

Lecture 19 – Data Visualization

Learning Objectives:

6. Learn how to document your work and prepare scientific publications.

6.1 Learn the basic principles of data visualization.

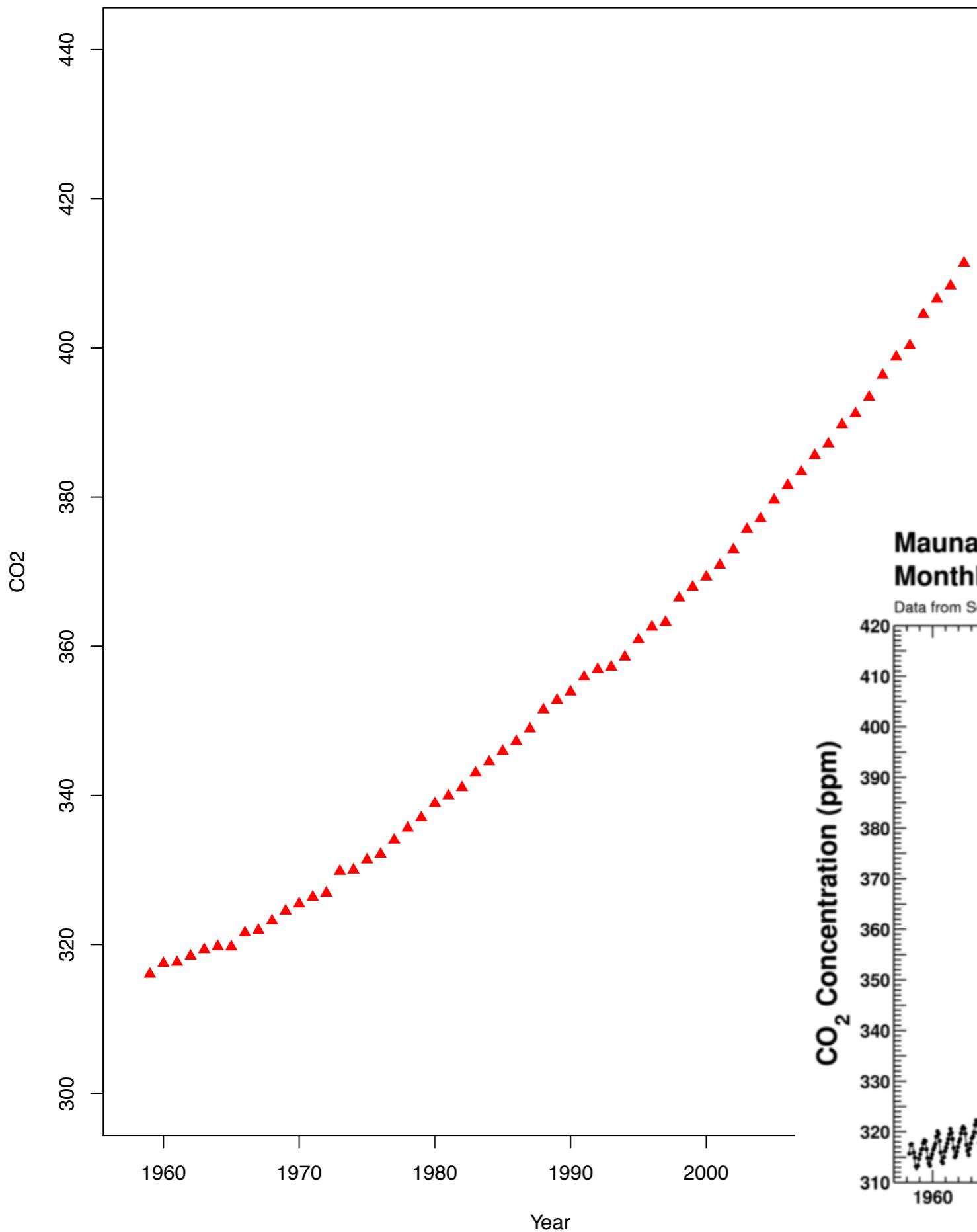
6.2 List some things to use and things to avoid when creating visualizations.

Why create data visualizations?

https://www.ted.com/talks/david_mccandless_the_beauty_of_data_visualization

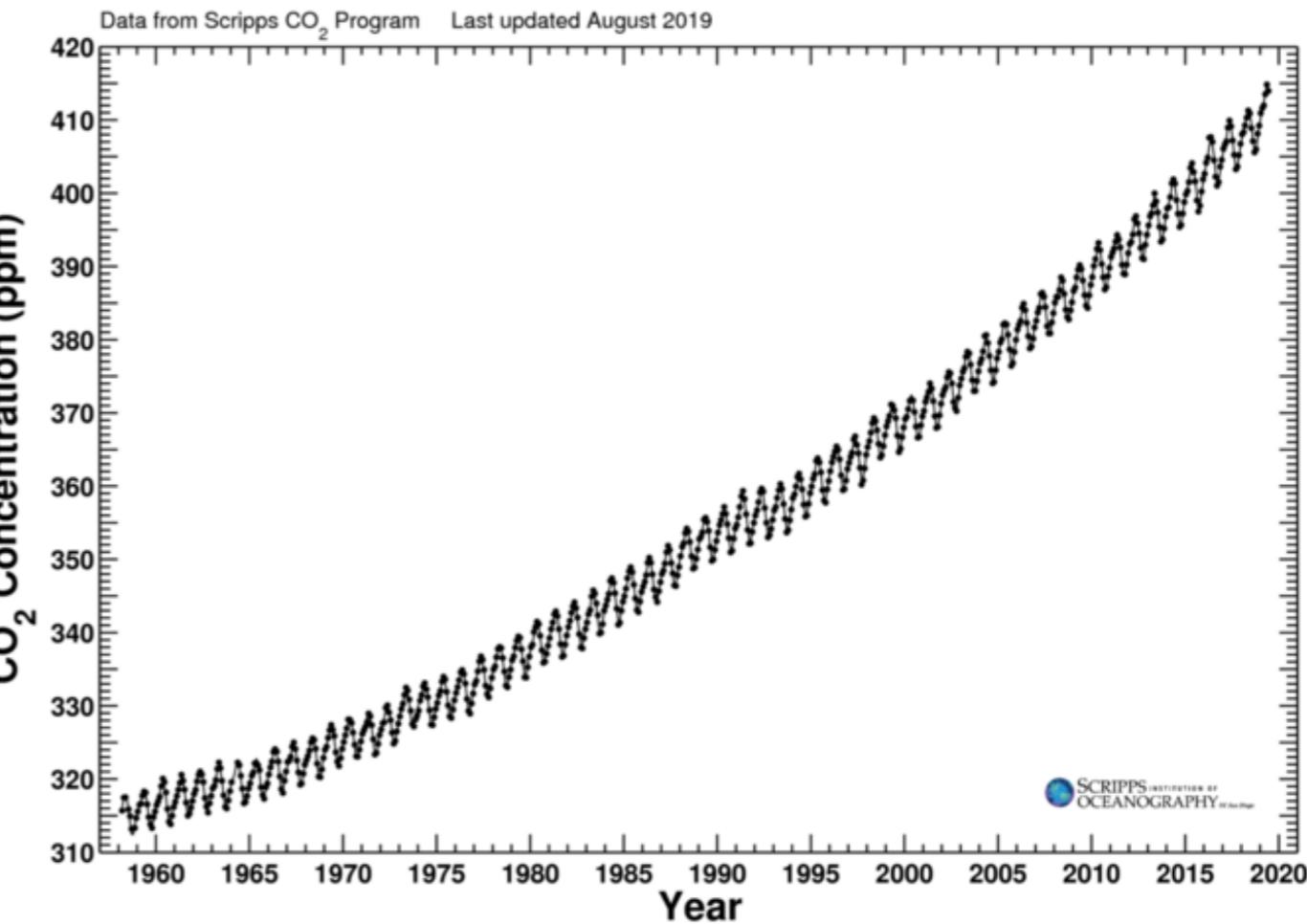
2003	4	37726	2003.2877	377.65	374.98	377.82	375.13	377.65	374.98
2003	5	37756	2003.3699	378.35	375.11	378.58	375.33	378.35	375.11
2003	6	37787	2003.4548	378.13	375.67	377.97	375.54	378.13	375.67
2003	7	37817	2003.5370	376.60	375.82	376.48	375.73	376.60	375.82
2003	8	37848	2003.6219	374.48	375.94	374.43	375.92	374.48	375.94
2003	9	37879	2003.7068	372.98	376.32	372.74	376.10	372.98	376.32
2003	10	37909	2003.7890	373.00	376.46	372.82	376.27	373.00	376.46
2003	11	37940	2003.8740	374.35	376.51	374.29	376.43	374.35	376.51
2003	12	37970	2003.9562	375.69	376.58	375.70	376.57	375.69	376.58
2004	1	38001	2004.0410	376.79	376.75	376.76	376.71	376.79	376.75
2004	2	38032	2004.1257	377.37	376.64	377.57	376.84	377.37	376.64
2004	3	38061	2004.2049	378.39	376.89	378.48	376.96	378.39	376.89
2004	4	38092	2004.2896	380.50	377.80	379.80	377.08	380.50	377.80
2004	5	38122	2004.3716	380.62	377.36	380.44	377.19	380.62	377.36
2004	6	38153	2004.4563	379.55	377.11	379.72	377.31	379.55	377.11
2004	7	38183	2004.5383	377.76	377.00	378.16	377.43	377.76	377.00
2004	8	38214	2004.6230	375.83	377.32	376.04	377.57	375.83	377.32
2004	9	38245	2004.7077	374.05	377.41	374.34	377.72	374.05	377.41
2004	10	38275	2004.7896	374.22	377.69	374.43	377.88	374.22	377.69
2004	11	38306	2004.8743	375.84	378.01	375.92	378.06	375.84	378.01
2004	12	38336	2004.9563	377.44	378.33	377.37	378.25	377.44	378.33
2005	1	38367	2005.0411	378.34	378.30	378.50	378.45	378.34	378.30
2005	2	38398	2005.1260	379.61	378.88	379.40	378.66	379.61	378.88
2005	3	38426	2005.2027	380.08	378.60	380.36	378.86	380.08	378.60
2005	4	38457	2005.2877	382.05	379.36	381.78	379.08	382.05	379.36
2005	5	38487	2005.3699	382.24	378.98	382.55	379.29	382.24	378.98
2005	6	38518	2005.4548	382.08	379.61	381.96	379.51	382.08	379.61
2005	7	38548	2005.5370	380.66	379.87	380.48	379.72	380.66	379.87
2005	8	38579	2005.6219	378.67	380.13	378.44	379.94	378.67	380.13
2005	9	38610	2005.7068	376.42	379.78	376.77	380.15	376.42	379.78
2005	10	38640	2005.7890	376.80	380.28	376.88	380.35	376.80	380.28
2005	11	38671	2005.8740	378.31	380.48	378.39	380.55	378.31	380.48
2005	12	38701	2005.9562	379.96	380.85	379.86	380.73	379.96	380.85
2006	1	38732	2006.0411	381.37	381.32	380.97	380.91	381.37	381.32
2006	2	38763	2006.1260	382.02	381.29	381.82	381.09	382.02	381.29
2006	3	38791	2006.2027	382.56	381.07	382.74	381.23	382.56	381.07
2006	4	38822	2006.2877	384.36	381.67	384.10	381.39	384.36	381.67
2006	5	38852	2006.3699	384.92	381.65	384.81	381.53	384.92	381.65
2006	6	38882	2006.4548	384.66	381.55	384.44	381.40	384.66	381.55

