptions of AVs, and has an awareness of how AVs may affect communities. Survey respondents strongly endorsed the need for informational and educational material and shared preferences for the types of engagement and content they see as most effective in influencing perceptions of AVs. Interview respondents reinforced the importance of influence on AV perceptions and provided evidence in the form of opinion leadership and moderated content.

**Biography:** Cornelius Darcy is a May 2022 graduate of Michigan State University with a Ph.D. in planning, design, and construction. He also holds an MBA and an MA in international affairs from Washington University in St. Louis. Prior to full-time studies at MSU, Dr. Darcy held sales and marketing managerial positions in technology and educational organizations. Dr. Darcy's research interests include disruptive technologies, automated driving, smart cities, communications theory, and technology adoption.

# Presenters

**Patrick Droste, M.S., M.D.**
Ophthalmologist
Grand Rapids, Michigan

## Resolution to American Medical Academy on Driver's License Restrictions for Visually Impaired Citizens

The current guidelines for visual acuity and visual fields were adopted by the American Medical Association (AMA) between 1920-1930. These guidelines restrict visual acuity to 20/50 in the better seeing eye and visual fields to greater than 110 degrees. Studies have shown that visual acuity between 20/50-20/80 is safe in daylight and nighttime conditions.

There is currently a resolution before the American Medical Association to re- study these guidelines with input from vision specialist and National Highway Safety Commission and leaders from the AMA, and American Academy of Ophthalmology, and American Academy of Optometry.

The purpose of this presentation is to obtain new information from scientists involved with The Eye, The Brain, and The Auto Symposium that can be used to strengthen the argument and in favor of passing the resolution for "Reform in Visual Acuity Requirements for Drivers Privileges" that will be presented to the American Medical Association House of Delegates (AMA-HOD), to be held in November 2022.

**Biography:** Dr. Droste is a Clinical Professor of Ophthalmology and Neurology at Michigan State University Schools of Human and Osteopathic Medicine, practicing pediatric ophthalmology and strabismus in Grand Rapids for 35 years. He graduated from Wayne State University School of Medicine in 1980. He completed his internship and ophthalmology residency at Henry Ford Hospital from 1980-1985. He served as the first clinic director for the Ophthalmology Residency Program at William Beaumont Hospital in Royal Oak from 1985-1986. This was followed by a Pediatric Ophthalmology and Ocular Motility fellowship at Indiana University, Indianapolis, Indiana. Dr. Droste is the past president of the Kent County Medical Society, Michigan Society for Eye Physicians and Surgeons and Ophthalmology and Division Chief for Butterworth Hospital for 10 years. He has presented internationally and nationally on a variety of subjects including retinopathy of prematurity, pediatric glaucoma, paralytic strabismus and learning differences. He is an active participant in the Pediatric Eye Disease Investigator Group (PEDIG) with numerous publications. In addition, he has been an active member on a variety of committees for the Academy of Ophthalmology, the American Academy of Pediatric Ophthalmology and Strabismus and Michigan Society of Eye Physicians and Surgeons. For the past 35 years, he has been involved legislatively with the Michigan State Medical Society in writing resolutions and promoting legislation pertinent to Ophthalmology. He represents the Michigan Society of Eye Physicians and Surgeons and Kent County Medical Society as a delegate in the Michigan State Medical Society. In his free time, Patrick plays on a men's ice hockey league, loves gardening and spending time with his grandchildren.

Keynote Speaker
**Jennifer Dukarski, J.D.**
Butzel Long Law
Ann Arbor, Michigan

## Beyond "HIPPA in the Car": The Real Impact of the Law on Automotive Biometric Data

JENNIFER A. DUKARSKI is a Shareholder based in Butzel Long's Ann Arbor office, practicing in the areas of emerging technology, media and intellectual property. She focuses her practice at the intersection of technology and communications, with an emphasis on the legal issues arising from emerging and disruptive innovation: including biotechnology, product safety, the internet of things, privacy, cybersecurity, blockchain, autonomous vehicles and mobility. Jennifer leads clients in securing and protecting technology through transactions and litigation.

Jennifer has assisted clients in multiple industries in evaluating compliance issues in blockchain and cryptocurrency, cloud computing, big data, autonomous technology, connected devices, telehealth, artificial intelligence and data breaches. She advises on compliance with the European Union General Data Protection Regulation (GDPR) as well as state and federal privacy and security regulations and law.

She co-authored the Healthcare Licensing Manual for the State Bar's Healthcare Law Section to assist individuals in navigating the licensing and disciplinary processes in Michigan. She is a national panelist on the topic of data protection in health care with an emphasis on HIPAA/HITECH, health IT and E-Health. Prior to joining Butzel Long, Jennifer advised Health Legislative Aids (HLA's) for the Michigan delegation in the United States House of Representatives and the Senate on arthritis initiatives. Working as a design engineer, Ms. Dukarski received multiple Record of Invention Awards for contributions to patents and trade secrets. She is a Six Sigma Master Black Belt.

She earned her B.S. degree in Mechanical Engineering, summa cum laude, from the University of Detroit Mercy College of Engineering and Science and her J.D. degree, magna cum laude, from the University of Detroit Mercy School of Law where she now teaches a course on the societal impacts of autonomous vehicles and the changing nature of mobility. Ms. Dukarski is a member of the American Bar Association and is the Co-Chair of the Women in Communication Law Committee of the Forum on Communication Law. She has been named a Rising Star by Super Lawyers, a Best Lawyer in America and a Top Lawyer by "dBusiness." She is also senior member of the Institute of Electrical and Electronics Engineers, where she is on the team developing standards for analyzing "fake news."

## Presenters

**Yamin Faraji, M.D.**
Amsterdam University Medical School
Amsterdam, Netherlands

### TREYESCAN: An Eye Tracking and Hazard Viewing Test for Driving with Visual Field Defects

**Purpose:** A reliable screening method for persons with visual field defects is essential for safe mobility. Presently, the Esterman binocular is mandatory in the Netherlands, but this static perimetry requires the patient's gaze to be fixated and does not measure compensatory viewing-skills needed for dynamic traffic-situations. Research on this subject is important, as the prevalence of age-related visual field disorders and the number of older drivers is rising due to a prolonged life expectancy. The aim was to develop the TREYESCAN (Traffic-eye-scanning-&-compensation-analyzer), which measures compensatory viewing with head and eye movements.

**Method:** The TREYESCAN is designed in collaboration with experts operating within ophthalmology, visual rehabilitation, mobility, and driving license administration. The Pupil Core eye tracker measures the gaze, whilst traffic videos are presented with a 100° field of view and head movements are permitted (Fig. 1). Traffic scenes were recorded in real life traffic from a driver's perspective and presented to experts to define relevant areas of interest (AOI). Analysis software was developed to determine the location of these AOIs, and to relate the gaze to these AOIs. We conducted a validation study to verify the developed tools, and a pilot study to select scenes for the TREYESCAN.

**Results:** The analysis software was tested in persons without visual field defects (n=11). Participants were asked to view 13 AOIs in traffic scenes (Fig. 2) from appearance to disappearance. For most followed objects (11/13), the calculated median dwell time percentages were around 90%, which showed the validity of the setup and software. Subsequently, in a pilot study traffic scenes were shown to persons without visual field defects (n=20). Based on the experience and viewing behavior of these individuals the best scenes were chosen to include into TREYESCAN.

**Conclusion:** The TREYESCAN will be used in a case-control study, in which compensatory eye movements of glaucoma patients will be measured and compared to normal-sighted individuals. We expect to discover if patients with glaucoma demonstrate sufficient scanning behavior and compensatory eye movements for mobility demands.


*Figure 1. TREYESCAN setup.*

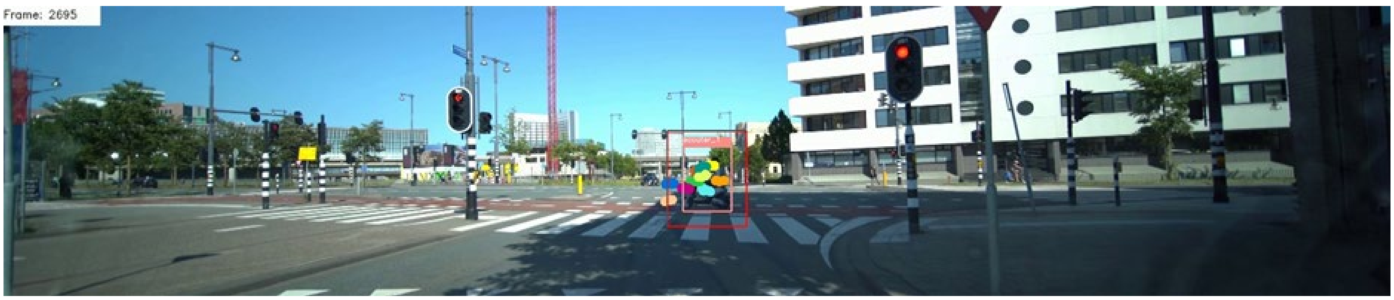



*Figure 2. Each dot represents the gaze of a participant on this frame of the validation task. The AOI bounds with applied margins are depicted with rectangles.*

**Biography:** Yasmin Faraji (Sari, 1995) graduated in 2019 as a medical doctor from the VU University Amsterdam. She worked as a medical doctor in the ophthalmology department of the Jeroen Bosch hospital in den Bosch. In 2020 she started her Ph.D.-research at Amsterdam UMC, titled: "Development of Treyescan: Safe driving for glaucoma patients with compensatory eye movements". The primary subject of this research project is the development of a test that measures compensatory eye movements of glaucoma patients whilst viewing scenes of traffic situations. Yasmin aims to provide a positive contribution to the difficulties that persons with visual impairments are challenged with on a daily basis, especially in the area of mobility. After her Ph.D., she will take part in the ophthalmology residency program of Amsterdam UMC.

