

**GLARE AND NIGHTTIME  
ROADWAY VISIBILITY:  
HUMAN FACTORS**

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# FOUR QUESTIONS

- **Why does disability glare make objects less visible?**
- **What is the effect of disability glare on visibility in practice?**
- **Which groups are particularly vulnerable to disability glare?**
- **What about discomfort glare?**

# Why does disability glare makes things less visible?

- Disability glare is caused by light scattered in the eye
- The scattered light in the eye lays a luminous veil over the retinal image. The effect of this luminous veil is to reduce the contrasts in the retinal image
- Mathematically:

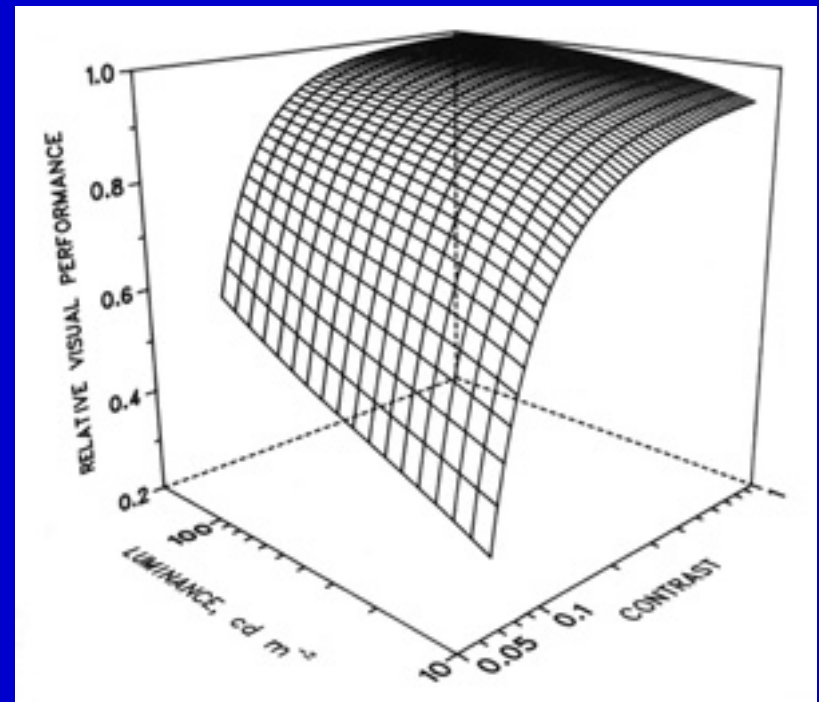
$$\text{Contrast} = (L_{\max} - L_{\min}) / (L_{\max} + L_{\min})$$

- Adding  $L_v$  = equivalent veiling luminance, to both  $L_{\max}$  and  $L_{\min}$  produces the following equation:

