

Aging-Related Vision Impairment and Its Relevance to Cognition

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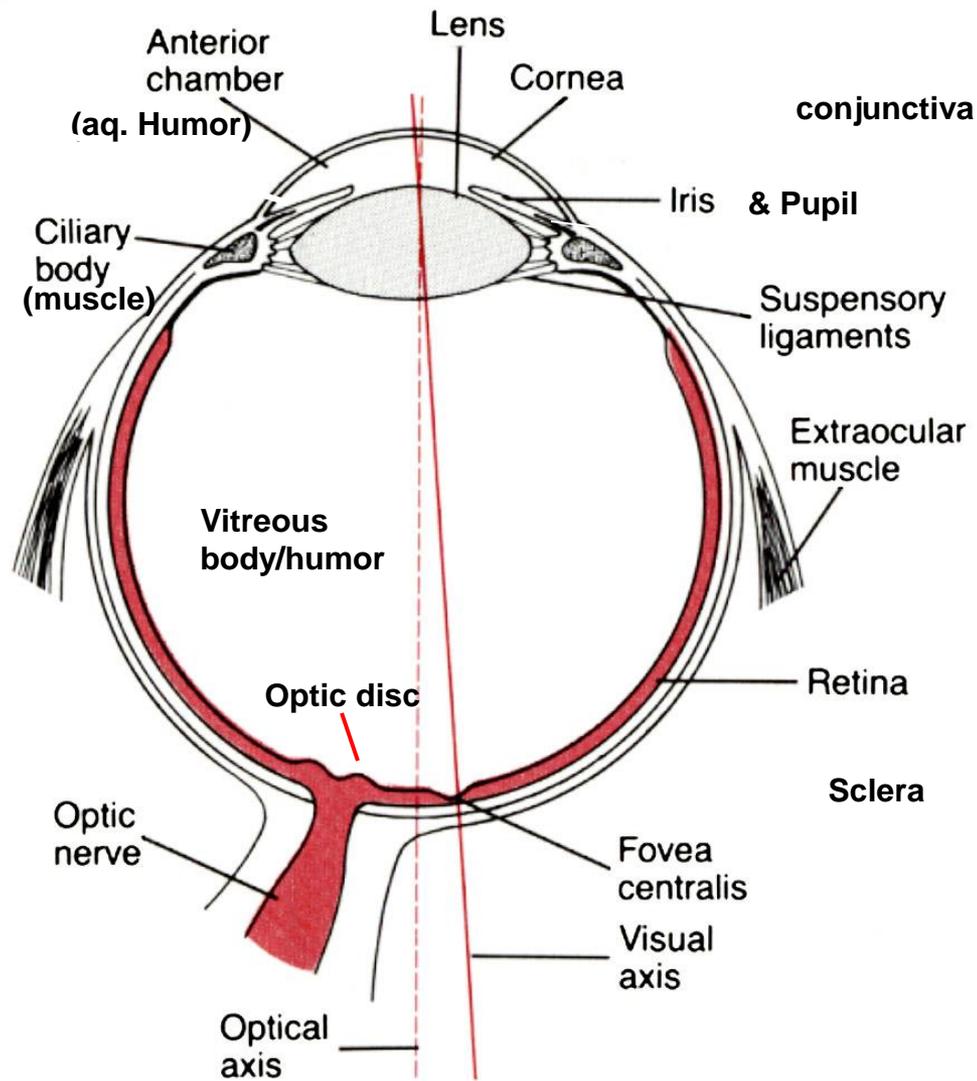
School of Medicine