Seasonally adjusted CO₂ measured at Mauna Loa 1958–2019

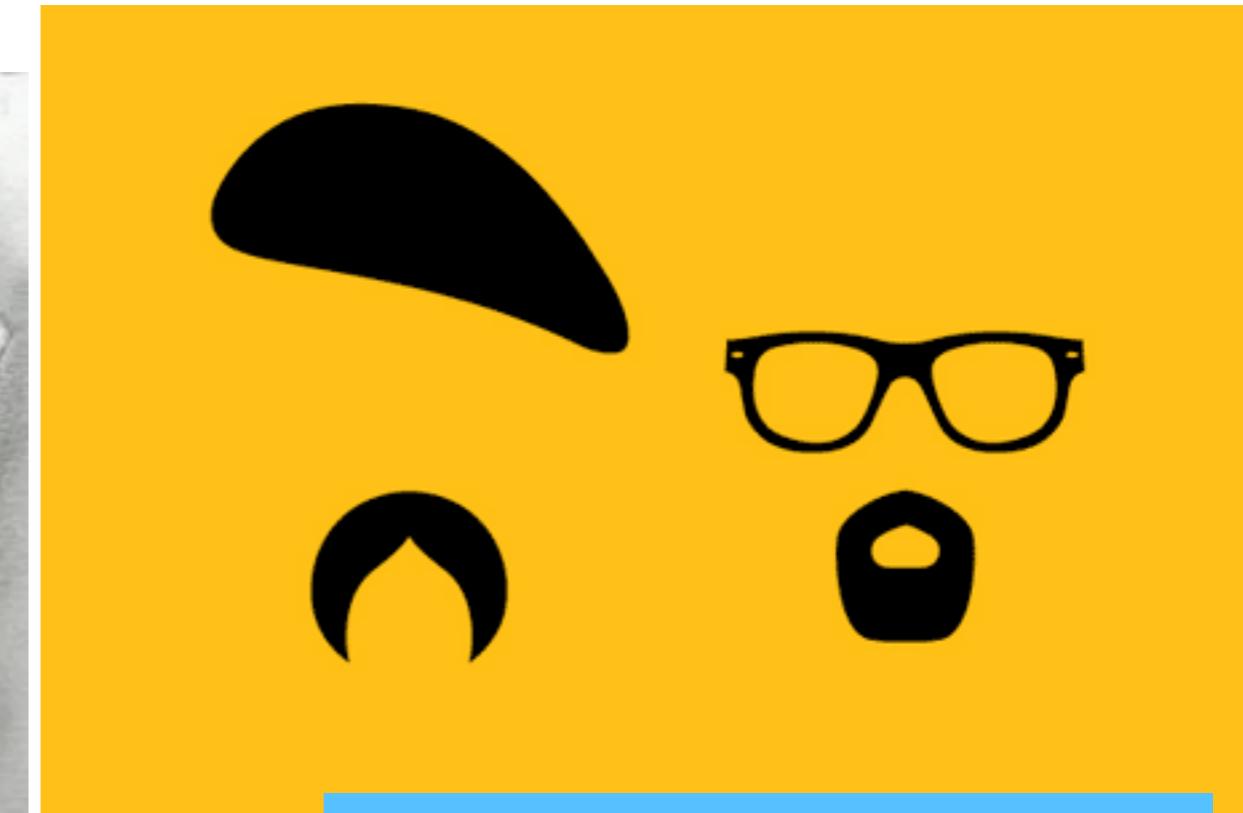
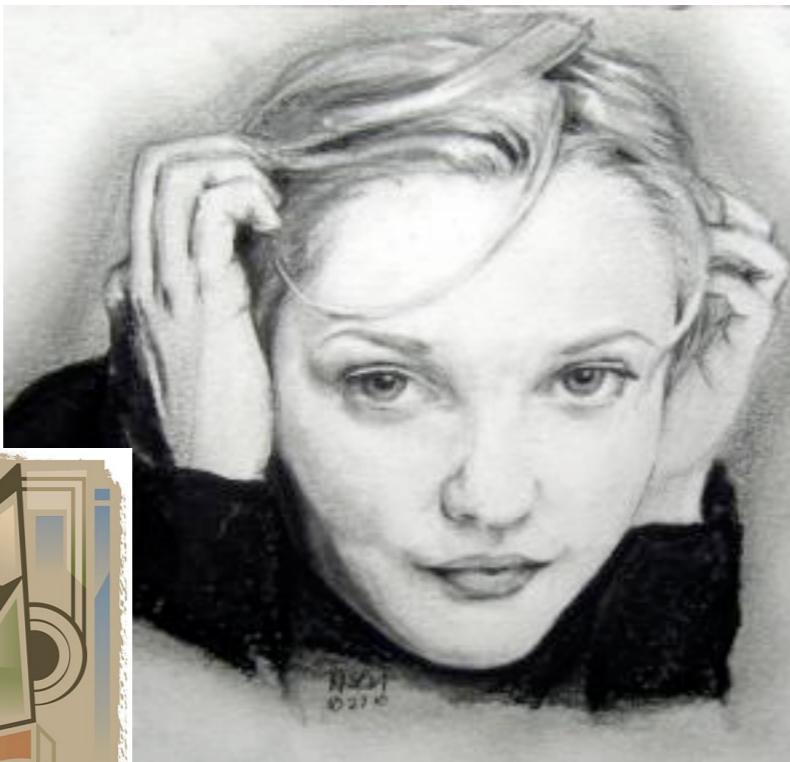


What makes some visualizations better than others?

**Mauna Loa Observatory, Hawaii
Monthly Average Carbon Dioxide Concentration**



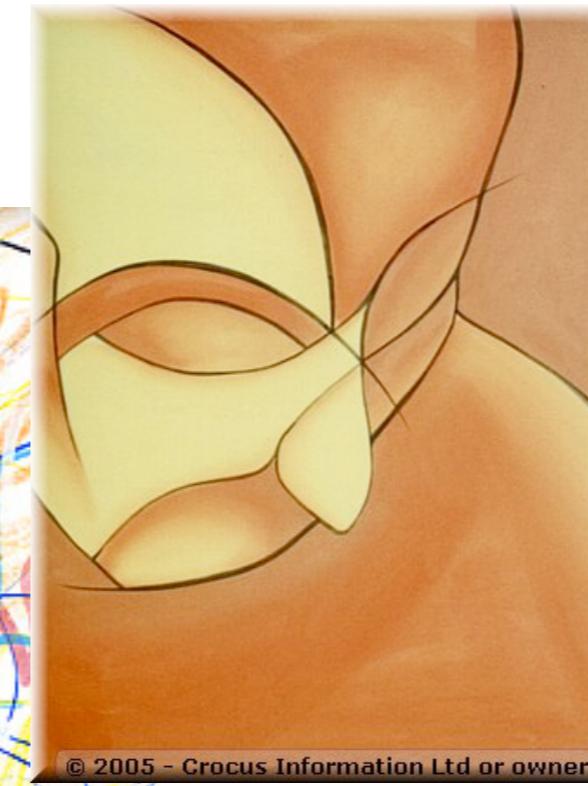
Visualization of a concept in art



Why do we see faces (even when they aren't there)?



© MDE-ART.COM



© 2005 - Crocus Information Ltd or owner



Outlet98



**How can we *reliably* create
powerful visualizations?**

Why create data visualizations?

**What makes some visualizations
better than others?**

**Why do we see faces (even
when they aren't there)?**

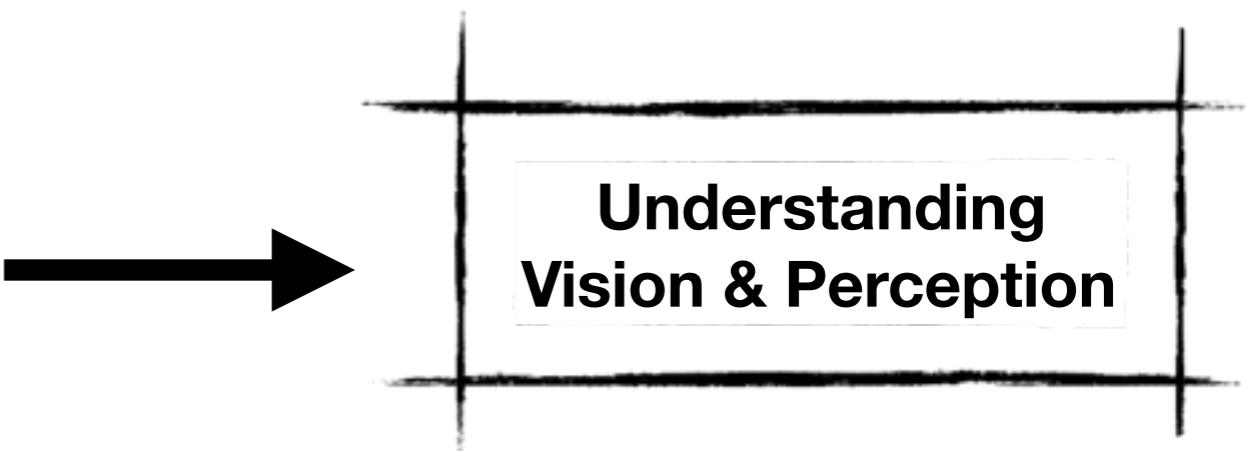
**How can we *reliably* create
powerful visualizations?**

Why create data visualizations?

What makes some visualizations
better than others?

Why do we see faces (even
when they aren't there)?

How can we *reliably* create
powerful visualizations?