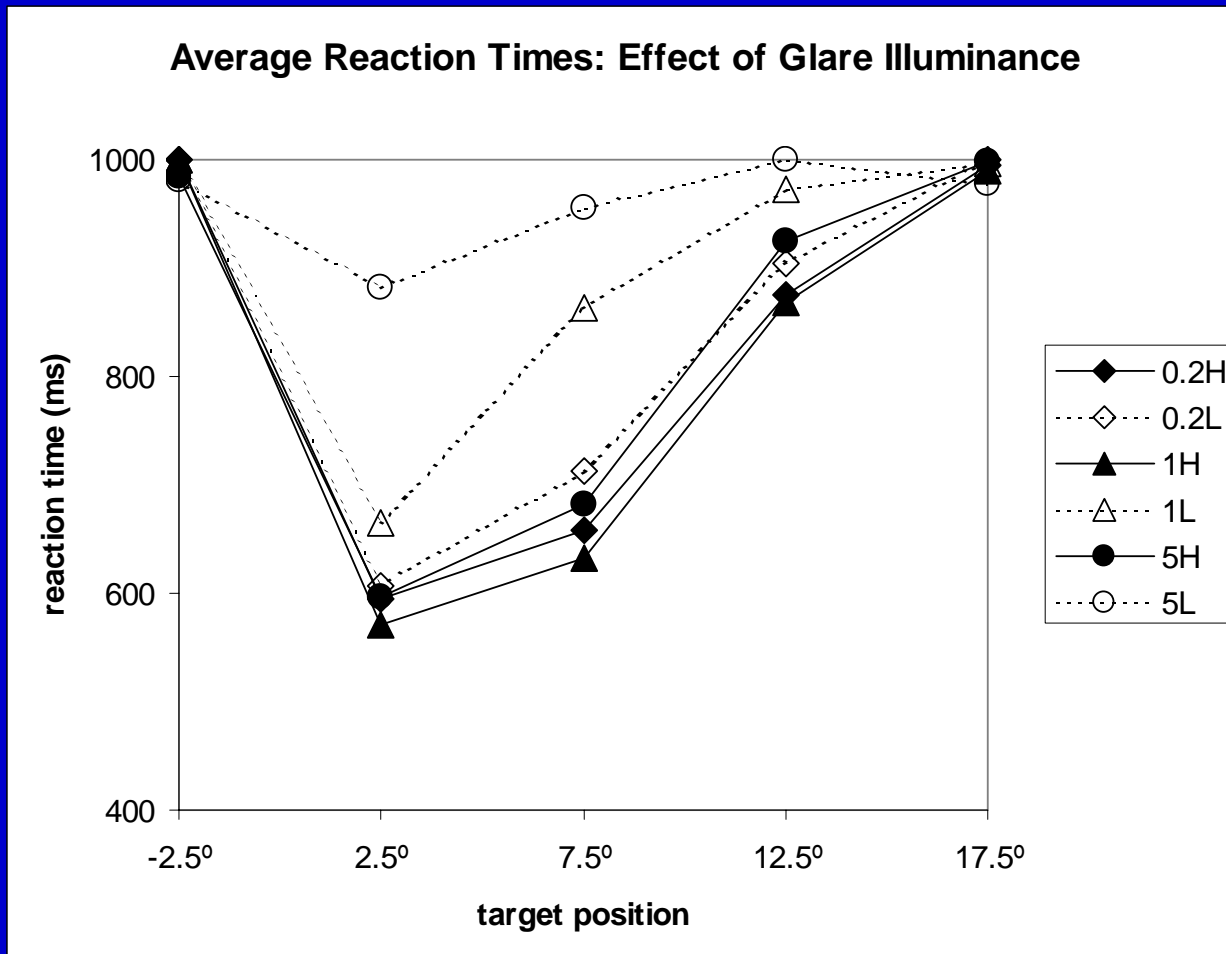
$$\text{Contrast} = (L_{\max} - L_{\min}) / (L_{\max} + L_{\min} + 2 L_v)$$

# Equal reductions in luminance contrast do not affect performance equally

- Therefore, the effect of disability glare depends on the ambient lighting conditions and the nature of the object to be seen