## Presenters


### Poster Presenter

**Paul Hemeren, Ph.D.**
University of Skövde, Sweden
Skövde, Sweden


## Biomotion Triggering Driver (In)Attention for Cyclists at Night


**Abstract:** Background: Visual Aids
Reflector placement on critical parts of the human body increases the visual conspicuity of cyclists at the daytime and night.

**Questions:** What differences in detection distance if any, do drivers experience in the visibility of cyclists wearing: reflector placement in the biomotion-enhancing pattern, standard vest pattern, no reflective material.

**Results:** Number of correctly detected cyclists as a function of reflector placement and route position is shown on poster table. Different reflector conditions varied as a function of position along the route.

**Conclusions:** Biomotion patterns significantly increase conspicuity and detection in most cases.
Vest is marginally better than no reflecting material.
Driver disattention of cyclists is reduced by reflector material that reflects biological motion.


**Biography:** Paul Hemeren is an associate professor in informatics at the University of Skövde and was recruited as a cognitive scientist to the University of Skövde where the subject area of informatics includes cognitive science for the development of computational models of intelligence and to improve the interaction between humans and different kinds of technology. His Ph.D. in Cognitive Science is from Lund University. In his research, he looks at how we form concepts for things. More specifically, he examines how we perceive other people's movements in the form of different actions. Humans and other creatures have an amazing ability to quickly perceive what others are doing. How does this happen? What information is used to perceive another person's intentions in an action or movement? One side of his research is about how we organize our knowledge of other people's and our own actions. The other side is on how movement information in connection with the actions of others is processed in the human brain. An important aim of his research is to integrate these two sides to gain a broader and deeper understanding of how we perceive our interaction with others. These questions turn out to be important inputs for more applied projects about how we can create safer situations for cyclists and how we can achieve a better interaction between humans and robots.

**Chuck Huss, COMS,**
Driver Rehabilitation Specialist
Dunbar,West Virginia

## Bioptic Driver Training and Testing: Similarities and Differences Across the United States

**Purpose:** To provide information re the similarities and differences in current bioptic driver training, driver testing and licensure practices across the United States.

**Method:** A bioptic driving survey questionnaire was sent out nationwide (August 2019 – April 2020) to direct services providers (i.e., driving instructors and eye care professionals) involved in the provision of bioptic driving related services. The questionnaire covered: visual and other criteria used as part of the application for bioptic driving services and licensure; types, hours or mode of delivery of bioptic driver training services; types of road testing for driver licensure; driver licensure renewal requirements; types of driving restrictions; and duration of time prior to removal of restrictions.

**Results:** Since dissemination (August 2019), forty-six (46) survey-questionnaires were completed and returned from 33 driver education/driver rehabilitation professionals and 13 eye care specialists, representative of thirty-two (32) states. A sampling of results follows:

1. 97% of states allow the use of bioptics for visual assistance in the driving task.
2. 9 to 1 ratio of states allowing bioptic driving with 20/80 or worse best corrected visual acuity (BCVA) through the carrier lens(es) versus states requiring 20/70 BCVA or better
3. 3 to 1 ratio of states requiring minimum horizontal fields of view between 90 -150 degrees versus states with no required minimums through 70 degrees horizontal field of view for driving purposes
4. 7 to 1 ratio of the number of states that allow use of binocular or monocular mounted bioptic lens systems versus states that only allow monocular mounted bioptic lens systems as driving aids
5. 3 to 1 ratio of states that require or recommend behind-the-wheel training versus those states that do not before application for driver licensure
6. Bioptic driver's training services are offered: sequentially in ten (10) states, concurrently in seven (7) other states, and either sequentially or concurrently in seven (7) other states.
7. Slightly less than a 3 to 1 ratio of the number of states that do not versus do require special on-road testing; that is longer, more in depth, and more challenging for bioptic driver applicants seeking driver licensure.
8. Slightly greater than a 2 to 1 ratio of states that allow a duration of 2 or more years for bioptic driver licensure versus states that require annual renewal of such driving privileges.

**Conclusions:**

1. Despite allowance in most states, the vision requirements, type and extent of services and licensure requirements of bioptic driving vary widely from one state to the next.

## Presenters

2. Findings suggest future research comparing driving performance and accrued driving records of bioptic drivers: trained vs. non-trained; trained in a sequential vs. concurrent manner; or restricted to daytime driving only vs. earned unrestricted driving privileges.

**Biography:** Mr. Huss received his Master of Arts degree in Orientation and Mobility from Western Michigan University, Kalamazoo, MI in 1976. He has worked as an Academy-certified Orientation and Mobility Specialist (COMS) in both the private and public sectors of Ohio and West Virginia for the past 45 years, serving clients or students, K through geriatrics. Mr. Huss is nationally known for his work and experience in formalized bioptic driver training and assessment. He served as one of the driver rehabilitation specialists within the West Virginia Pilot Low Vision Driving Study ('85-'88), its continuum of related services ('89-'08) and its full-time West Virginia Bioptic Driving Program ('09-'22). Mr. Huss also served on a multi-disciplinary Bioptic Driving Work Study Committee, '16-'21, which resulted in the passage of Pennsylvania HB 2296 (bioptic driving bill), November '20; and has since assisted in the in-service staff training of 60+ professionals now involved in the provision of formalized biopic driving services statewide in Pennsylvania, starting Sept.'21. Prior to his retirement (1/05/22), his full-time employer for the past thirty-nine (39) years has been the West Virginia Division of Rehabilitation Services (WVDRS).

Poster Presenter
**Behrang Keshavarz, Ph.D.**
Kite Research Institute
Toronto, Canada

## Comparing motion sickness in a high-fidelity driving simulator during manual and automated driving in older adults

**Abstract:** Fully automated vehicles promise to improve on-road safety and to ensure more efficient traffic flow. Older adults, in particular, may benefit from fully automated vehicles to support their independence and mobility even if they are no longer physically fit to drive. Unfortunately, motion sickness, characterized by symptoms such as nausea, disorientation, and/or fatigue, is especially pronounced in passive vehicle passengers compared to drivers who actively control the vehicle; as such, it has been speculated that automated vehicles may in fact exacerbate the risk of motion sickness. In the present study, we compared the severity of motion sickness in older adults during manual and fully automated driving in a high-fidelity driving simulator with physical motion cues provided by a hexapod motion platform. Thirty-nine older adults (>65 years; 16 females) participated in 6 simulated driving sessions with different weather and traffic conditions under manual and fully automated driving modes. Motion sickness was measured using the Simulator Sickness Questionnaire before and after each drive. Our results showed that motion sickness severity was significantly higher in female compared to male participants, but no differences between manual and automated driving modes were found after the drives. Our findings are encouraging and suggest that fully automated vehicles may not cause more motion sickness in older adults than traditional, manually driven vehicles.

**Biography:** Dr. Behrang Keshavarz is a Scientist at The KITE Research Institute–University Health Network and an adjunct Professor with the Department of Psychology at the Toronto Metropolitan University. His research combines Virtual Reality (VR) technologies with traditional behavioural, physiological, and neuro-cognitive measures to investigate human cognition, perception, and performance. Dr. Keshavarz's research focuses broadly on Human Factors with a specific emphasis on (visually induced) motion sickness, the sensation of self-motion in VR (vection), and topics related to driving simulation. Overall, his research has a strong applied component and provides a balance between theory and application.

## Presenters

**Behrang Keshavarz, Ph.D.**
Kite Research Institute
Toronto, Canada

### Using Physiological Measures in Combination with Machine Learning to Detect Motion Sickness

**Poster Abstract:** Motion sickness is a common sensation when travelling or when using virtual reality applications such as driving simulators, resulting in nausea, disorientation, fatigue and a variety of other symptoms. To date, an objective method to reliably detect motion sickness is missing. Here, we combined Machine Learning techniques with various physiological measures (ECG, EDA, EGG, respiration, body/facial skin temperature, body movements) to detect the severity of motion sickness in real-time. Forty-three healthy younger adults (25 female) were exposed to a motion sickness-inducing video while the severity of motion sickness was recorded using the Fast Motion Sickness Scale (FMS) and the Simulator Sickness Questionnaire. Overall, 31 participants (72%) experienced motion sickness in the present study. Results showed that changes in facial skin temperature and body movement had the strongest relationship with motion sickness. On a minute-by-minute basis, Machine Learning models revealed a medium correlation (r = .43) between the physiological measures and the FMS scores. An acceptable classification score (ROC = .75) distinguishing between sick and non-sick participants was found. Our results suggest that physiological measures may be helpful for measuring motion sickness, but that they are not a reliable standalone method to detect motion sickness severity in real time.

**Biography:** Dr. Behrang Keshavarz is a Scientist at The KITE Research Institute–University Health Network and an adjunct Professor with the Department of Psychology at the Toronto Metropolitan University. His research combines Virtual Reality (VR) technologies with traditional behavioural, physiological, and neuro-cognitive measures to investigate human cognition, perception, and performance. Dr. Keshavarz's research focuses broadly on Human Factors with a specific emphasis on (visually induced) motion sickness, the sensation of self-motion in VR (vection), and topics related to driving simulation. Overall, his research has a strong applied component and provides a balance between theory and application.

**Paul Krajewski, Ph.D.**
General Motors Research and Development
Warren, Michigan

## Global Human Body Modeling: Vision and Opportunities

**Abstract:** The automotive industry has set aggressive targets for 100% virtual validation which requires very accurate models for both the vehicle and the vehicle occupants. In support of this vision, GM has led a large industry consortium to produce a biofidelic virtual human body model. This model will become more important as the industry moves to autonomous vehicles and alternate seating positions which can be more accurately modeled with such a model. In addition, the human body model will allow better understanding and prediction of human injuries during vehicle crash events. This talk will first introduce the human body model and then talk in more detail about how it can be used to specifically look at head and brain injuries, and hopefully lead to a larger discussion on how this information can be useful to the EBA community.