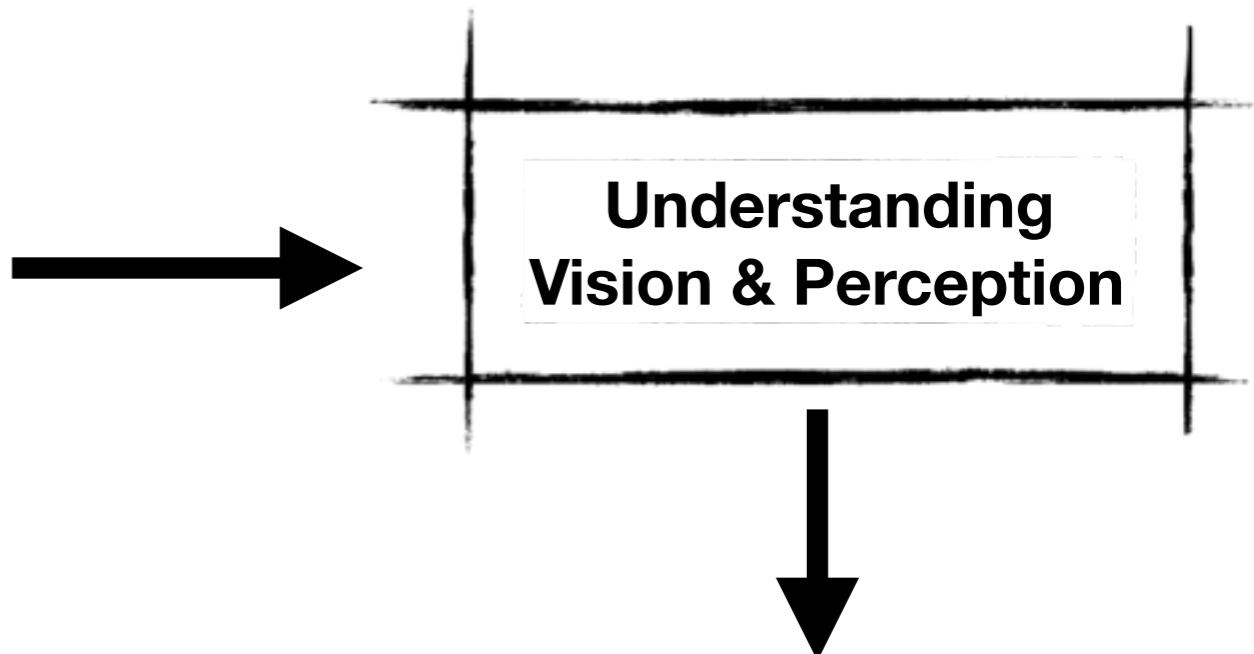


Why create data visualizations?

What makes some visualizations better than others?

Why do we see faces (even when they aren't there)?

How can we *reliably* create powerful visualizations?