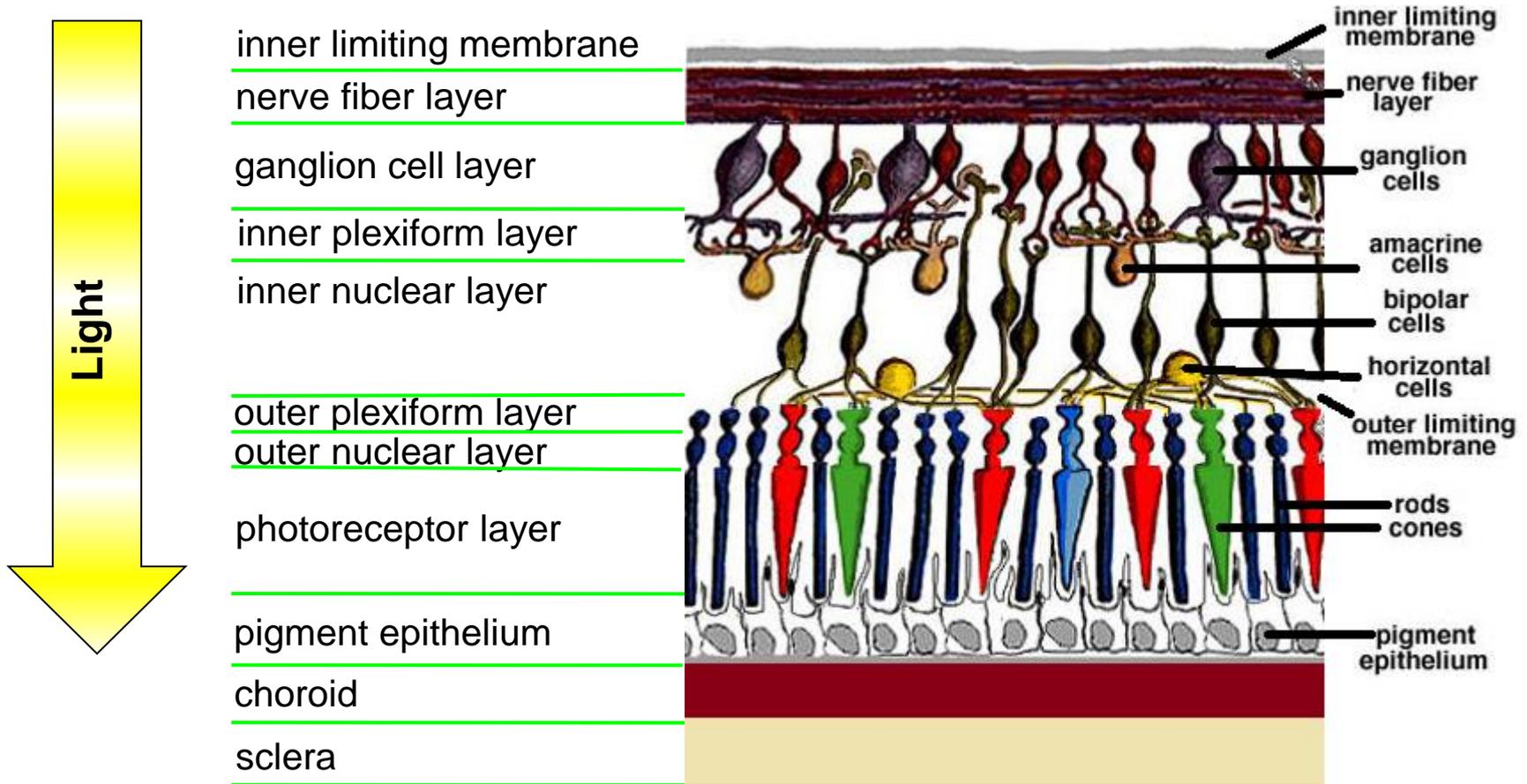
Callahan Eye Hospital

University of Alabama at Birmingham

Acknowledgments

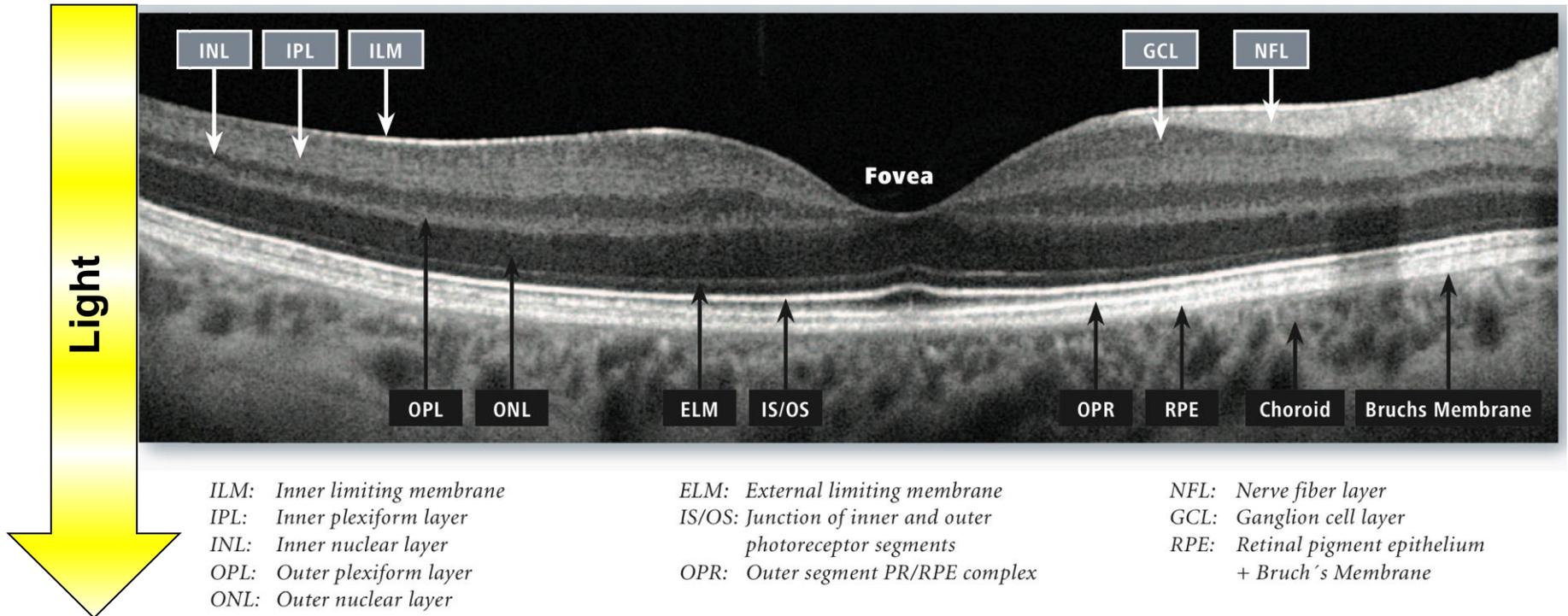
- National Institute on Aging
 - R01AG004212
 - P30AG022838
- National Eye Institute
 - R01EY018966
 - R21EY027817
 - P30EY003039
- Research to Prevent Blindness
- EyeSight Foundation of Alabama