**Biography:** Dr. Paul E. Krajewski is the Director of the Vehicle Systems Research Lab at the General Motors Global Research and Development Center. His laboratory is responsible for R&D in a variety of areas including Interior and Safety Systems, Autonomous Driving, Connectivity, User Experience, Cybersecurity, Displays, and Electrical Architecture. Paul also represents GM as the USCAR Leadership Group Director, as a JOG member for USDRIVE, and as the Technical Director for HRL Laboratories. He received his bachelor's and Doctorate in Materials Science and Engineering from the University of Michigan. Dr. Krajewski has over 75 publications and has been awarded 54 US Patents. He is a Fellow of ASM International and a member of the National Academy of Engineering.

## Presenters

**Mia Levy, M.S.**
HRL Laboratories
Agoura Hills, CA

### Passenger Emotional State Assessment using Physiological Sensors in Autonomous Vehicles

**Background:** In autonomous driving research, it is important to assess the emotional state of passengers in order to gauge their comfort level and trust of the autonomous system. Numerous potential physiological sensors exist to detect emotional state but using a large number of sensors is oftentimes impractical and uncomfortable for drivers.

**Purpose:** Our core objectives are to (1) identify the most informative subset of sensors for indicating emotional state in passengers to reduce the number of required sensors, and (2) validate that a machine-learning (ML) model can be trusted to detect passenger emotional state.

**Methods:** We studied the emotional responses of passengers in a simulated driving environment to a variety of potentially stress-inducing stimuli, such as motorcycles cutting into the passenger's lane. We collected eye tracking, electroencephalogram (EEG), Galvanic Skin Response (GSR), heart rate, and Functional Near-Infrared Spectroscopy (fNIRS) signals from subjects. First, we visualized individual physiological signals using traditional signal processing techniques such as low pass filtering, wavelet filtering, and z-scoring to determine which signals showed a noticeable difference during the stressful driving events. Next, we trained a Long Short-Term Memory Network (LSTM) using the physiological sensor data to detect stressful events, and applied Shapley Additive Explanations (SHAP) to visualize which signals contributed the most to the LSTM's detections.

**Results:** We confirmed that gaze location, pupil size, and GSR provided the most significant responses. We also confirmed that the signals with the highest importance in SHAP were the same signals that appeared to be important in our initial assessment.

**Conclusions:** This result indicates that the LSTM is as trustworthy as traditional signal processing techniques for detecting emotional state. By selecting a subset of sensors, we can streamline analysis for lower latency and computational cost in real-time use cases and improve passenger comfort. This work also demonstrates that the ML model is as trustworthy as traditional signal processing techniques, which may provide a framework for developing deployable emotional state detection and prediction models.

**Biography:** Mia Levy received a B.S. and M.S. in Electrical Engineering with a specialization in signals and systems from the University of California, Los Angeles. She is a research scientist at HRL Laboratories and has worked on human-machine teaming, explainable AI, and autonomous driving algorithms. Her research interests include autonomous driving, machine learning, and neuroscience.

**Gang Luo, Ph.D.**
Harvard Medical School,
Boston, Massachusetts

## How Bus Drivers Keep Distance From Obstacles When Braking – A One-year Naturalistic Driving Study

**Objective:** Safety distance is an essential concept in driving. Quantification of safety distance are important for driving safety research and automated emergence braking in vehicle design. By analyzing the braking behaviors of bus drivers, this study investigated if time-to-collision (TTC) can be used to quantify safety distance.

**Methods:** A collision detection system was installed on a bus operated by 5 drivers alternately. The system calculates TTC based on relative motion between a camera and objects (stationary or moving). A liberal TTC threshold was set to trigger saving of event data log. For a recorded event, the shortest TTC during the event, shortest gap between the camera and obstacles, and largest deceleration required to avoid collision are extracted. Data collapsed across all drivers were collected for 12 months. Total mileage was 68,262KM.

**Results:** In total 19678 events were logged. There was no accident according to bus company's record. The correlation between the shortest TTC and speed was very weak (R2=0.08). With speed stratified into 8 bins from 0 to 40 KMH, the median and 97.5% percentile of shortest TTC for each bin were calculated. It was found that the median of shortest TTC was almost constant, 1.97 seconds (linear regression with speed not significant p=0.07), but the 97.5% percentile TTC linearly increases with speed (R2=0.91). The median of shortest gap to obstacles linearly increases with speed (R2=0.98), e.g. 11.8m gap at speed 25KMH, 20m gap at speed 40KMH. While the 97.5% percentile of required deceleration linearly increases with speed (R2=0.99), the actual deceleration during the events did not increase monotonically. Based on the actual speed drop, the largest deceleration occurred when speed was about 17KMH, and the deceleration was much smaller when speed was above 25KMH. Videos show that the higher speed events were usually pulling over or lane changing maneuvers, and the drivers typically steered away rather than braking. Obstacles include vehicles, pedestrians, plants, road barriers.

**Conclusion:** In city driving (speed limit 40KMH), the bus drivers kept a nearly constant safe distance based on TTC (1.97 second) when braking, regardless driving speed. The inconsistency between required deceleration and actual deceleration suggests that the required deceleration or TTC alone is not very predictive of risk events. Further scenario understanding is needed in order to identify the true risk situations in bus transit.

**Disclosure:** The data were collected using a prototype collision warning device developed by Toramon Ltd based on one of author's patents.

**Biography:** Gang Luo received the Ph.D. degree from Chongqing University, China, in 1997. In 2002, he finished his post-doctoral Fellow training at the Harvard Medical School, where he is currently an Associate Professor. His primary research interests include basic vision science, image processing, and technology related to driving assessment, driving assistance, low vision, and mobile vision care. He has published more than 100 peer reviewed papers. He was the recipient of the William Feinbloom award presented by American Academy of Optometry in 2021.

## Presenters

**Gerald McGwin, Ph.D.**
University of Alabama, Brimingham
Birmingham, Alabama

### Vision Screening for Motor Vehicle Collision Involvement Among Older Drivers

**Objective:** To evaluate the epidemiologic association between visual acuity and other measures of visual function and motor vehicle collisions (MVCs) as well as their performance as screening tests for MVCs.

**Design:** Prospective cohort study.

**Participants:** 2,000 licensed drivers aged 70 years and older who resided in the environs of Jefferson County, Alabama.

**Methods:** Visual acuity, contrast sensitivity, Useful Field of View (UFOV), Motor-Free Visual Perception test (MVPT) and visual field sensitivity were measured at a baseline visit. Study participants were followed for up to four years for the occurrence of MVC involvement. Area under the curve (AUC), sensitivity and specificity were calculated to determine the screening performance of each visual function measure with respect to MVC occurrence. Poisson regression was used to estimate rate ratios (RRs) for the association between each visual function measure and MVC occurrence.

Main Outcome Measures: Police-reported MVCs.

**Results:** For all visual function measures, the AUC values were only slightly higher than 0.50; additionally, none of the measures exhibited adequate values for both sensitivity and specificity (i.e., >80%). For all visual function measures except visual acuity, there were statistically significant positive RRs for the association between vision impairment and MVC occurrence, though the magnitude of the associations were weak (i.e., <2.0).

**Conclusions:** The negative impact of involuntary driving cessation on mobility and the associated mental health implications likely outweighs the safety benefit of vision screening. Alternative approaches to improving older driver safety should be considered.

**Biography:** Dr. McGwin is vice chairman and professor in the **UAB Department of Epidemiology** and holds a secondary appointment in the Department of Ophthalmology and Visual Sciences, where he currently serves as the associate director for the UAB Clinical Research Unit. Additionally, he holds secondary appointments with the **UAB Department of Surgery** and the **Birmingham Veterans Affairs Medical Center.** Dr. McGwin is also director of advanced enterprise analytics for UAB Health System and the biostatistics, epidemiology, and research design component of the **UAB Center for Clinical and Translational Science.** Dr. McGwin has authored or coauthored over 450 peer-reviewed manuscripts, with an emphasis on the epidemiology of injury, aging, eye disease and vision impairment and systemic lupus erythematosus.

**Phillip Olla, Ph.D.**
Audacia Bioscience
Windsor, Canada

**Arezoo Emadi, Ph.D**
University of Windsor,
Canada

## Volatolomics of Breath as an Emerging Frontier for Wellness Screening in Autonomous Vehicles

**Objectives:** The objective of our research is to develop a conceptual framework for a passive exhaled breath analysis platform. The system is designed to be embedded within an autonomous or semi-autonomous vehicle, monitoring and categorizing exhaled breath in real-time. Our presentation will identify the 5 layers of the framework that are pertinent to designing a secure, robust, open, and configurable architecture.

**Methods or Design:** There is accumulating evidence of the significant improvement in survival rates and clinical outcomes when diseases or drug abuse are diagnosed at early stages. Nonetheless, it is a major clinical and engineering challenge to easily detect medical conditions, drug or alcohol in a nonintrusive manner. The key inhibitors to deploying a breath analysis solution can be categorized into five distinct layers: electronic sensors, breathomic biomarkers, Artificial Intelligent (AI) modules, network and security, and use interface.

**Results:** The presentation will present results from each of the 5 layers of the framework and discuss mechanisms to integrate the data into the car infrastructure. The sensor data presented is from 4 or 6 multi array sensors capable of detecting diverse Volatile Organic Compounds (VOCs) relevant to a specific use case. A key challenges of breath analysis is the lack of knowledge regarding which exhaled compounds and levels constitute normal or problematic vales. Another challenge is the lack of standardization of collection and analysis of compounds. Our framework will present a solution for rapid literature analysis of breath compounds that either originate from within the body (endogenous VOCs) or from external sources such as environmental exposure, diet, and prescription drugs (exogenous VOCs). We will also explore the potential viability of the use of the vehicle as an intelligent breath sensing chamber. The AI layer addresses 2 key challenges, pattern recognition of the multidirectional VOC from the sensor array, and the determination of VOC profiles from the sensors for biomarker determination. The network and security layer focuses on the technology infrastructure to securely transmit the data from the sensors to the in-vehicle control use and access the secure cloud infrastructure.