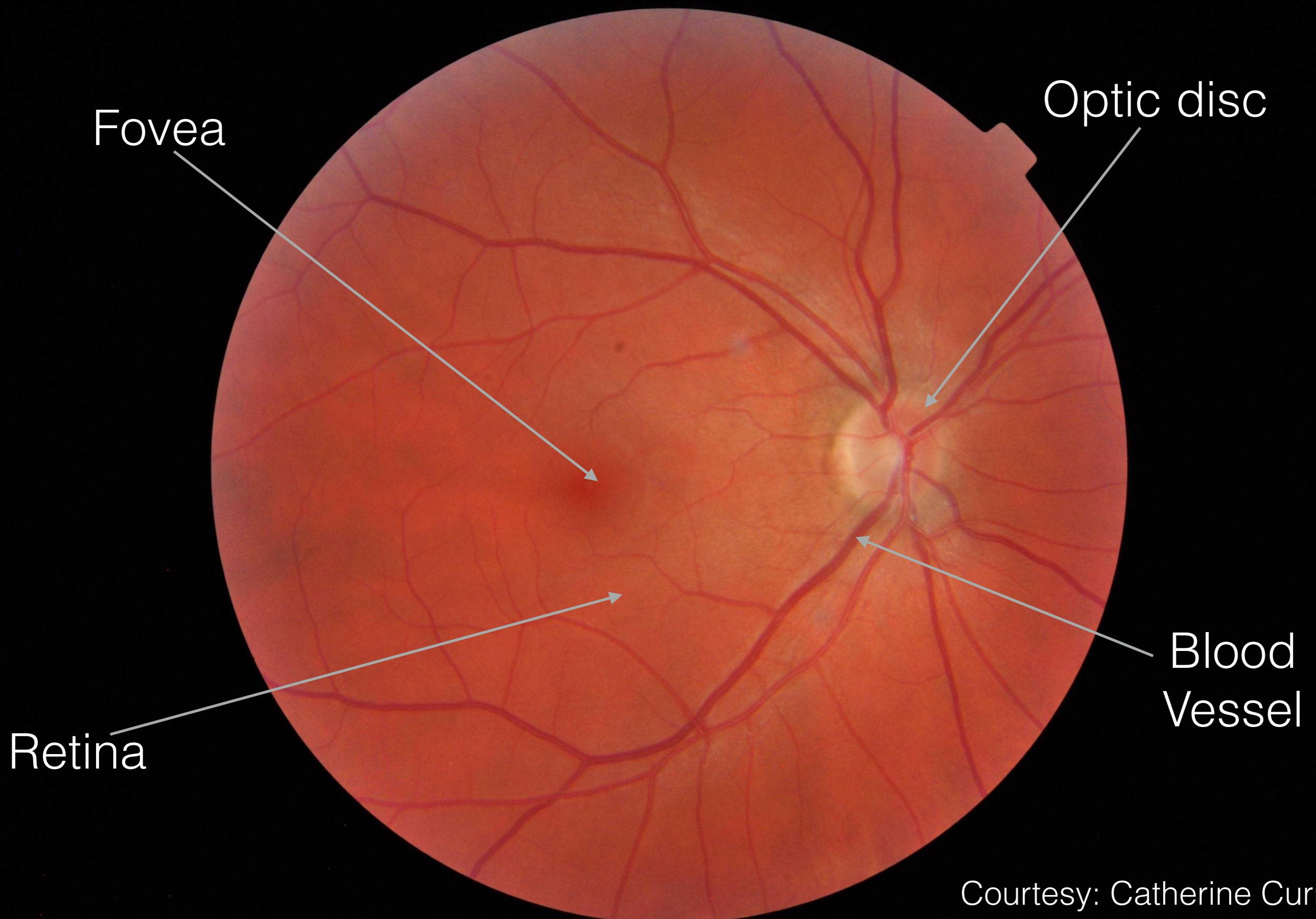


1. Contrast is Queen

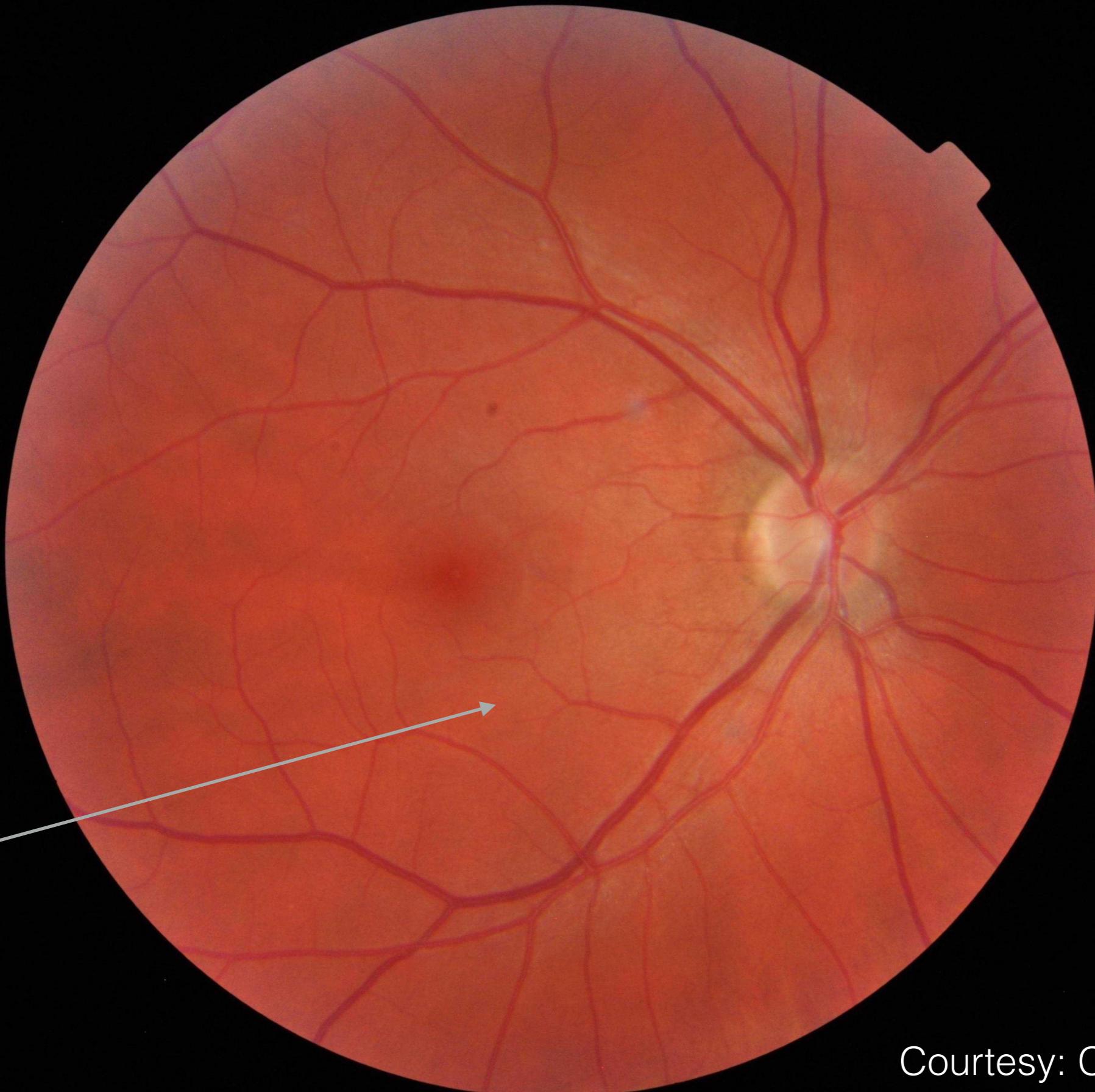
2. You don't see by transmitting images

3. Acuity drops from the center of vision

1. Contrast is Queen – This is My Eyeball.

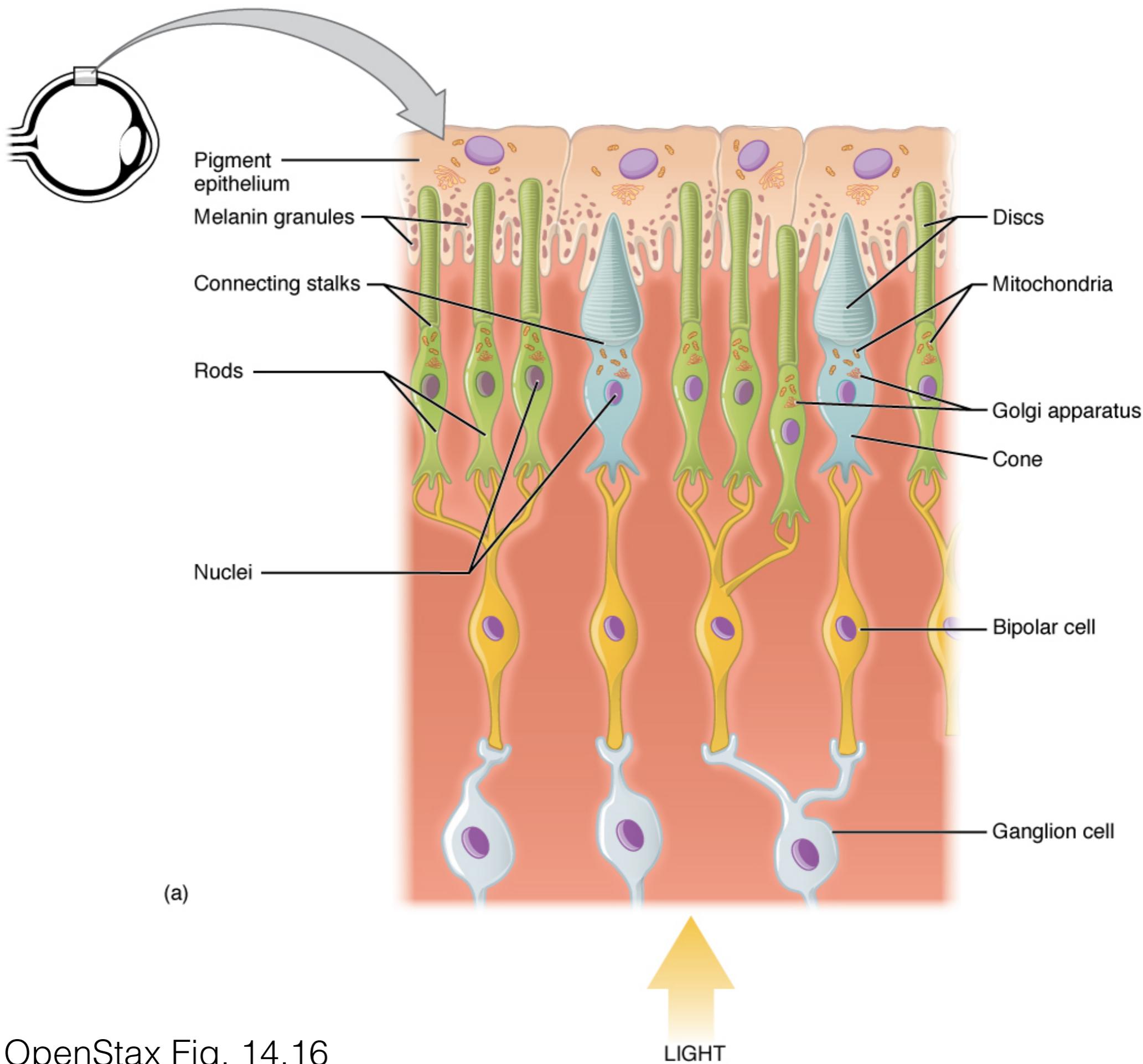


1. Contrast is Queen – This is My Eyeball.



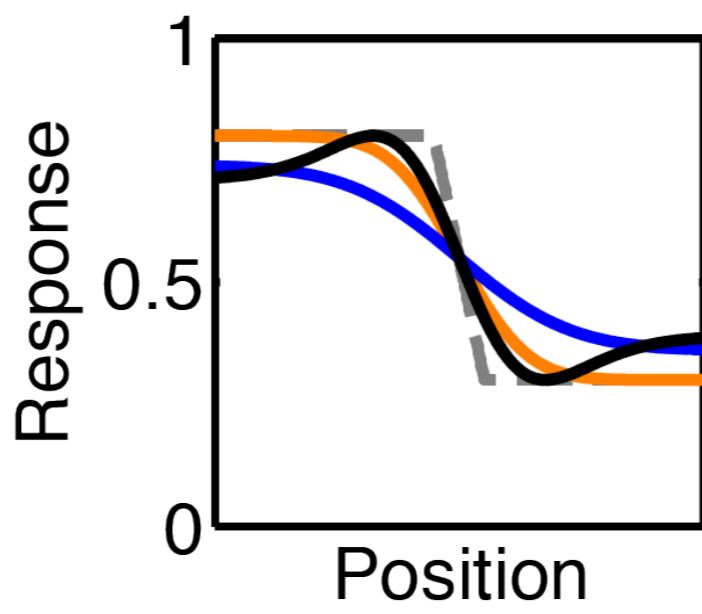
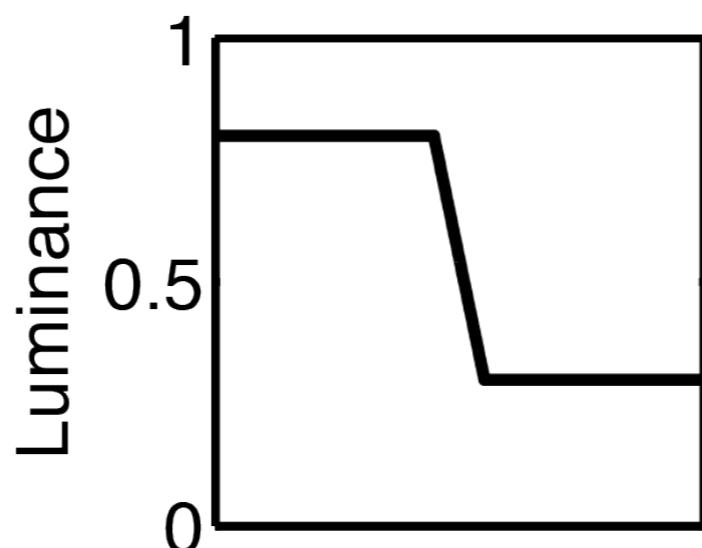
Retina