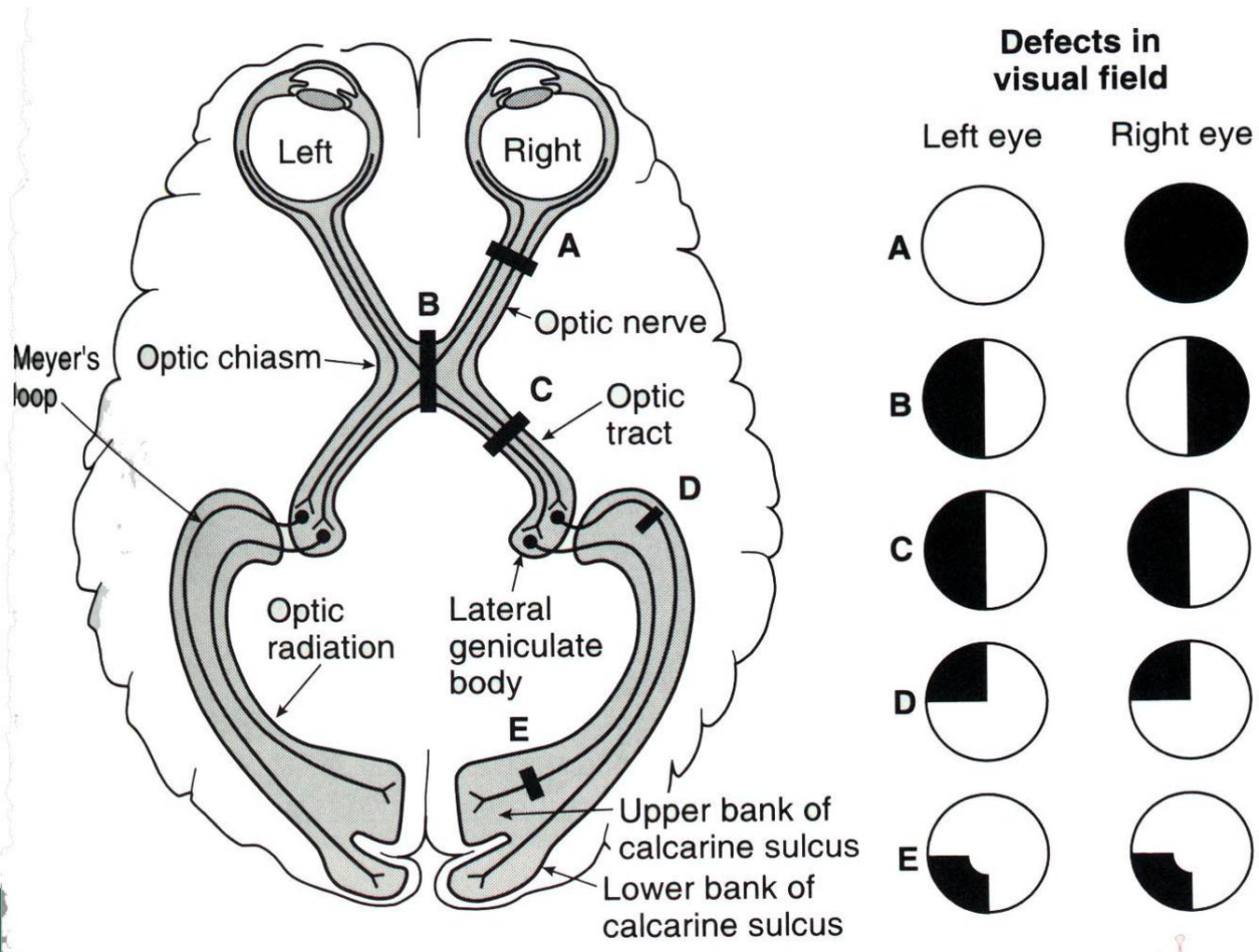
Plexiform layer = synapses
 Nuclear layer = cell bodies

Spectral Domain Optical Coherence Tomography (SDOCT)