**Conclusion:** In conclusion, we review the advantages and disadvantages of our passive sensing approach in relation to the existing in vehicle breath initiatives. To illustrate the potential use of the system we will highlight viable use case that provide societal benefits. In addition, we deliberate the different design approaches used and recommend a "multi-layered bottom–top" model, from sensor to application, required to move this important innovation forward in a collaborative, open and transparent way.

## Presenters

**Biography:** Dr. Phillip Olla is the CEO of Audacia Bioscience, a Biotechnology company incorporating breath biomarkers, Artificial Intelligence and smartphone technology to transform clinical diagnostics. Prior to founding Audacia Bioscience, he served 15 years as a Professor of Health Informatics and the Executive Director of the Center for Research at Madonna University, Michigan USA.

**Biography:** Dr. Arezoo Emadi is an Associate Professor in the Department of Electrical and Computer Engineering. She received her Ph.D. degree from the Department of Electrical and Computer Engineering at the University of Manitoba and her Licentiate Degree from the Department of Microtechnology and Nanoscience at the Chalmers University of Technology in Sweden. She is a Senior Member of IEEE and a Professional Engineer. Dr. Emadi's research activities revolve around the area of Micro Electromechanical Systems (MEMS), medical MEMS sensors and transducers, bio and chemical sensors, advanced diagnosis sensor technologies, micro and nano electronic devices and fabrication and medical imaging systems.

**Cynthia Owsley, Ph.D., M.S.P.H.**
Director Clinical Research
Department of Ophthalmology and Visual Sciences
University of Alabama at Birmingham
Birmingham, Alabama

## Older Adults' Person Abilities about Vehicle Dashboard Designs and Their Association with Vision

Co-authors: Thomas Swain, Gerald McGwin Jr., Scott Snyder, and Thomas Seder

**Objectives:** We are motivated to identify ways vision and cognitive scientists can facilitate automotive manufacturers' engineering and design of vehicles for older drivers. Older adults are the fastest growing group of drivers in the US both in terms of annual mileage and the number of current drivers. Here we summarize a research program to (1) identify older drivers' attitudes about instrument cluster ("dashboard") designs; (2) develop a survey obtaining information from older drivers about preferences (person abilities); and (3) use a population-based study of older drivers to examine associations between their visual function and their person abilities from the survey.

**Methods:** We used 8 focus groups of older drivers ages 66 – 92 years old (N = 54) using a multi-step content analysis methodology, where participants generated comments on gauges, knobs/switches, interior lighting, color, lettering, symbols, location, entertainment, GPS, cost, uniformity, and getting information. The results guided our development of a survey of statements on dashboard design using a Likert-scale ("Definitely True" to "Definitely False") which was administered to 1,000 older drivers ≥ 70 years old from a population-based study of older drivers. A Rasch model was used to identify themes in participant responses. These drivers also had their visual function measured – visual acuity, contrast sensitivity, visual field sensitivity, visual processing speed, and spatial ability. Associations between visual function and person abilities from the survey were examined, adjusting for age and sex.

**Results:** In the focus groups, comments on gauges and knobs/switches represented half of comments. Women made more comments about getting information whereas men made more comments on uniformity. Positive and negative comments were made in each comment category. When the survey based on focus group content was administered, driver responses revealed four thematic subscales fitting the Rasch model: cognitive processing, lighting, pattern recognition, and obstructions. For all the following associations, increased visual function was indicative of better person ability. Contrast and visual field sensitivities were associated with cognitive processing, lighting, and pattern recognition subscales ($p \leq 0.00052$). Visual processing speed, as measured by Trails B and UFOV2, was associated with the lighting subscale ($p=0.0008$ and $p=0.0007$, respectively). UFOV2 was associated with the pattern recognition subscale ($p=0.0165$). Spatial ability was the only visual function associated with the visual obstruction subscale ($p=0.0347$).

**Conclusions:** Through use of focus groups which guided the development of a vehicle dashboard survey using Rasch analysis, we have demonstrated that better visual function in older drivers is associated with their better self-reported person abilities in dealing with the dashboard. Conversely, those with worse visual function reported worse person abilities. These results document the relevance of visual function to older drivers' abilities to interact with the dashboard and provide guidance to engineers and designers on how to configure dashboards, if they are meant to be relevant to one of the largest groups of drivers in the US.

**Biography:** Cynthia Owsley Ph.D., MSPH holds the Nathan E. Miles Endowed Chair and is Professor in the Department of Ophthalmology & Visual Sciences, Heersink School of Medicine, University of Alabama at Birmingham (UAB). She is a Phi Beta Kappa graduate of Wheaton College, Massachusetts and received the Ph.D. in Experimental Psychology from Cornell University and the MSPH in Epidemiology from UAB. Dr. Owsley's research program focuses on aging-related eye disease and vision impairment. Her research program uses many techniques including psychophysics, epidemiology, clinical trials, retinal imaging, and health services research. Dr. Owsley has been continuously funded by NIH since 1983 and has 277 publications indexed in PubMed. She has served on panels for the National Research Council including the Committee on Vision and the Committee on Disability Determination for Individuals with Vision Impairment. Dr. Owsley chaired the scientific review panel for NIH's Center for Scientific Review on Central Visual Processing and currently serves on Brain Imaging, Vision, Bioengineering, and Low Vision Technology (BIVT) study section. She serves on the editorial board of *Annual Review of Vision Science and Investigative Ophthalmology and Visual Science*. She is a Gold Fellow of the Association for Research in Vision and Ophthalmology for which she is past chair for the Committee on Ethics and Regulations in Human Research. Dr. Owsley serves on the Scientific Advisory Panel for Research to Prevent Blindness. She is the recipient of the Roger H. Johnson Macular Degeneration Award from the University of Washington, the Oberdorfer Award in Low Vision from ARVO, the Pomeroy Award for Excellence in Vision and Public Health from Prevent Blindness, the Glenn A. Fry Award from the American Optometric Foundation and the Bartimaeus Award from the Detroit Institute of Ophthalmology/Henry Ford Health System.

**Derrick Redding, M.S.**
Betterfrost Technologies
Oakville, Ontario, Canada

## Driver Engagement Support systems for Commercial Trucking

As automated safety features like Adaptive Cruise Control (ACC) and Lane Keeping Assist (LKA) are added to vehicles, secondary issues are arising, including over-trust and driver disengagement. Research at Virginia Technical Transportation Institute has shown that once ACC and LKA are active, achieving Level 2 on the SAE Automated Driving scale, drivers are nearly twice more likely to engage in a secondary task. Also, these drivers take longer and more frequent off-road glances due to over-trust in these automated systems.

Passenger vehicles from automakers such as Tesla, Cadillac, and Volvo have Driver Engagement Support systems to help mitigate these effects by monitoring driver engagement and use different methods to nudge driver attention back to the road when the driver passes a minimum level of attention. I will describe research at MIT that shows new methods of how to measure driver engagement and how it can be used to compare different systems and cab designs for maintaining safe driver engagement.

However, these systems have not appeared in commercial trucks yet. I'll present a Case Study from an experienced class 8 truck driver who drove a passenger vehicle with the most advanced Driver Engagement System in it. I'll share his comparisons of the passenger car with versus a class 8 truck with the latest Level 2 systems. I'll summarize the benefits for Driver Engagement Support systems in commercial trucking to reduce over-trust, improve implementation of automated driving systems, and reduction of driver stress. Finally, I describe the next steps needed to develop a Driver Engagement System for commercial trucking.

**Biography:** Derrick Redding has had automotive experience at Toyota, JCI, EG Transpire and start-ups to develop new products and processes based on defining customer value, developing technical talent, increasing go-to-market productivity, and improving operations. He has led companies and organizations with sales ranging from start-up to $1B. His key accomplishments include:

- Developed installation and training process for largest DOT- funded Connected Vehicle Project
- Created and executed go-to market plans at multiple startups
- Recovered innovation product launch after major supplier disruption
- Implemented cost reduction processes that achieved 3% of sales/year on over $1.5B in sales
- Received three awards at JCI from Toyota for successful development and launch of seat programs.
- As CFO, played major role in the turnaround of JCI Japan Automotive. Margins improved by over 10%
- Led implementation of two key manufacturing strategies and two launches in Toyota Assembly

**Keynote Speaker**
**Matthew Rizzo, M.D.**
University of Nebraska Medical Center
Omaha, Nebraska

## Driver Engagement Support for Commercial Trucking

The National Highway Traffic Safety Administration (NHTSA) is investigating a fatal Tesla crash on July 6, 2022, near Gainesville, Florida. The driver and passenger died when their car left the highway and ran under a parked tractor trailer, crushing the roof and the occupants. Lawyers and the decedents' family are counting on audio and video records of the crash to better understand what happened and why. How can we impute causality in adverse driving events from naturalistic data? NHTSA reported 367 crashes involving vehicles with driver-assist systems from July 2021 to May 15, 2022 and is investigating dozens of Tesla crashes where driver-assist systems were thought to have been engaged. This lecture will review principles, practices, strategies, and limitations in understanding safe and unsafe driving behavior and adverse events from naturalistic data in our patients who drive, from root cause analyses to philosophical climbs up Pearl's ladder of causality.