Courtesy: Catherine Currie

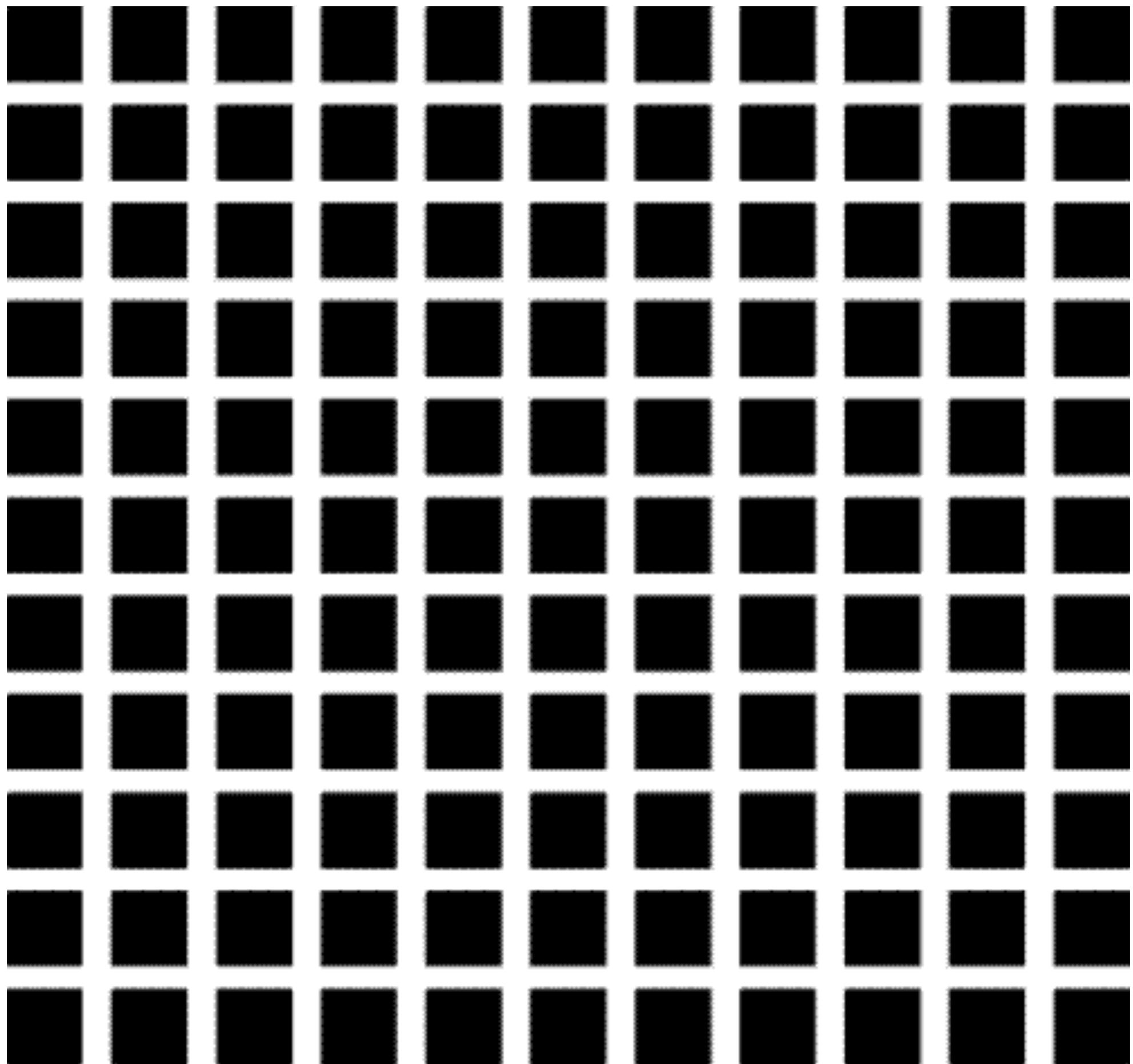


OpenStax Fig. 14.16

How Contrast Works

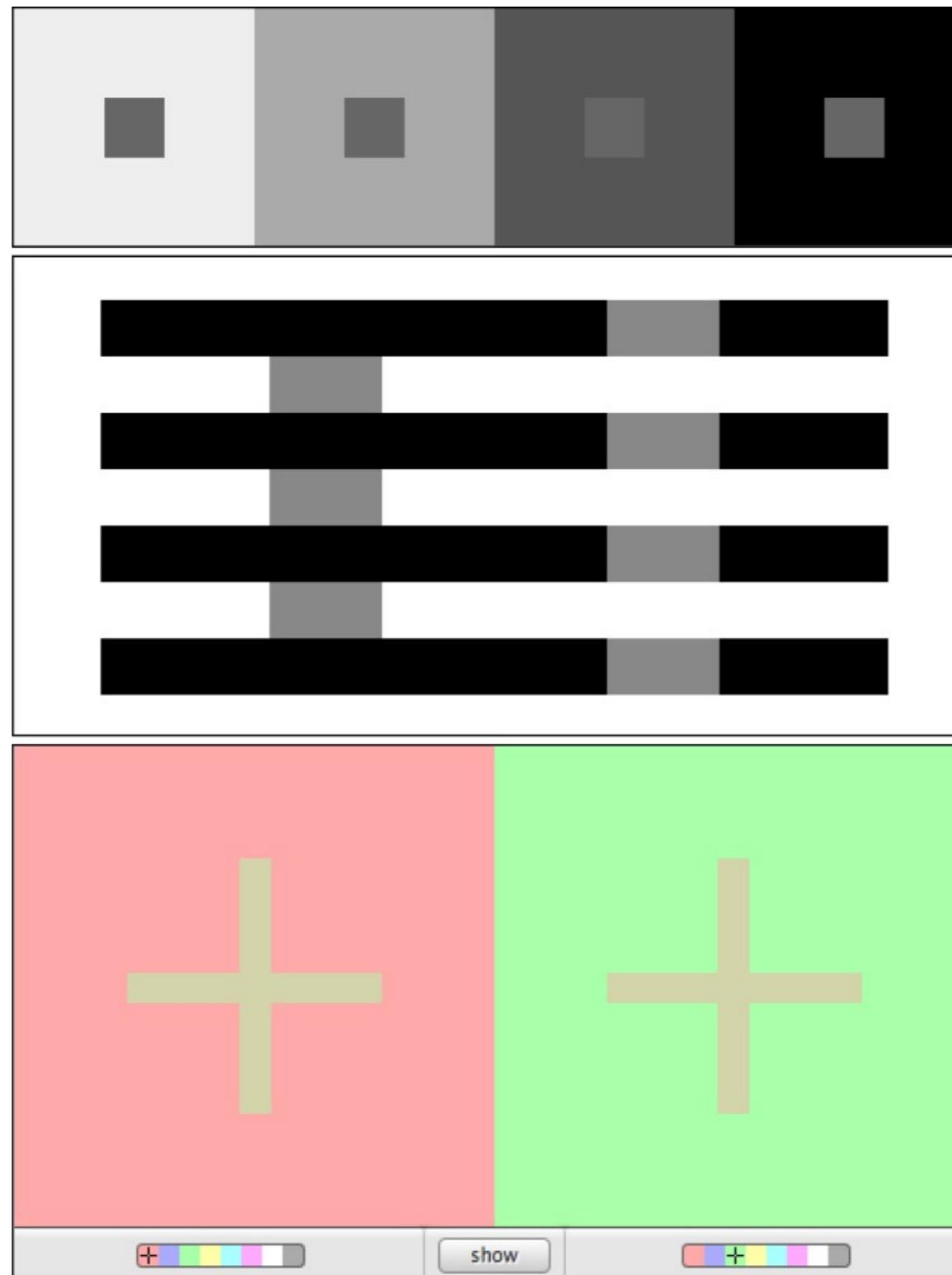


Mach band illusion
Hartline and Ratliff 1957
Dylan Muir

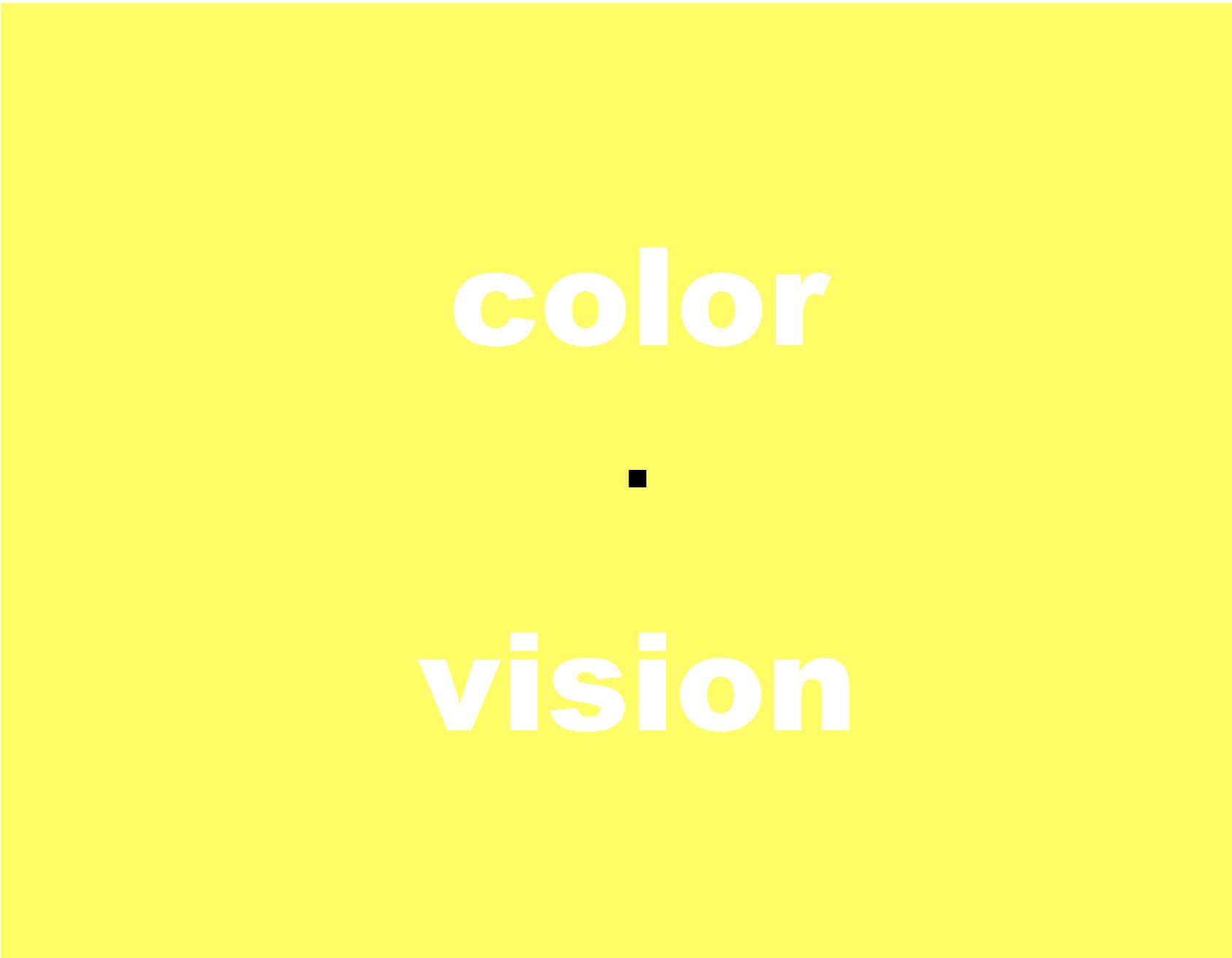


Contrast makes luminance tricky!

This text is white.

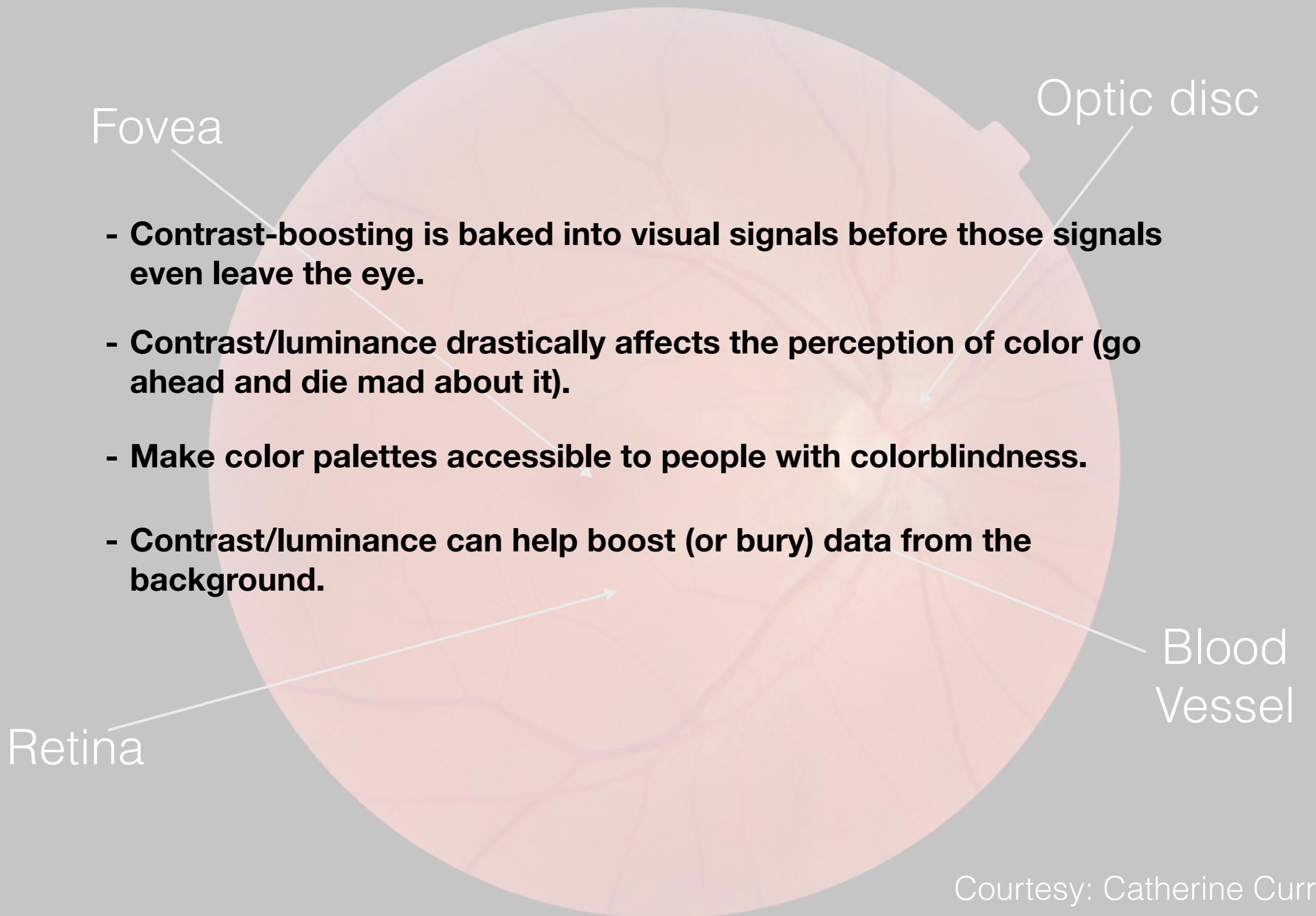


Contrast makes luminance tricky!