# An example

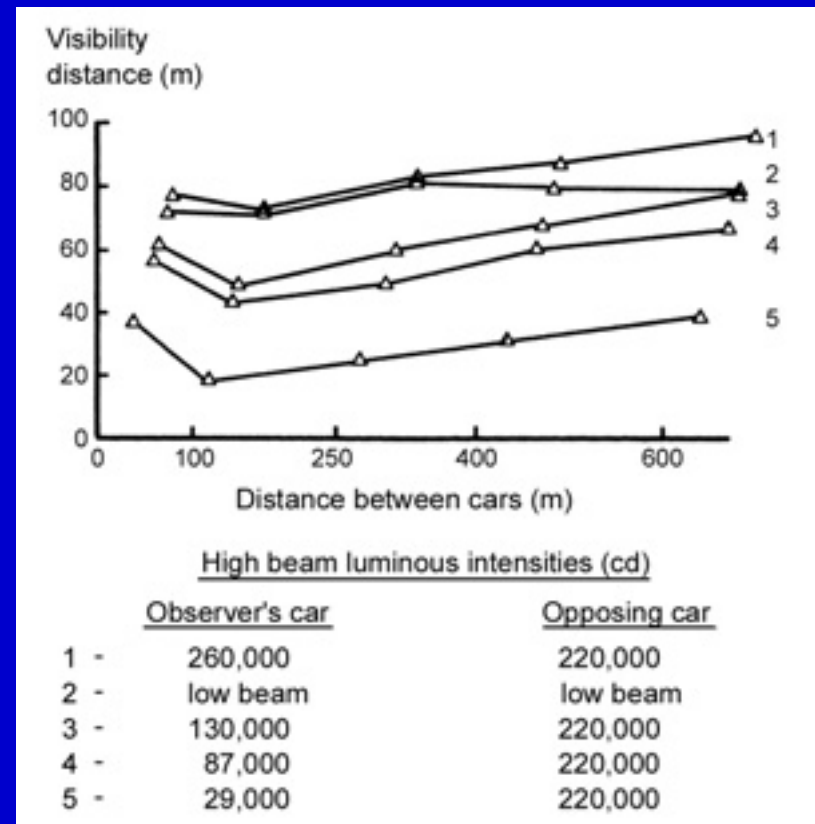




# What is the effect of disability glare on visibility, in practice?

**Helmers and Becker (1975)**

- For a small, dark-gray target, visibility distance without an opposing set of headlights is 220 m
- When an opposing set of headlights is present, visibility distance is reduced to about 40 to 80 m



# What is the effect of disability glare on visibility, in practice?

## Theeuwes and Alferdinck (1996)

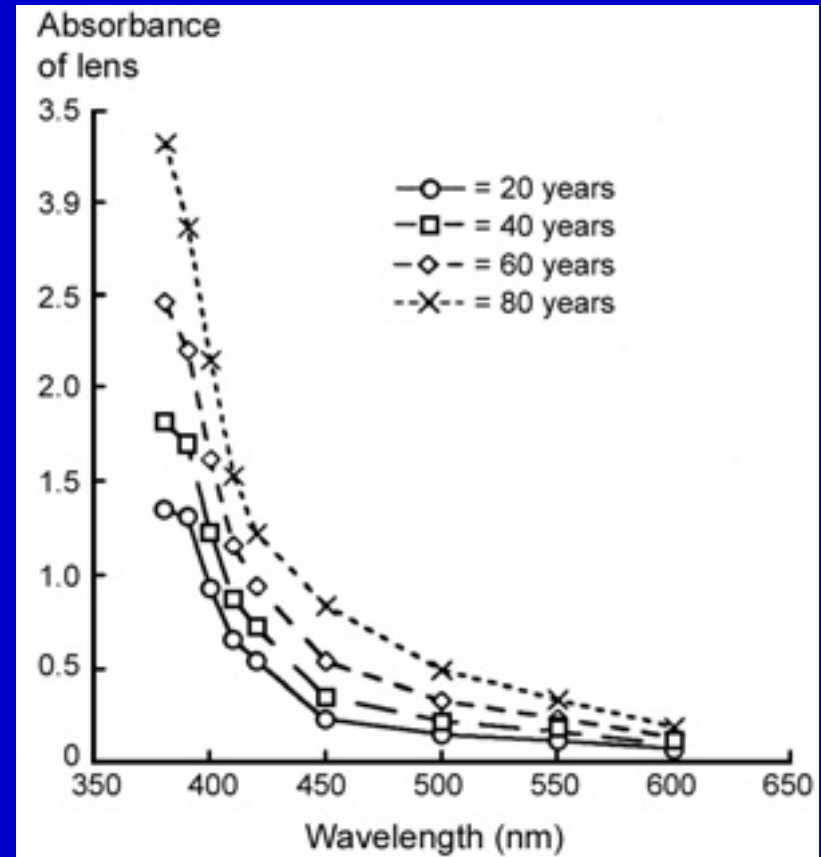
- People drove on roads at night with a glare source simulating the headlights of an approaching vehicle on the hood
- It was found that, with the glare source on:
  - ◆ People drove more slowly, particularly on dark, winding roads where lane-keeping was a problem
  - ◆ People missed more roadside targets
- These effects were largest for older drivers