**Biography:** Dr. Rizzo is 1) Reynolds Professor and Chair, Department of Neurological Sciences, 2) Chief Physician for Neurological Services (Neurology, Neurosurgery, Pain, PM&R, Psychiatry) at the University of Nebraska Medical Center (UNMC), 3) Founding Director NIH NIGMS Great Plains IDeA-CTR network spanning all NE University Institutions, Creighton, Omaha VA, Children's Hospital, Children's Health Research Initiative, Boys Town, and the Dakotas; and 4) Director, NE Practice Based Research Network spanning 70 sites. His principal previous employment (until 2014) was at the University of Iowa as 1) Professor of Neurology, Engineering, and Public Policy; 2) Vice Chair of Translational and Clinical Research; 3) Director, Division of Neuroergonomics; and 4) Founding Director, Aging Brain and Mind Initiative, spanning Colleges of Medicine, Nursing, Engineering, Public Health, and Liberal Arts and Sciences.

Dr. Rizzo proudly serves the Chair for the Executive Committee of the American Brain Coalition (ABC), a 501(c)3 organization comprising nearly 150 partner organizations (patient advocacy, industry, medical professional, and government groups), advocating to advance research for neurological cures. He has made distinct, sustained, original contributions to US biomedical science and education. His work on cerebral substrates of human vision creatively combined the human lesion method with visual psychophysics and cognitive science. Building on ethological principles pioneered by Lorenz, he helped forge Neuroergonomics, a new field bridging medicine, neuroscience, and engineering. He pioneered simulation and "brain-in the wild" work using sensors in a person's own vehicle and devices as egalitarian, passive-detection systems for flagging age- and disease-related aberrant behavior and physiology ("digital biomarkers") that may signal early signs of functional decline or incipient disease (e.g., degenerative).

Relevant service spans the US National Academy of Sciences Board on Human-Systems Integration, US FDA Panel for PNS and CNS Drugs, and FMCSA Medical Advisory Committee (appointed by US Secretary of Transportation), and extensive science and policy service and leadership with the American Academy of Neurology, the American Neurological Association, and multiple universities. He also serves on the Association for Clinical and Translation Science (ACTS) Executive Committee to empower members to develop, implement, and evaluate the impact of research and education programs. He has extensive experience working with other leaders, investigators, and trainees from academic medical centers, government, industry, and philanthropy. As a cellist, he founded the Nebraska Medical Orchestra. He is a clinician scientist who believes strongly in silo-spanning work, as promoted by CP Snow and EO Wilson.

**Sameh Saad**
CTO Betterfrost Technology
Oakville, Ontario, Canada

**Terry Yim, R&D Manager**
Asahi Glass
Ypsilanti, Michigan

## Windshields as an Electronic Device for Perception and Comfort

Electric Vehicle (EVs)range is significantly lower at colder and warmer temperatures. EV driving range drops by about 20% for each 10C change from ambient temperatures (AAA, GeoTab). This makes range anxiety a larger problem on cold and hot days. Based on EV driver surveys, EV drivers change their behaviors at temperature extremes. In some examples, drivers have said that they either are too cold or can't see through fogged windshields. This results from EV's managing the limited power that is allocated to the cabin.

We'll discuss how new windshields in EVs are able to keep the windshield clear of frost and fog without any driver intervention and reduce solar gain in the summer. These changes are safer by improving visibility and reducing driver distractions. They are also much more energy efficient than current methods. This reduces range anxiety for drivers to allow drivers greater range in cold and warm temperatures. These changes will also reduce the packaging requirements for the HVAC system to allow space in the cabin.

**Methods:** We will share R&D validation activities that have been done at Tier 1s and OEMs to validate that these systems work and confirm the energy savings and impact on driving range.

**Results:** This solution has been shown to reduce energy consumption by 5 kWh/day during an average drive in the winter, which equates to about 38 km of further range in winter.

**Conclusions:** This new technology will allow no human interaction to keep a windshield clear of frost, ice and fog. It also allows improved cabin comfort for the drivers and uses less space than current methods.

**Biography:** Sameh Saad is an experienced engineering professional with 14 years of experience in design, product cycle life, and automation. He is the co-founder and CTO of Betterfrost Technologies, Inc.

**Biography:** Terence (Terry) Yim is Strategic Marketing Leader for AGC Automotive Americas, a leading supplier of automotive glazing for the North American OEM and aftermarket industries. His current role includes finding innovative ways to integrate glass-based technologies into the evolving automotive mobility landscape. Before AGC, Terry worked for Samsung's mobile division managing global open innovation and product strategy initiatives. Prior to that, he was a strategy analyst and consultant for Accenture's South Korea office.

**Ulrich Schiefer, Ph.D.**
University of Applied Science Aalen University
Tuebingen, Germany

# Night-time driving in older people: Quantifying the relation between visual acuity, contrast sensitivity, and hazard detection distance in a driving simulator

**Purpose:** (i) To assess how well contrast sensitivity (CS) predicts night-time hazard detection distance (one key component of night driving ability), in normally sighted older drivers, relative to a conventional measure of high contrast visual acuity (VA); (ii) To evaluate whether CS can be accurately quantified within a night driving simulator.

**Methods:** Participants were fifteen (five female) ophthalmologically healthy adults, aged 55 to 81 years. CS was measured in a driving simulator using Landolt Cs, presented under *static* or *dynamic* driving conditions, and *with* or *without* glare. In the *dynamic* driving condition, the participant was asked to maintain two (virtual) speed levels (60 km/h and 90 km/h, as indicated by corresponding speed limit traffic signs) on a straight country road. In the (*dynamic*) *with glare* condition, two calibrated LED arrays, moved by cable robots, simulated the trajectories and luminance characteristics of the (low beam) headlights of an approaching car. For comparison, CS was also measured clinically (with & without glare) using a Optovist I instrument (Vistec Inc., Olching/FRG). Visual acuity (VA) thresholds were also assessed at high and low contrast using the Freiburg Visual Acuity Test (FrACT) under photopic conditions. As a measure of driving performance, median night-time hazard detection distance (MHDD) was computed, in meters, across three kinds of simulated obstacles of varying contrast.

**Results:** CS and low contrast VA were both significantly associated with driving performance (both $p < 0.01$), whereas conventional high contrast acuity was not ($p = 0.10$). There was good correlation ($p < 0.01$) between CS measured in the driving simulator and a conventional clinical instrument (Optovist). As expected, CS was shown to decrease in the presence of glare, in dynamic driving conditions, and as a function of age (all $p < 0.01$).

**Conclusions:** CS and low contrast photopic VA predict night-time hazard detection ability in a manner that conventional high contrast photopic VA does not. Either may therefore provide a useful metric for assessing fitness to drive at night, particularly in older individuals. CS measurements can be made within a driving simulator, and the data are in good agreement with conventional clinical methods (Optovist I).

**Biography:** Ulrcih Schiefer, Ph.D., holds a W3 Full Professorship at the Aalen University of Applied Sciences, Germany and is the Head of the Competence Centre of "Vision Research" at this institution. In addition, he is Senior Resident at the Department & Research Institute for Ophthalmology, University of Tuebingen, Germany.
His Research Group is mainly focused on the detection and follow-up of circumscribed visual pathway lesions in order to evaluate their functional and morphological interrelationship as well as to facilitate statements regarding indication and prognosis of therapeutical methods and their impact on visual exploration and on mobility.
Research activities of this group are funded among other by the German Ophthalmological Society (DOG), Allergan, Pfizer, MSD, Alcon and Haag-Streit.
Dr. Schiefer is Board Member of the International Perimetric & Imaging Society (IPS) since 2000. He holds several patents with regard to perimetric examination techniques. He is Member of the Commission for Quality Assurance of Neurophysiological Investigation Procedures and Instruments of the German Ophthalmological Society (DOG) since 2007.

**Manoj Sharma, Ph.D.**
General Motors, Research and Development
Warren, Michigan

## Imaging Through Scattering Media for Automotive Applications

**Objectives:** The objective is to use computational imaging techniques to generate perceivable information/images through scattering media, like fog and smog. This is extremely important as scattering due to fog, rain, and snow, could create problems for a driver or the detectors of an automotive vehicle at the same time. Scattering also imposes challenges in other areas such as tissue imaging, underwater imaging, and surveillance. It is almost impossible for conventional detectors to perceive information from scattering altered images, however, computation can help retrieving information from the distorted images.

**Designs:** In this paper, I will provide a brief overview of imaging through scattering media techniques, highlight the key challenges and limitations of the existing technology to imaging through scattering media and review some of the existing techniques to image through scatting and its applications to the automotive industry.

**Results:** There are various computational imaging-based techniques developed, to see through scattering for various applications. Single shot imaging methods are available to retrieve images smeared by low scattering (through thin scatterers). Medium characterization-based techniques are useful to image through arbitrarily thick but static scattering medium. There are various other methods which use time of flight or gating techniques to retrieve information from scattered/smeared images or utilize machine learning for image reconstruction using a large training dataset. We will review these computational imaging techniques for de-scattering in this paper.

**Biography:** Manoj Sharma received his Ph.D. degree from the Indian Institute of Technology, Delhi, India, in 2014. He is currently working as a researcher with vehicle systems research VSR lab, General Motors R&D. Previously he has worked as a research scientist with the Department of Electrical and Computer Engineering (ECE), Rice University, Houston, TX, USA. He has also worked as a postdoctoral research scholar with Electrical Engineering and Computer Science (EECS), Northwestern University and College of Optical Sciences, University of Arizona. His research interests include holography, 3D imaging, head up displays, image processing, image enhancement, phase retrieval, compressive sensing, imaging through scattering media, computational imaging, and high-resolution imaging.