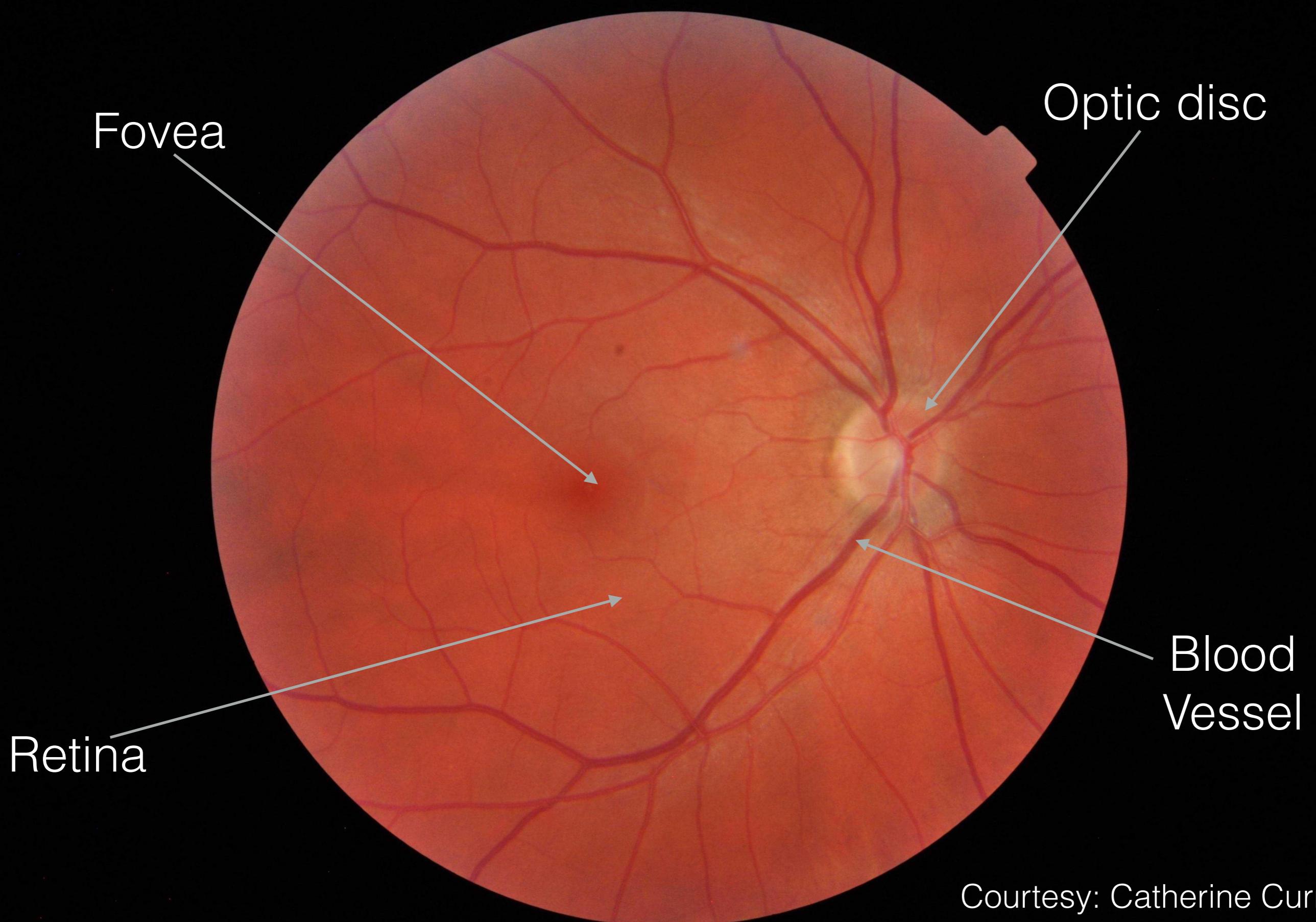


Contrast makes luminance tricky!

