## THE BALANCE BETWEEN SEEING LIGHT AND GLARE

### Michael Larsen

https://www.idrivesafely.com/defensive-driving/trending/dark-side-sun-driver-safety-face-brightness

# THE BALANCE

- Static Low Beam patterns involve balancing Glare Light and Seeing Light in the beam pattern and in the vehicle aim
- This presentation explores this balance



### GLARE: 2001 NHTSA HEADLAMP GLARE REQUEST FOR COMMENTS

- In 2001, NHTSA opened a public docket requesting comments from the public regarding headlamp glare
- More than <u>5,700</u> responses received ... largely complaints about glare
  - The most comments NHTSA has ever received
- Example Comment:

"I wanted to add my complaint about the high intensity headlights. When I am in the vicinity of such cars coming towards me I become blinded by the light. At first drawn to the light, distracted and then unable to see as after the old flash bulbs. I find them highly dangerous in all vehicles. The headlights regular or otherwise in SUVs and other tall vehicles are also very distracting."



## CONGRESS AUTHORIZATION TO STUDY GLARE

2005: Congress authorized NHTSA to conduct a study on the risks associated with glare

#### PUBLIC LAW 109–59—AUG. 10, 2005 SAFE, ACCOUNTABLE, FLEXIBLE, EFFICIENT TRANSPORTATION EQUITY ACT: A LEGACY FOR USERS

#### SEC. 2015. DRIVER PERFORMANCE STUDY.

(a) IN GENERAL.—Using funds made available to carry out section 403 of title 23, United States Code, for fiscal year 2005, the Secretary shall make \$1,000,000 available to conduct a study on the risks associated with glare to oncoming drivers, including increased risks to drivers on 2-lane highways, increased risks to drivers over the age of 50, and the overall effects of glare on driver performance.

(b) REPORT.—Not later than 18 months after the date of enactment of this Act, the Secretary shall transmit to the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a report on the results of the study and any recommendations regarding measures to reduce the risks associated with glare to oncoming drivers.

# Some of the Resulting Reports:

### Available on the Web



### GLARE: DOT HS 811 043 – RESEARCH FINDINGS



"Despite the logical connection between visibility during nighttime driving and safety, and the abundant evidence that headlamp glare reduces visibility, there is little direct evidence linking headlamp glare to crash risk (NHTSA, 2007)." ...

"Evidence linking exposure to headlamp illumination from oncoming or following vehicles to crash risk is important because the study of headlamp glare by an organization such as NHTSA, whose purpose is to assess and improve driving safety, should be demonstrated to have implications for safety." ...

"On the other hand, it has been demonstrated that if all drivers used their [US] high-beam headlamps consistently, visibility when approaching and passing oncoming vehicles would be improved compared to if they used their low-beam headlamps ..., even though sensations of visual discomfort would increase ..., a finding that would seem to be inconsistent with the expectation that headlamp glare reduces safety."

### SAFETY: UMTRI-1999-21 PEDESTRIAN DEATHS, FARS, 1987-2003

- Deaths due to darkness •
  - "... Most existing research on crash data converges on the conclusion that pedestrians are the road users who are most vulnerable to dark conditions"
    - Based on this research, the estimate is that on the order of 2,000 deaths occur each year due to darkness
  - Presumably, extending the light emitted by headlamps further down the road would help mitigate pedestrian deaths due to darkness





## SUPPORTING RESEARCH

#### SAFETY SYSTEM FIELD EFFECTIVENESS



provides you whiter, brighter low and high beam headlighting than conventional headlamps.

ON THE ROAD TO

ZERO CRASHES

#### FORWARD AUTOMATIC BRAKING

can alert you when a front-end collision is detected to be imminent with a vehicle ahead you are following. It also can help reduce the collision's severity or avoid the collision by automatically applying hard, emergency braking if you have not already, or by enhancing driver hard braking.

#### LANE CHANGE ALERT W/ SIDE BLIND ZONE ALERT

can help you avoid lane change crashes by providing side mirror alerts when a moving vehicle is detected rapidly approaching a side blind zone or in a side blind zone.

#### **REVERSE AUTOMATIC BRAKING**

can alert you in Reverse when it detects a collision with a detected object directly behind the vehicle is imminent, and if necessary automatically apply hard emergency braking if you have not already.