# Presenters


### Keynote Speaker

**Timo Tervo, M.D., Ph.D.**
University of Helsinki
Finnish Crash Data Institute
Helsinki, Finland


## Medical Condition as a Risk Factor in Fatal Motor Vehicle Crashes


Timo Tervo[1], Kalle Parkkari[2], Tapio Koisaari[2], Juho Wedenoja[1]
[1] Department of Ophthalmology, University of Helsinki and Helsinki University Hospital, Helsinki, Finland. [2] Finnish Crash Data Institute, OTI, Helsinki, Finland


**Purpose:** To assess the role of medical conditions as the risk factor of the crash we examined all fatal motor vehicle road crashes in Finland. Of these crashes, we examined the prevalence of the most common illnesses.

**Method:** We carried out a cross-sectional study of all fatal motor vehicle crashes in Finland during the years 2014-2018 (N=907). To gain the information, we accessed the registry of Finnish Crash Data Institute (OTI) and included all at-fault crashes in our study. First, we separated those cases in which the crash investigators had concluded that a medical condition had been a risk factor. Secondly, we divided the above-mentioned cases in two groups: (1) cases where the medical condition acted as the primary risk factor, (2) cases where the medical condition was a secondary risk factor. Finally, we accessed the case files and listed the prevailing illnesses case by case.

**Results:** During the study period, the road accident investigation teams investigated 907 fatal motor vehicle crashes. Of these, 141 (16% of all crashes) were caused by a sudden illness attack (illnesses in Table 1). The crashes involved 179 people, 142 of whom died, 14 suffered minor injuries and 23 survived uninjured. In 124 (88%) crashes, the at-fault driver was a male with a median age of 66 years.

Table 1. The most common medical conditions in crashes where a medical condition acted as the primary risk factor (141 accidents).

| Disease [# of crashes] | Cardiovascular disease | Mental disorders | Reduced mobility | Cerebrovascular diseases | Epilepsy | Diabetes mellitus | Substance dependence |
|---|---|---|---|---|---|---|---|
| Cardiovascular disease | **119** | 7 | 18 | 10 | 6 | 28 | 15 |
| Mental disorders | 7 | **7** | 0 | 0 | 2 | 3 | 2 |
| Reduced mobility | 18 | 0 | **18** | 2 | 0 | 4 | 1 |
| Cerebrovascular diseases | 10 | 0 | 2 | **12** | 1 | 1 | 2 |
| Epilepsy | 6 | 2 | 0 | 1 | **8** | 1 | 3 |
| Diabetes mellitus | 28 | 3 | 4 | 1 | 1 | **29** | 8 |
| Substance depency | 15 | 2 | 1 | 2 | 3 | 8 | **19** |

In addition to above-mentioned crashes, 352 crashes (33% of all) involved a medical condition as a secondary risk factor. In these cases, the condition may have been a physical or mental one (Table 2). The crashes with a medical condition as a secondary risk factor involved 806 people, 391 of whom died, 73 suffered serious injuries, 161 suffered minor injuries and 181 avoided injuries. 90 % (n=316) of the at-fault drivers for these accidents were male with a median age of 40 years.

Table 2. The most common medical conditions in crashes where the condition was a secondary risk factor (352 accidents). Eye conditions played a minimal role as risk factor.

| Disease [# of crashes] | Cardiovascular disease | Mental disorders | Reduced mobility | Cerebrovascular diseases | Epilepsy | Diabetes mellitus | Substance dependence |
|---|---|---|---|---|---|---|---|
| Cardiovascular disease | **108** | 28 | 21 | 11 | 2 | 29 | 57 |
| Mental disorders | 28 | **162** | 22 | 3 | 5 | 7 | 108 |
| Reduced mobility | 21 | 22 | **38** | 2 | 0 | 5 | 25 |
| Cerebrovascular diseases | 11 | 3 | 2 | **24** | 1 | 3 | 4 |
| Epilepsy | 2 | 5 | 0 | 1 | **9** | 0 | 5 |
| Diabetes mellitus | 29 | 7 | 5 | 3 | 0 | **34** | 18 |
| Substance depency | 57 | 108 | 25 | 4 | 5 | 18 | **217** |

**Conclusion:** During the years 2014-2018, a medical condition acted as a risk factor (primary or secondary) in 54% (n=493) of all fatal motor vehicle crashes on average. The overall picture based on this figure differs significantly from the official accident statistics of many countries since illness attacks and deliberately caused accidents have been omitted from these statistics. In addition, medical conditions are not a problem of older age groups only.

All authors declare no financial disclosures.

**Biography:** Timo Tervo, M.D., PH.D. is Professor of Traffic Medicine (emeritus) in Helsinki University and crash investigator in Finnish Crash Data Institute (OTI). He started his scientific work on histochemistry and innervation of cornea in Dept. of Anatomy, U. Helsinki, and became Assistant Professor in 1978. After military service and research on naval medicine he moved via neurology to Dept of Ophthalmology, U. Helsinki. He then investigated corneal cell biology, wound healing, refractive surgery, nerve regrowth and infections. He reached speciality in ophthalmology in 1983 and served as Professor of Apllied Clinical Ophthalmology 2000-2014 in U. Helsinki. Besides that, and related to his life long interest on car technology, he started as crash investigator in 2003, established education and clinical service on driving fitness in Helsinki U Hospital. He served as Professor of Traffic Medicine 2014-7 publishing studies on the field from 2005 onwards. He scores some 230 peer-reviewed articles and 150 other scientific papers.

**Judith Ungewiss, Ph.D.**
Aalen University of Applied Sciences
Aalen, Germany

## Correlations between Intraocular Straylight Perception and Contrast Sensitivity, Halo Size, and Hazard Recognition Distance with and without Glare Results from a Nighttime Driving Simulator Study

**Purpose:** Evaluation of the relationship between intraocular straylight perception and (i) contrast sensitivity (CS)
(ii) halo size
(iii) hazard recognition distance
in a driving simulator with and without glare.

**Subjects and methods:** Fifteen (five female) ophthalmologically healthy adults, aged 54 to 80 (median: 67.2) years participated in the study. Intraocular straylight (log s) was measured using the C-Quant (Oculus GmbH, Wetzlar/Germany). CS with glare was assessed clinically using the Optovist I device (Vistec Inc., Olching/FRG) and also within a driving simulator using Landolt Cs presented under both static or dynamic viewing conditions with or without glare. Hazard recognition distance was measured for obstacles of varying contrast. Therefore, each participant was required to drive at a speed of 60 km/h within a simulator. Glare was simulated by LED arrays, moved by cable robots to mimic an oncoming car's headlights. Halo size was measured by moving Landolt Cs outwards originating from the center of a static glare source, allowing for the evaluation of the halo radius (angular extent, in degrees visual angle).

**Results:** Correlation between intraocular straylight perception (log s), and hazard recognition distance under glare was poor for low contrast obstacles (leading/subdominant eye: r = 0.27/r = 0.34). Conversely, log CS measured with glare strongly predicted hazard recognition distances under glare for both clinical measurement (Optovist I: r = 0.93) and within the driving simulator, under static (r = 0.69) and dynamic (r = 0.61) conditions as well as halo extent (r = 0.70). Glare and motion lead to a degradation of log CS.

**Conclusion:** Intraocular straylight was a poor predictor of visual function and driving performance within this experiment. Conversely, CS was a strong predictor of both hazard recognition and halo extent. Future studies are necessary to evaluate the effectiveness of all above-mentioned vision-related parameters for predicting fitness to drive under real-life conditions.

**Biography:** Judith Ungewiss received an M.Sc. in Ophthalmic Optics and Psychophysics and a Ph.D. (Dr. rer. nat.) in Cognitive Science. She works at Carl Zeiss Vision International GmbH (Aalen, Germany) and at the Aalen University of Applied Sciences (Germany), where she is the head of the driving simulator at the Aalen Mobility Perception & Exploration Lab (AMPEL). She is a member of the Competence Center "Vision Research" (Head of the Competence Center: Prof. Dr. Ulrich Schiefer) at this institution. This Research Group is mainly focused on the detection and follow-up of circumscribed visual pathway lesions in order to evaluate their functional and morphological interrelationship as well as to facilitate statements regarding indication and prognosis of therapeutical methods and their impact on visual exploration and on mobility.

**Michael Woerner, Ph.D.**
Aalen University of Applied Sciences
Aalen, Germany

## Impact of Glare and Other Interference Factors on Visual Exploration and Nighttime Driving in a Simulator

**Purpose:** Driving habits depend on fitness to drive and vehicle-/environment-related factors. These factors can be operationalized by *driving dynamics parameters* and *driver's activities*, such as head and gaze movements. Purpose of this study was (i) to evaluate the impact of glare and other interference factors (optotype recognition, motion) on lane keeping and speed keeping as well as head and gaze movements in a nighttime driving simulator, (ii) to assess the inter-subject variability of the above-mentioned variables.

Subjects and methods: Participants were fifteen (five female) ophthalmologically healthy adults, aged 54.6 to 80.6 (median: 67.2) years. Contrast sensitivity (CS) was measured by presenting optotypes (Landolt Cs, visual acuity level 0.1, with varying contrast levels, using an adaptive BestPest algorithm), presented under static as well as under *dynamic* viewing conditions, first *without* and subsequently *with* glare. In the static scenario, the optotypes were presented at a virtual distance of 50 m. Under *dynamic* conditions, the participant was simultaneously required to maintain an ideal course on a virtual country road, alternating between a target speed of 60 km/h during the contrast sensitivity tasks and 90 km/h on route to the next glare event, as indicated by appropriate speed limit signs. Lane and speed keeping datasets were extracted from the simulation software and expressed as relative deviations from the optimal course and target speeds, respectively. Eye and head movements were recorded by the integrated (contactless) eye and head tracking system Smart Eye Pro (three tracking cameras, one scene camera, sampling rate 120 Hz; SmartEye, Gothenburg, Sweden). Eye and head tracking data was aligned with the stimulus presentations and vehicle location using time synchronization and event synchronization respectively. Head movements were quantified as the median distance from the head's centroid position in 3D space. Gaze movements were expressed as the percentage of gaze points registered towards the right side of the road, where optotypes and obstacles would appear, relative to the total number of gaze points.
Differences between the individual study tasks were tested on their statistical significance using two-sided pairwise Wilcoxon tests.