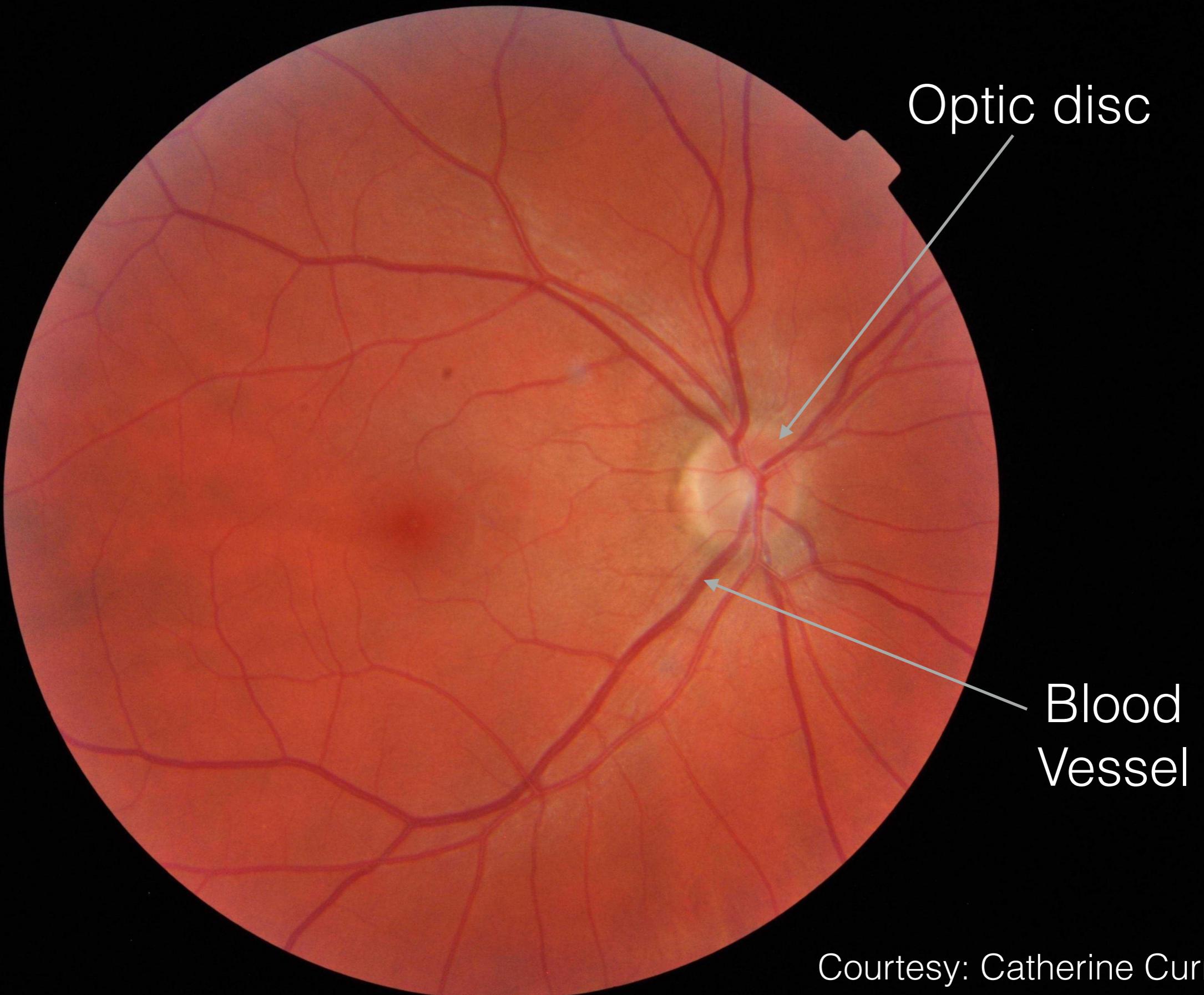
1. Contrast is Queen



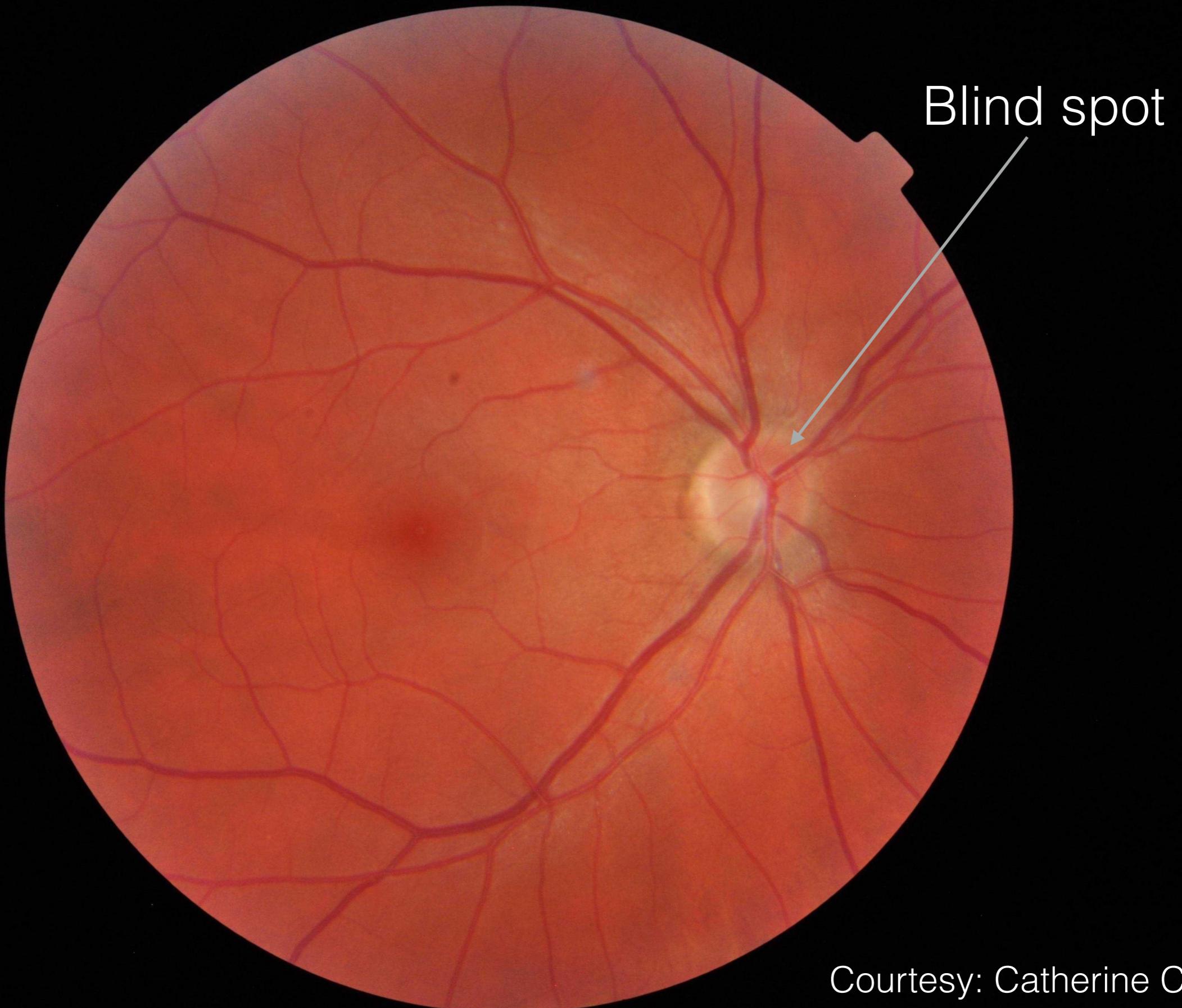
2. You don't see by transmitting images



2. You don't see by transmitting images



2. You don't see by transmitting images



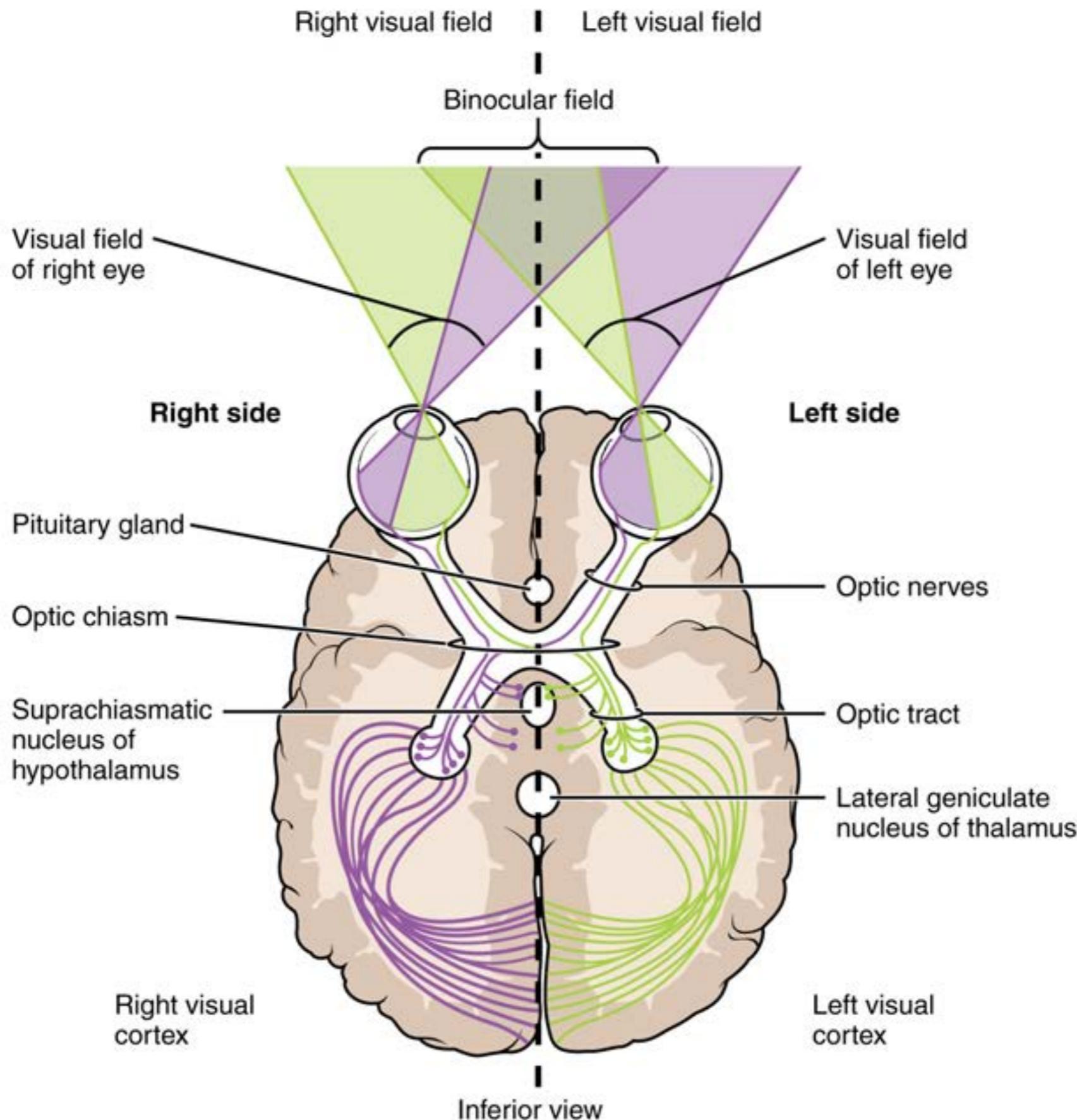
Courtesy: Catherine Currie

Find Your Blind Spot

O

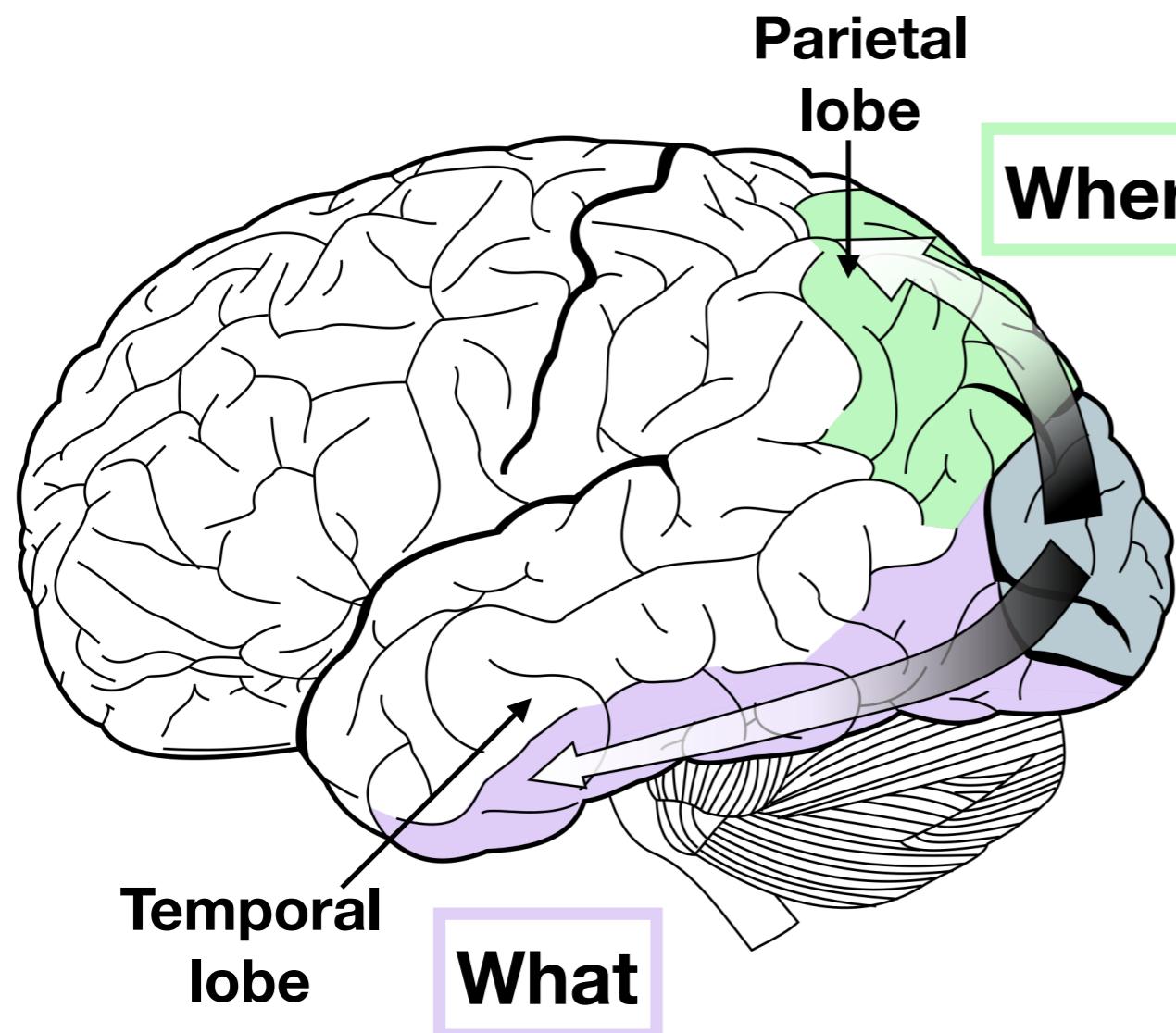
X

Visual Field Tracts



OpenStax Fig. 14.22

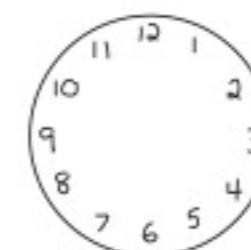
Visual Field Processing



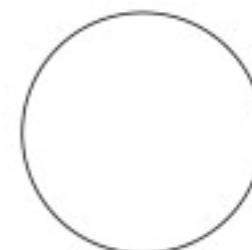
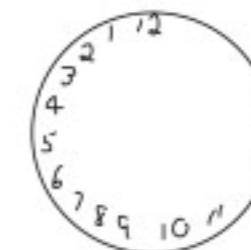
Where system
Visual guiding
Motion
Colorblind
Calculated across retina