#### REAR VISION CAMERA

provides you a view of the scene directly behind the vehicle on the infotainment display (or inside rear-view mirror) to help you park and avoid crashing into nearby objects when in Reverse.

#### INTELLIBEAM

can automatically turn your high beam headlights on and off according to surrounding traffic conditions.

#### FORWARD COLLISION ALERT

can alert you when it detects a front-end collision is imminent with a vehicle ahead you are following. The system also can alert you if you are following a detected vehicle much too closely.

#### LANE KEEP ASSIST W/ LANE DEPARTURE WARNING

can help you avoid crashes due to unintentionally drifting out of your lane by providing gentle steering wheel turns when the system detects you are drifting out of your lane with no turn signal or steering activity. It can also provide Lane Departure Warning alerts when a lane marker is crossed.

#### REAR PARK ASSIST

can provide distance alerts to nearby detected objects behind the vehicle to help you park and avoid objects when in Reverse at low speeds.

#### REAR CROSS TRAFFIC ALERT

can alert you to detected left- or right-cross traffic behind you when in Reverse.

#### GENERAL MOTORS

https://www.gm.com/safetystudy.html#

# THE BALANCE

- Public complaints about glare emphasize minimizing glare
  - However, there is little counterbalance in public opinion for the resulting loss of light down the road
    - The glare I experience versus my risk of striking a pedestrian
    - Perhaps further educating the public would be helpful
      - Seat Belt Usage
- The Balance is defined in Headlamp Ratings
  - CR, IIHS, and NHTSA's proposed NCAP for Headlamps
    - The measured systems are based on the photometric requirements for headlamps at certain mounting heights and the assumption that headlamps are aimed to the nominal photometric aim

## **IIHS MEASUREMENTS**

### **Observations:**

HID is leaving the market

Halogen is phasing out

LED is becoming the predominant headlamp light source

There are still vehicles today that do not do well for 5 lux distance – there is still room for improvement



## **IIHS MEASUREMENTS**

### **Observations:**

Glare violators predominantly have higher distance scores

This does not mean that the vehicles that scored higher distances didn't do well in IIHS, because the glare demerits are variable

But penalizing for glare will tend to discourage maximizing light down the road distances



## IIHS AIM MEASUREMENTS

### **Observations:**

Today, there still seems to be a great deal of variation in aim

However, this is difficult to assess, since a headlamp's aim location need not be at a specific angle



# THE BALANCE

- Sacrificing light down the road to minimize glare can result in a reduction in safety
  - However, looking at IIHS measured headlamp performance, there appears to be room for improvement in light down the road independent of glare
- An appropriate balance between seeing light and glare is needed, and based on Nighttime Pedestrian Safety Research and Glare Research, this balance should emphasize improving seeing light
  - Safety versus Comfort
- This balance is difficult

## THE FUTURE

- Adaptive Driving Beam has the potential to greatly improve seeing light while reducing glare light
  - However, the FMVSS 108 proposal to allow ADB greatly emphasized glare reduction
    - No glare light is allowed for any duration in any of the dynamic tests
    - This could reduce the potential safety benefit of ADB in the US as compared to other countries
- Also, the US ADB final rule has not been published yet

## THE ADB JOURNEY

 Tomorrow is the 10-year anniversary of the Request for Interpretation to allow ADB under FMVSS 108

#### ΤΟΥΟΤΑ

TOYOTA MOTOR NORTH AMERICA, INC.

WASHINGTON OFFICE TEL: (202) 775-1707 601 THIRTEENTH STREET, NW - SUITE 910 SOUTH, WASHINGTON, DC 20005 FAX: (202) 463-8513

September 22, 2011

O. Kevin Vincent, Esq. Chief Counsel National Highway Traffic Safety Administration 1200 New Jersey Avenue, S.E. Washington, D.C. 20590

RE: Request for Interpretation of FMVSS No. 108

Dear Mr. Vincent:

On behalf of Toyota Motor Corporation, Toyota Motor North America is submitting this request for interpretation of FMVSS No. 108.



## THANK YOU FOR YOUR ATTENTION

### Michael Larsen



https://www.idrivesafely.com/defensive-driving/trending/dark-side-sun-driver-safety-face-brightness