Results: Subsequently, median values are listed {the related inter-subject scatter is expressed as inter-quartile range = IQR and listed in braces}:
*Head movements* during *optotype* presentations significantly increased from 3.7 {3.3} mm to 6.9 {5.4} mm under *glare exposure;* ($p = 0.0034$); combining both virtual driving and glare exposure increased head movements significantly to 9.4 {14.6} mm ($p = 0.023$) – compared to the baseline scenario (*static* conditions *without glare*), each. No significant changes in the deviation from the *ideal lane position* could be observed during the presentation of visual stimuli or when adding glare. Similarly, the relative gaze point annotation during virtual driving or glare exposure did not show significant changes compared to the baseline scenario.
*Glare exposure* led to a significant improvement of the deviations from the target speeds, from 10.7 km/h {6.1

# Presenters

km/h} to 3.3 km/h {2.5 km/h}; p = 0.016 *without optotype presentation* and to 4.5 km/h {2.8 km/h}; p = 0.016 *during optotype presentation*. Because glare expositions were always carried out *after* the experiments without glare, these improvements are most likely attributable to sequence/learning effects.

**Conclusions:** Glare exposure significantly increased the extent of (evasive) head movements. The deviation of the ideal lane position was neither significantly influenced by visual stimulus presentations nor by glare. The observed significant improvement of speed keeping under glare exposure, compared to the baseline twilight condition, may be at least partially attributable to a bias due to sequence/learning effects.

**Biography:** Michael Wörner received an MSc (Dipl.-Inf.) in software engineering and a Ph.D. (Dr.-Ing) in computer science from the University of Stuttgart. In 2016, he co-founded the spin-off startup Blickshift, which specializes in the visual analysis of eye tracking data, and is one of its managing directors. Michael Wörner joined the Vision Research group at the Aalen University of Applied Sciences in 2018, where he handles the IT aspects of system integration, data acquisition, and evaluation. His research interests include visualization and data analysis with a focus on the eye tracking domain.

Keynote Speaker

**Joanne Wood, Ph.D.**
Queensland University of Technology
Brisbane, Australia

## Night-time Driving: Visual Challenges, Lighting Issues and Improving Visibility

### Abstract

Night driving is dangerous. Even though driving exposure is much lower at night, fatality rates are up to 3x higher than in the daytime adjusted for distances travelled. This increased crash risk at night is exacerbated for collisions between pedestrians and vehicles, where pedestrians are 3-7 times more likely to be involved in a fatal collision with a vehicle at night than in the day. Reduced lighting and poor visibility are associated with these high rates of night-time crashes, independent of other factors that vary between day and night-time driving. Importantly, the visual environment when driving at night is particularly challenging, as the low luminance conditions alter many aspects of visual function, in addition to the challenges presented from the fluctuating light levels typically encountered.

This presentation will provide an overview of our research work on the impact of vision on night driving ability, highlighting research undertaken on a closed road facility, which provides an ideal environment in which to conduct such investigations. Research presented will discuss the impact of vision on night driving across a range of young and older populations, both with and without vision impairment. Findings will also be presented from studies assessing the effect of streetlighting levels on hazard detection, as well as research on improving the visibility and hence safety of vulnerable road users, such as pedestrians and cyclists.

**Biography:** Professor Joanne Wood is from the Centre for Vision and Eye Research, School of Optometry and Vision Science, Queensland University of Technology, Brisbane, Australia. Her research focuses on the impact of visual impairment and ageing on functional outcomes, including understanding how visual impairment affects driving performance, the factors affecting night-time, pedestrian visibility and identifying risk factors for unsafe older drivers.

# Presenters


**Poster Presenter**

**Jing Xu, Ph.D.**

Envision Research Institute

Wichita, Kansas


## Effects of Different Hazard Warning Modalities and Timings for Older Drivers with Impaired Vision

**Purpose:** Impaired contrast sensitivity (ICS) may delay drivers' responses to road hazards. Advanced Driver Assistance Systems that provide hazard warnings can mitigate crash risk; however, the benefits may vary with warning design. We tested 3 collision warning systems with different modalities and timing thresholds and evaluated their impact on the responses of drivers with ICS to pedestrian hazards in a simulator.

**Methods:** 17 subjects with ICS (63–84 y, median CS 1.35 log units) and 17 with normal vision (NV) (65–86 y, median CS 1.95) participated. They completed 6 city drives with 3 warning conditions: auditory (pulse beeps), directional tactile (pulse vibrations on either left or right side), and non-directional tactile (pulse vibrations on both sides). For each condition, they completed one drive with early and one drive with late warnings, triggered when time-to-collision was 3.5s and 2s, respectively. There were 10 pedestrian hazards per drive that crossed the road from the left or right, requiring a braking response by the driver to avoid a collision.

**Results:** ICS subjects triggered more early warnings (62 vs 56%) and late warnings (17 vs 7%) than NV subjects and had more collisions (2.4 vs 0.4%). When warnings were triggered (data pooled across groups), early warnings reduced time to fixate hazards (late 1.9 vs. early 1.2s, $p<.001$), reduced brake response times (2.7 vs 1.7s, $p<.001$) and collision rates (7.6 vs 0.4%). Brake times did not differ between the groups for early warnings; however, ICS subjects took 0.7 s longer to brake than NV subjects with late warnings ($p=.001$) and still had an 11% collision rate. Warning modality had no effect on fixation times, but NV subjects were faster to initiate braking with directional tactile warnings ($p <.001$). For late warnings, non-directional tactile warnings resulted in the lowest collision rates for ICS subjects (4% vs Auditory 12% vs Directional tactile 15%).

**Conclusions:** Both groups were faster to fixate and brake for hazards and had low collision rates with early warnings. In events with late warnings, ICS subjects were slow to brake resulting in high collision rates. These results suggest that ICS drivers will benefit more from earlier warnings. Warning modality may be important for late warnings and non-directional tactile warning provides the most benefit for ICS drivers. Customizable ADAS interface designs may be beneficial for drivers with impaired vision.

**Biography:** Dr. Jing Xu is a Research Associate at Envision Research Institute. She earned her Ph.D. in Industrial Engineering with a concentration in human-machine interaction and driving safety at Northeastern University. She received postdoctoral training at Schepens Eye Research Institute of Mass Eye and Ear, Department of Ophthalmology, Harvard Medical School. Her current research focuses on investigating the impact of vision impairments on driving and using driver-vehicle interfaces and investigating driver assistance and vehicle automation systems to support safe mobility and life independence for road users who are blind and visually impaired.

**Jing Xu, Ph.D.**
Envision Research Institute
Wichita, Kansas

## Experiences of Drivers with Vision Impairment when Using Tesla Cars: A One-year Follow-up Study

**Objectives:** To investigate how drivers with vision impairment make use of assistance and automation systems in Tesla cars based on real-world experiences of using these technologies.

**Methods:** Semi-structured interviews over about a one-year period are being used to quantify vision impaired driver's driving habits, coping strategies, use of the assisted and semi-autonomous driving features in their Tesla car, and use of other vision assistive devices such as bioptic telescopes. Driving related history and clinical evaluations are also being collected.

**Results:** The first patient investigated was a 53-year-old male with Stargardt's Disease and 20/182 visual acuity. He purchased a Tesla Model Y with the Full Self-Driving (FSD) package in October 2020. With this car, he typically drives 80 miles per week and has driven about 10,000 miles in one year including long-distance cross-state trips. When driving a Tesla car, he developed new driving strategies by co-driving with different assistance and semi-autonomous functions (e.g., Traffic Aware Cruise Control, Enhanced Autopilot, Traffic Light and Stop Sign Control) in different road environments. He shifted his main task from active driving to supervising the car automation systems in most driving situations. He also integrated a new use of his bioptic telescope to support him with monitoring the road environment before granting permission to the automated systems for car maneuver changes. The patient reported that driving confidence greatly increased and that he is able to drive more often and in situations that he would otherwise avoid due to difficulties related to his vision.

**Conclusions:** This first case demonstrates how assisted and semi-autonomous driving systems in a Tesla car were used to support daily driving by a driver with vision impairment. Co-driving with these systems allows him to confidently drive more often and to avoid less situations than he used to. Recruitment of other vision-impaired Tesla drivers is ongoing to determine whether others have also adopted these co-driving behaviors. Assisted and autonomous driving technologies may be a new paradigm shift for the driving rehabilitation field to enable less restricted driving, increase driving confidence and maintain driving safety for drivers with vision impairment.

**Biography:** Dr. Jing Xu is a Research Associate at Envision Research Institute. She earned her Ph.D. in Industrial Engineering with a concentration in human-machine interaction and driving safety at Northeastern University. She received postdoctoral training at Schepens Eye Research Institute of Mass Eye and Ear, Department of Ophthalmology, Harvard Medical School. Her current research focuses on investigating the impact of vision impairments on driving and using driver-vehicle interfaces and investigating driver assistance and vehicle automation systems to support safe mobility and life independence for road users who are blind and visually impaired.

Poster Presenter
**Richard Young, Ph.D.**
Driving Safety Consulting
Troy, Michigan

## Will Automated Vehicles Be Safer Than Conventional Vehicles?

**Objectives:** A critically important question about advanced transportation technologies is how to test the actual effects of these advanced systems on safety. In particular, the question of how to evaluate the real-world safety of a highly automated driving system (here called an automated vehicle or AV) is unusually difficult. My new book (see **https://lnkd.in/eAiEE8ck**) deep-dives into this difficult AV safety question. My objective is to give a brief overview of the main result. I also hope that the information and analysis methods in my book will help the transportation safety field improve the validity of future studies of AV safety.