# Which groups are particularly vulnerable to disability glare?

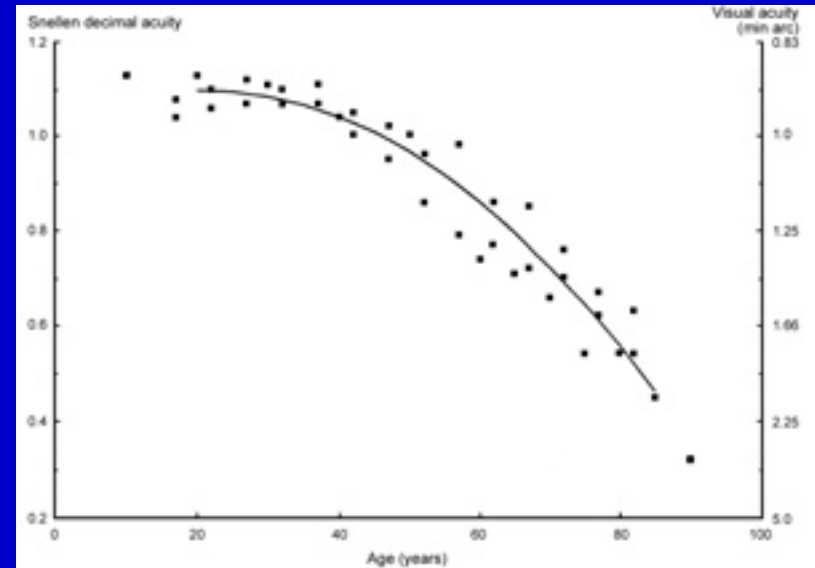
## The elderly, for four reasons

1. Older people are working at lower light levels, because of greater absorption of light on passage through the eye



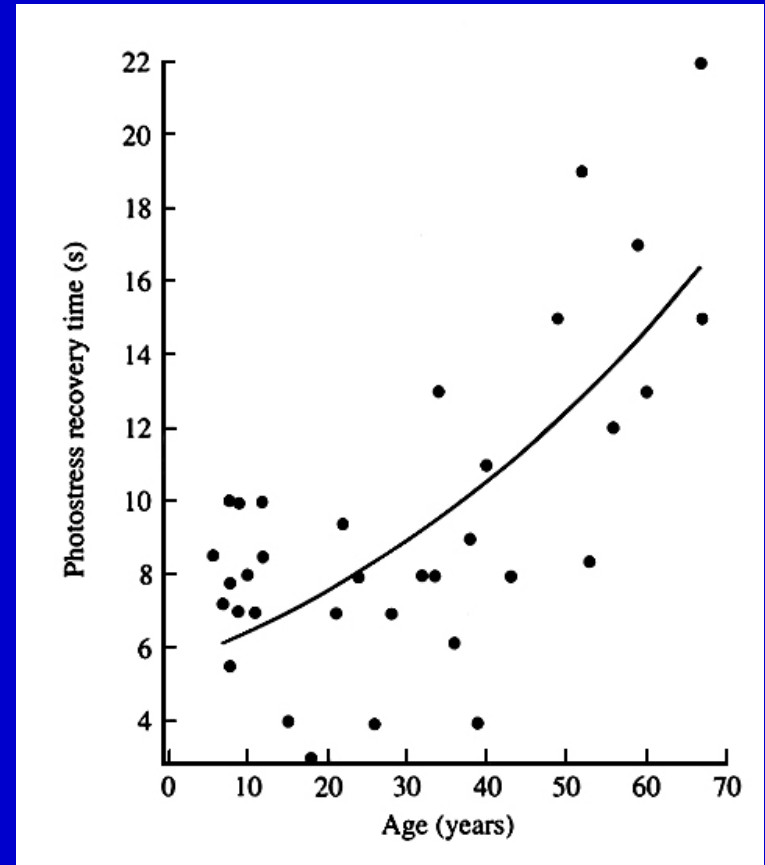
# Which groups are particularly vulnerable to disability glare?