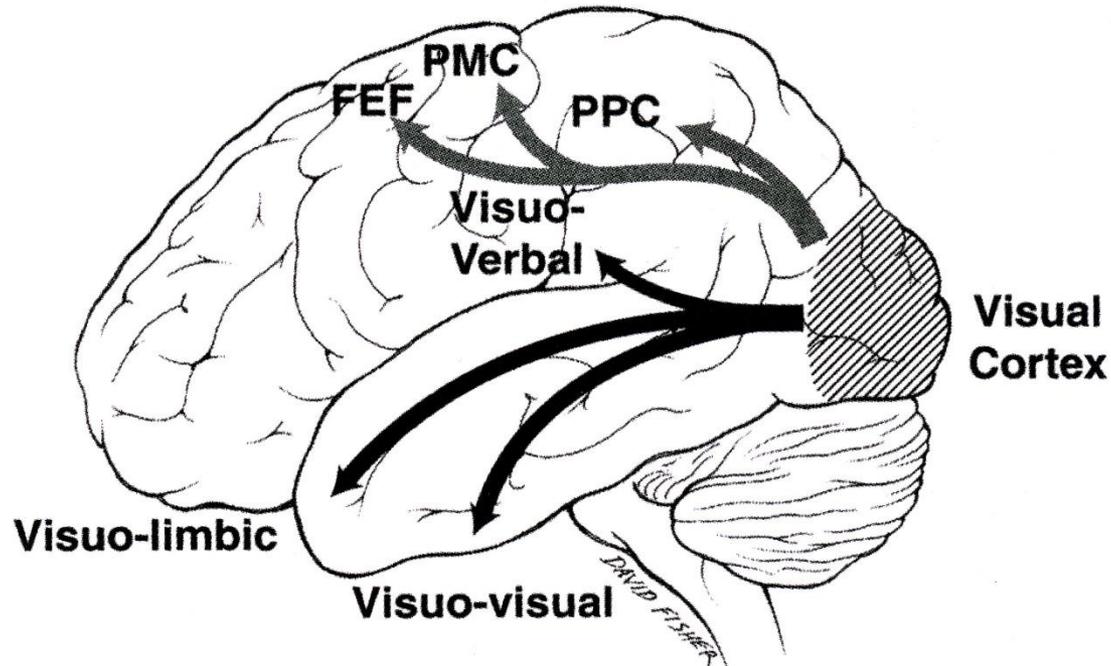


Plexiform layer = synapses
 Nuclear layer = cell bodies

- Visual field defects with Lesions along Geniculo-cortical pathway



Integrative Visual Pathways



← Dorsal Occipitofugal
"Where" pathway

← Ventral Occipitofugal
"What" pathway

[From JD Trobe. The Neurology of Vision. Oxford, 2001]

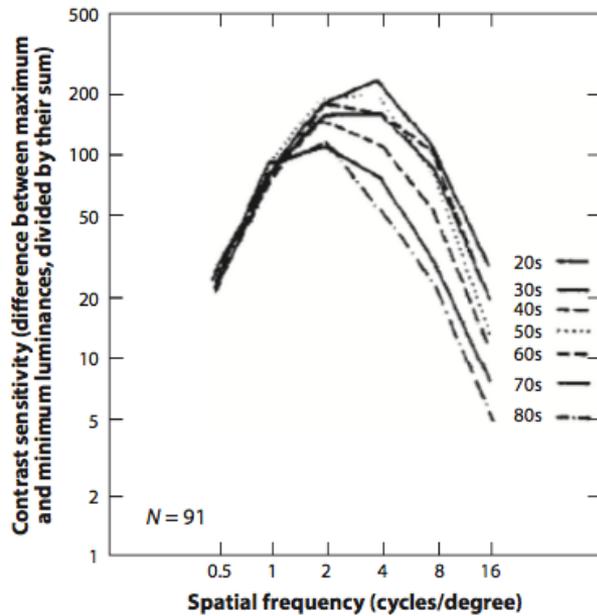
Common Aging-Related Vision Problems

- Spatial contrast sensitivity impairment
- Scotopic dysfunction
- Slowed visual processing speed

Owsley. *Annual Rev Vision Sci* 2016; 2: 255-271.

Owsley. *Vision Res* 2011; 51; 1610-1622.