**Methods:** 1. Summarize the data collection and analysis methods in the first six scientific studies that compared the crash rates of AVs to conventional vehicles (CVs). 2. Identify systematic errors, biases, and best practice violation issues. 3. Attempt to fix these with the information provided in each study.

**Results:** The Figure summarizes the final corrected AV crash Incidence Rate Ratio (IRR) estimates (green squares) for Google/Waymo AVs in Mountain View, CA, compared to a conventional vehicle (CV) crash rate in three studies. (Of the six studies, only these three provided sufficient information that their errors, biases, and best practice violations could be mostly resolved by reanalyzing their data.) The left estimate had a *lower*, the center estimate had about *equal*, and the right estimate had a *higher* AV crash rate than the comparison CV crash rate. This heterogeneity likely arose because each study used a different criterion for selecting Google AV crashes and a different reference dataset for CV crashes.

**Conclusions:** Whether AVs have a lower, equal, or higher crash rate vs. CVs is still an open question. Future studies should avoid the biases, systematic errors, and best practice violations identified in my book. Otherwise, AV safety will remain an open question, limiting future customer acceptance.

**Richard Young, Ph.D.**
Driving Safety Consulting
Troy, Michigan

## The Eye and the Brain vs. the Automated Auto: A Comparison

**Objectives:** How do the eye and brain enable human drivers to see? How does the human process compare with an automated driving system, also termed an *automated vehicle* or AV?

**Methods:** Briefly summarize the anatomy, physiology, and neural processing of the eye and brain that enables resolution, hyperacuity, motion detection, object recognition, etc. Compare how an AV "sees" non-fixed objects by combining sensor outputs from cameras, Lidar, and radar and then outputting to a "neural network" trained to recognize patterns.

**Results:** Humans see by analyzing the output of "receptive fields" of neurons in our eyes and brain. A "receptive field" maps the spatial regions where light affects a visual cell's output. Millions of such fields at many levels analyze and filter the neural signals from the spatio-temporal patterns of light falling on retinal receptor cells. Figure 1 summarizes the major anatomical structures in the primary visual pathway from the eye to the brain. Note the feedback (thick black line) from the visual cortex to the Lateral Geniculate.

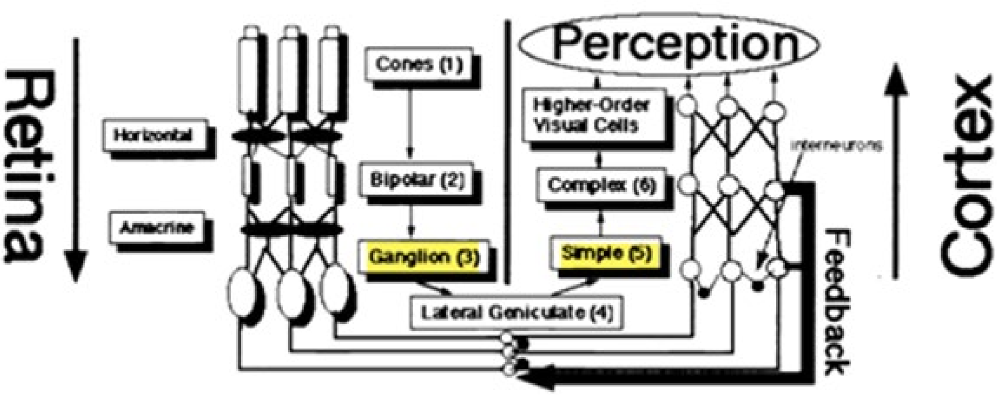



*Figure 1. Simplified schematic of the neural pathways in the primary visual system.*

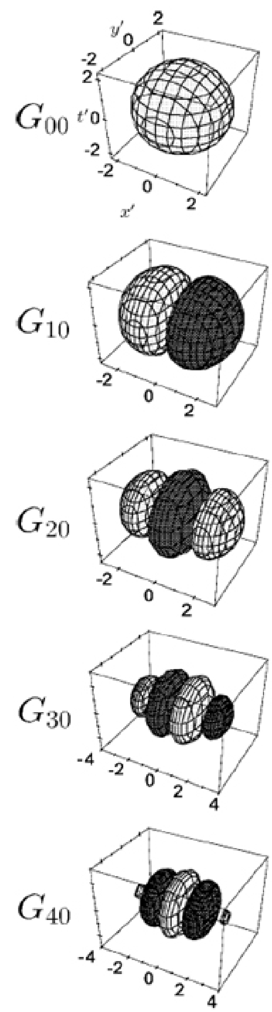


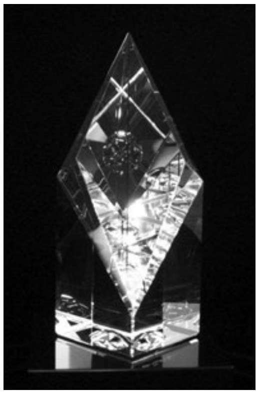

*Figure 2. Basis functions for monophasic simple cell receptive fields in Ara V1 in the primate visual cortex.*

# Presenters

In 1978, I discovered a concise mathematical model for describing the spatial receptive field shapes of the ganglion and simple cells (yellow in Figure 1). I later extended the model to time, naming it the *Gaussian Derivative Spatio-Temporal Model* (Figure 2). In computer vision, filters based on this model estimate robust local spatial-temporal derivatives in moving images. Such derivatives reproduce fixed and moving objects' form, motion, color, and depth. Using this method, humans respond well to novel visual objects.
AVs obtain information about fixed objects and structures from stored high-definition maps. However, AVs must detect unfixed objects using real-time sensor input. AV companies use simulators to train simple three-layer "neural networks" to recognize unfixed objects in the sensory output from driving scenes. The trained neural networks are then downloaded into AVs to detect unfixed objects. However, AVs respond poorly to novel unfixed objects or "edge cases," unlike humans.

**Conclusions:** The human visual system is far more complex and powerful than the pattern recognition systems in today's AVs. AV companies must develop new methods before AVs approach normal human performance for untrained visual objects.

**Biography:** Richard Young is the Founder and President of Driving Safety Consulting, LLC. His academic background is in vision: Ph.D. from NYU in physiological psychology (electrical stimulation of the human eye to generate specific phosphene colors); Post-Doc at Harvard (neural basis of learning); Post-Doc at U. C. Berkeley (single-unit recording in primate vision system); Joint Research Appointment at U. of Oregon in Psychology and Biology (single-unit recording in primate vision system). He then moved to industry: Apple Computer (technical support for Steve Jobs, development of Lisa and Macintosh computers); GM R&D (developed robot vision systems based on human vision); GM Engineering Human Factors (Global Lead for Driver Vision and Workload). He returned to academia as Research Professor at Wayne State University, with a joint appointment in the School of Medicine and College of Engineering. He received contracts for driver distraction research from all automotive companies. Since forming Driving Safety Consulting in 2016, legal firms have hired him as an expert witness for the defense in cases involving cell phone use and crashes. He has authored over 100 journal articles and presentations. In 2018, he presented a paper on automated vehicle safety at this conference which grew into his recent book published by the Society of Automotive Engineers: "Critical Analysis of Prototype Autonomous Vehicle Crash Rates: Six Scientific Studies from 2015–2018" (see https://lnkd.in/eAiEE8ck).



**The The Eye, The Brain and The Auto Bartimaeus Award is presented to an investigator who has distinguished himself or herself by prolonged substantial contributions to the progress in this field of The Eye, The Brain & The Auto, formerly The Eye and The Auto.**

## Bartimaeus Award Recipients

2003 - 2018

**Cynthia Owsley, Ph.D. (2003)**
Department of Ophthalmology
School of Medicine
University of Alabama at Birmingham
Birmingham, AL

**Leonard Evans, Ph.D. (2005)**
President, Science Serving Society
Bloomfield Hills, MI

**Joanne Wood, Ph.D. (2009)**
Professor, School of Optometry &
Vision Science and Institute of Health & Biomedical Innovation
Queensland University of Technology
Brisbane, Australia

**Gerald McGwin, MS, Ph.D. (2011)**
Vice Chairman & Professor of Epidemiology
Department of Epidemiology
School of Public Health
University of Alabama at Birmingham
Birmingham, AL

**Matthew Rizzo, M.D. (2013)**
Professor of Neurology
University of Iowa
Iowa City, IA

**Eli Peli, MSc., OD (2015)**
Professor of Ophthalmology
Schepens ERI, MEE
Harvard Medical School
20 Staniford St
Boston, MA

**Ulrich Schiefer, M.D. (2018)**
Professor, Tuebingen University
Aalen University of Applied Sciences
Aalen, Germany


**2018 Bartimaeus Award presentation to Ulrich Scheifer**

L-R: Leonard Evans, Ph.D., Cynthia Owsley, Ph.D., Gerald McGwin, Ph.D., Ulrich Schiefer, M.D., and Joseph Rizzo, M.D.

## The Henry Ford Department of Ophthalmology and the Detroit Institute of Ophthalmology graciously acknowledge and thank the educational support of this World Research Congress provided by:


### Signature Supporter
Macular Degeneration Foundation

### Bartimaeus Dinner Supporter
Friends of Vision

### Leadership Supporters
ALCON
GM Research and Education Development

### Poster Session Supporter
William and Happy Rands

### Pioneer Supporter
Bausch and Lomb

### Donations
Bill Warner - Amelia Island Concours D'Elegance Foundation
Ann and James Nicholson


HENRY FORD HEALTH®

**Department of Ophthalmology**
Detroit Institute of Ophthalmology

HENRY FORD HEALTH®

**Department of Ophthalmology**
Detroit Institute of Ophthalmology

313.824.4710
henryford.com/TheEyeAndTheAuto

151467