2. The amount of light scatter is greater, so the equivalent veiling luminance is higher. Therefore visual acuity is reduced.



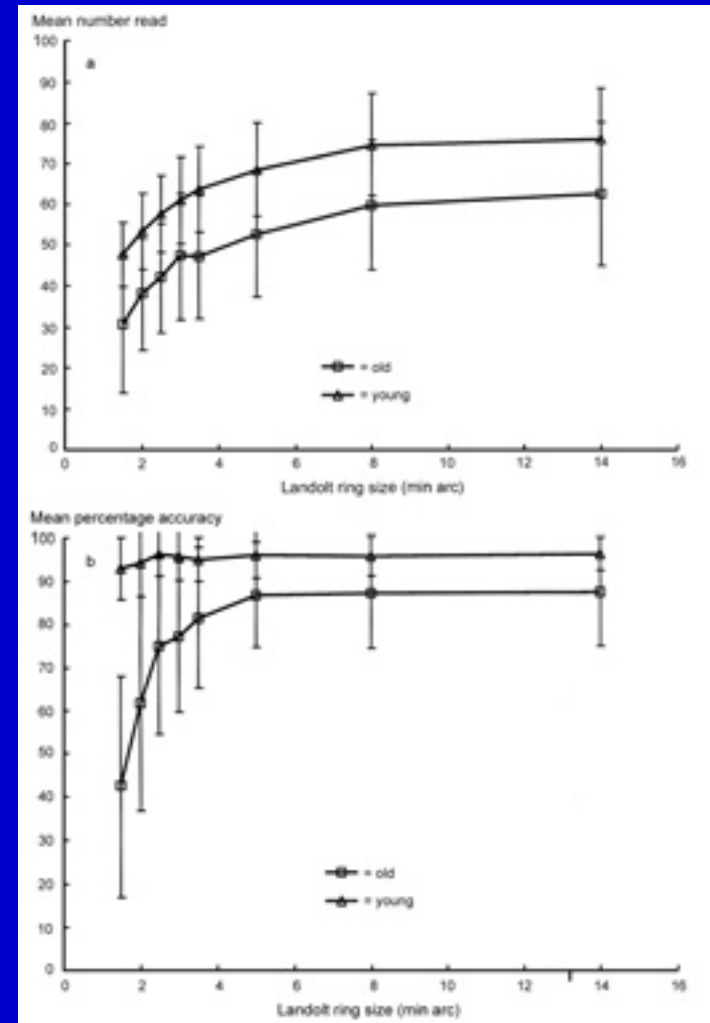
# Which groups are particularly vulnerable to disability glare?

3. Older people take longer to recover from exposure to glare



# Which groups are particularly vulnerable to disability glare?

4. Older people generally have a slower cognitive response



# What about discomfort glare?

- Taken literally, discomfort glare does not affect visual performance because if it did, it would be disability glare.
- Such semantics are not helpful. The difference between disability glare and discomfort glare is really a matter of measurement.
- Disability glare measures what you can do. Discomfort glare measures how you feel.

## **Disability glare is always possible because**

- All light sources produce some scattered light in the eye. Whether this affects the visibility of a target depends the ambient conditions and how close that target is to threshold. When it does, disability glare can be said to have occurred.

## **Discomfort glare is always possible because**

- Any light source that makes what needs to be seen more difficult to see will be considered uncomfortable.

# **Discomfort glare can occur without disability glare because**

- **The visual system can only deal with a limited luminance range at one instant in time**
- **How much discomfort is experienced will depend on both the stimulus conditions and on people's experience and expectations**

# **Will a glare source that produces only discomfort cause changes in visual performance?**

- **Not by reducing the luminance contrast of what needs to be seen**
- **But maybe by acting as a distraction**