Spatial contrast sensitivity loss

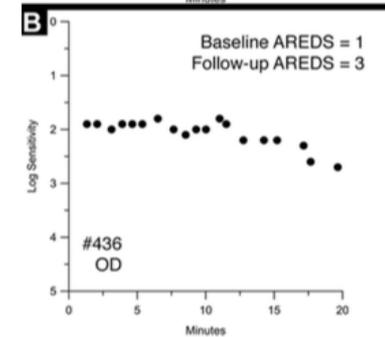
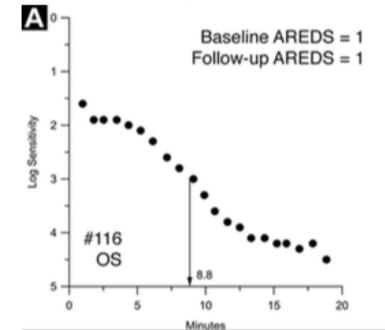
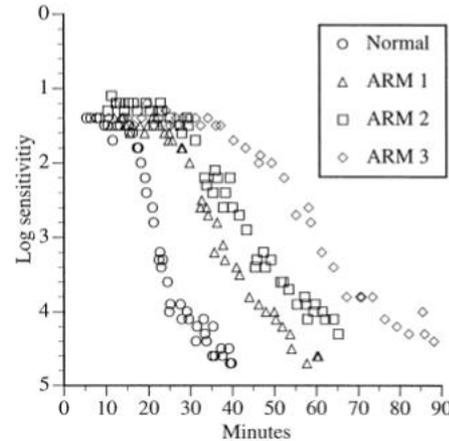
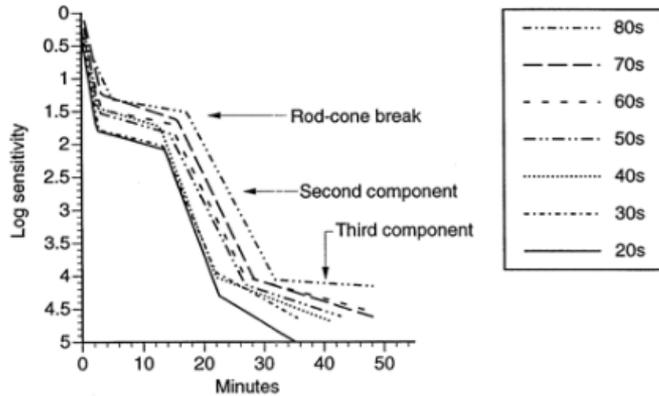


Owsley, Sekuler, Siemsen *Vision Res* 1983; 21: 689-699

Owsley et al. *Arch Ophthalmol* 2001; 119: 881-887

Owsley et al. *JAMA* 2002; 288: 841-849.

Slowed dark adaptation



Jackson, Owsley, McGwin. *Vision Res* 1999; 39: 3975-3982.
 Owsley et al. *Ophthalmology* 2001; 108: 1196-1202.
 Owsley et al. *Ophthalmology* 2016; 123: 344-351.

Slowed visual processing speed

- Time needed to make a correct judgment about a visual target or event.
- One of the most robust behavioral phenomena of human aging
- Deficits in many cognitive domains are associated with slowed visual processing speed
- Population-based studies indicate 1 out of 3-4 older adults have severe processing speed slowing.
- Slowed visual processing speed associated with many daily life difficulties.



Summarized in Owsley *Vision Res* 2013; 90: 52-56.

Vision-Cognition Relationships

- “Bottom-up” influences
 - Near visual acuity impairment associated with worse cognitive function several years later (Reyes-Ortiz et al. *JAGS* 2005; 53: 681-686)
 - Improving near vision by correcting refractive error reduces depressive symptoms in nursing home residents (Owsley et al. *Arch Ophthalmol* 2007; 125: 1471-1477)
- “Top-down” influences
 - Semantically salient visual targets are located and fixated more rapidly than cognitively irrelevant targets (Henderson et al. *Psychon Bull Rev* 2009; 16: 850-856).
 - A “preferred retinal locus” (when foveal fixation is not possible) is more likely to be located in a retinal area where sustained attentional performance is at its best (Barraza-Bernal et al. *Vision Res* 2017; 140: 1-12.)
- “Common cause” hypotheses (Olderbak et al. *Frontiers in Psychology* 2015; 6: 1189)

Plasticity

- When the macula has an absolute scotoma due to end-stage AMD, is the visual cortical area devoted to the fovea recruited for other purposes?
- “Brain training” for older adults: most of these exercises rely on visual stimulation– can aging-related cognitive declines be mitigated or postponed by these practice with these visual exercises?

Thank you
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Callahan Eye Hospital at UAB

Kinetic sculpture
"Complex Vision"
Artist: Yaacov Agam