Breaks

Normal patterns:



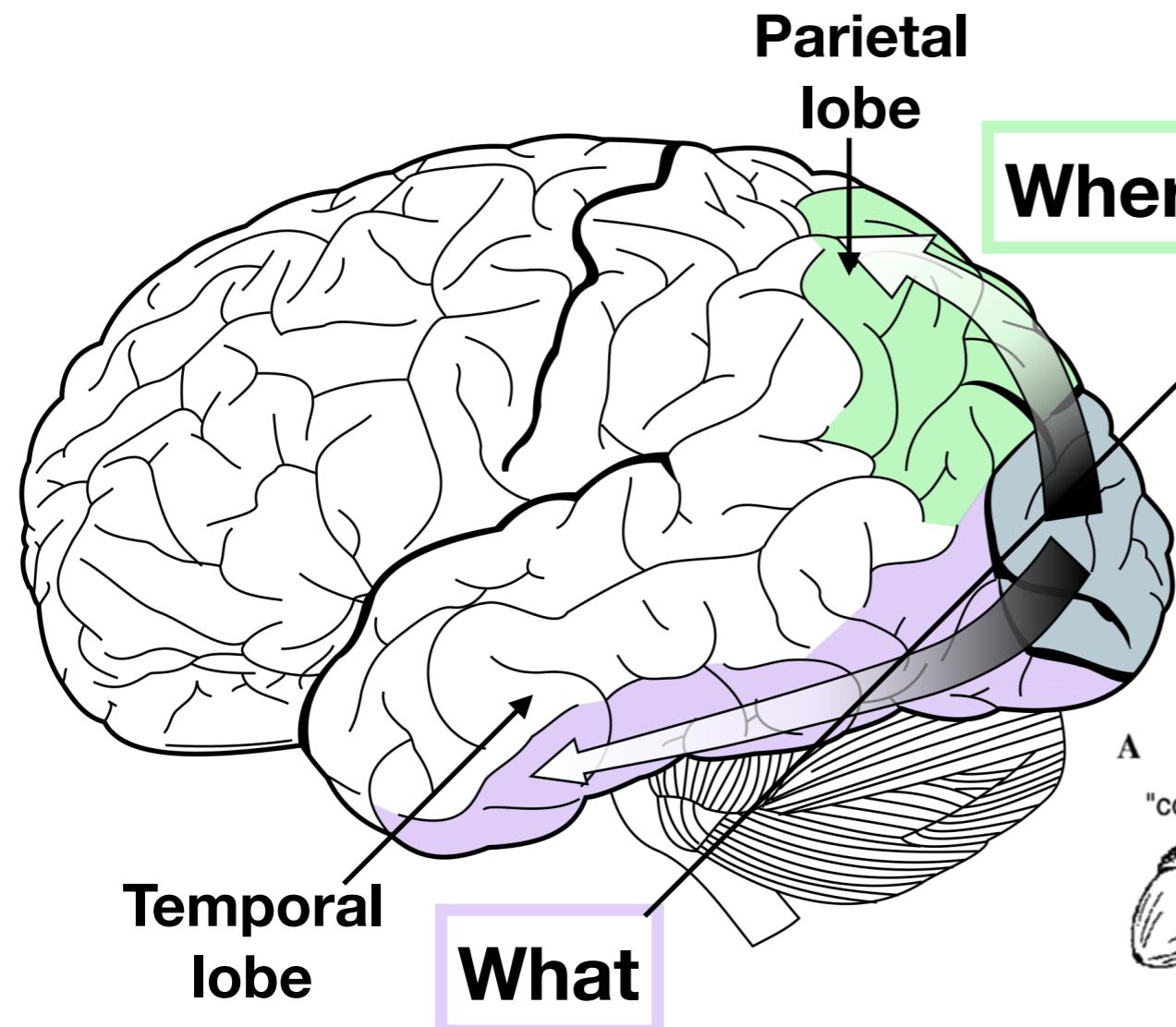
Abnormal patterns:



Note: colors do not correspond to visual tracts slide!

McGee, Mental Status exam, 2012

Visual Field Processing

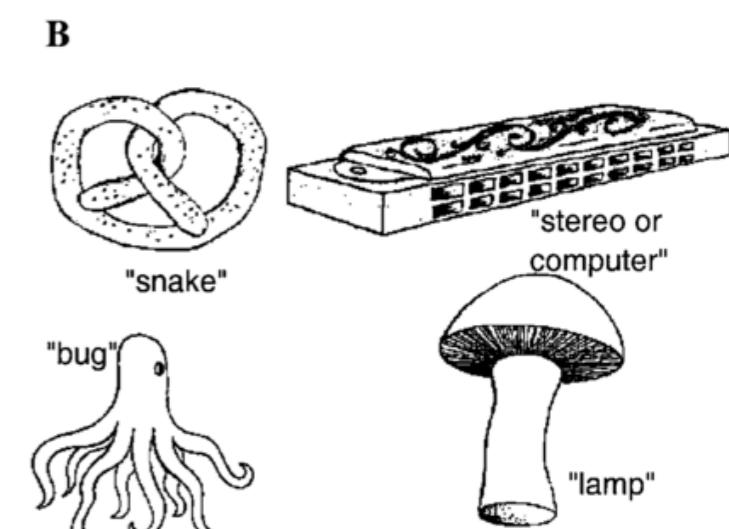
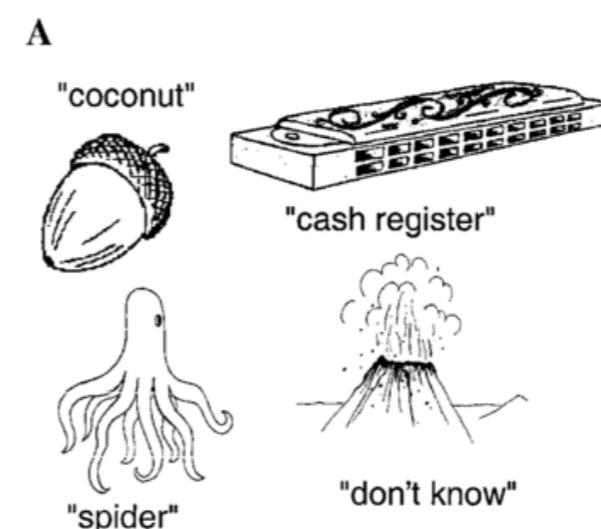


What system

Object recognition
Detailed but slow
Color recognition
Fovea (local)

Breaks

“visual agnosias”



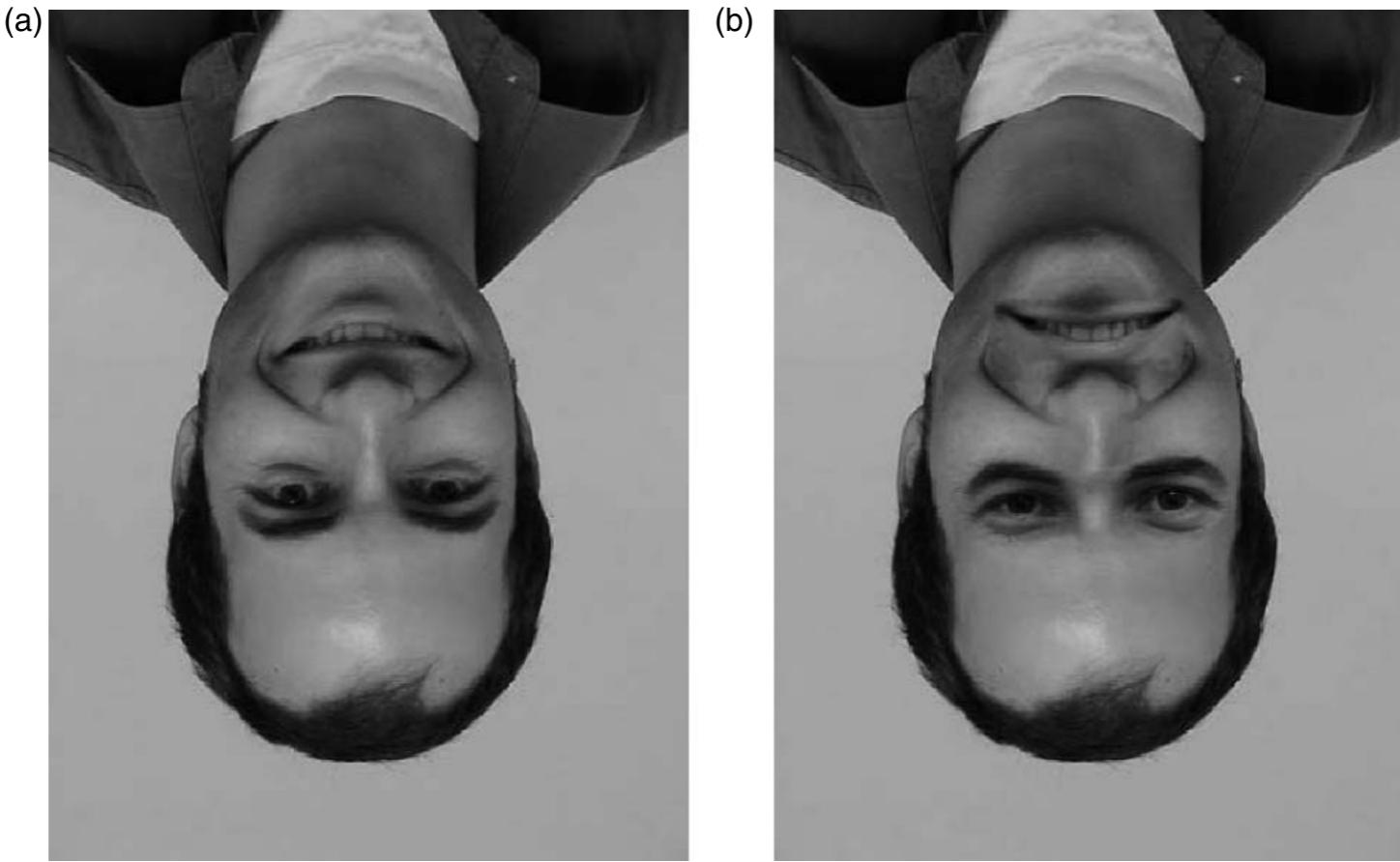
Responses of “S.M.” and “R.N.”, Behrmann 2003

Note: colors do not correspond
to visual tracts slide!

Face blindness

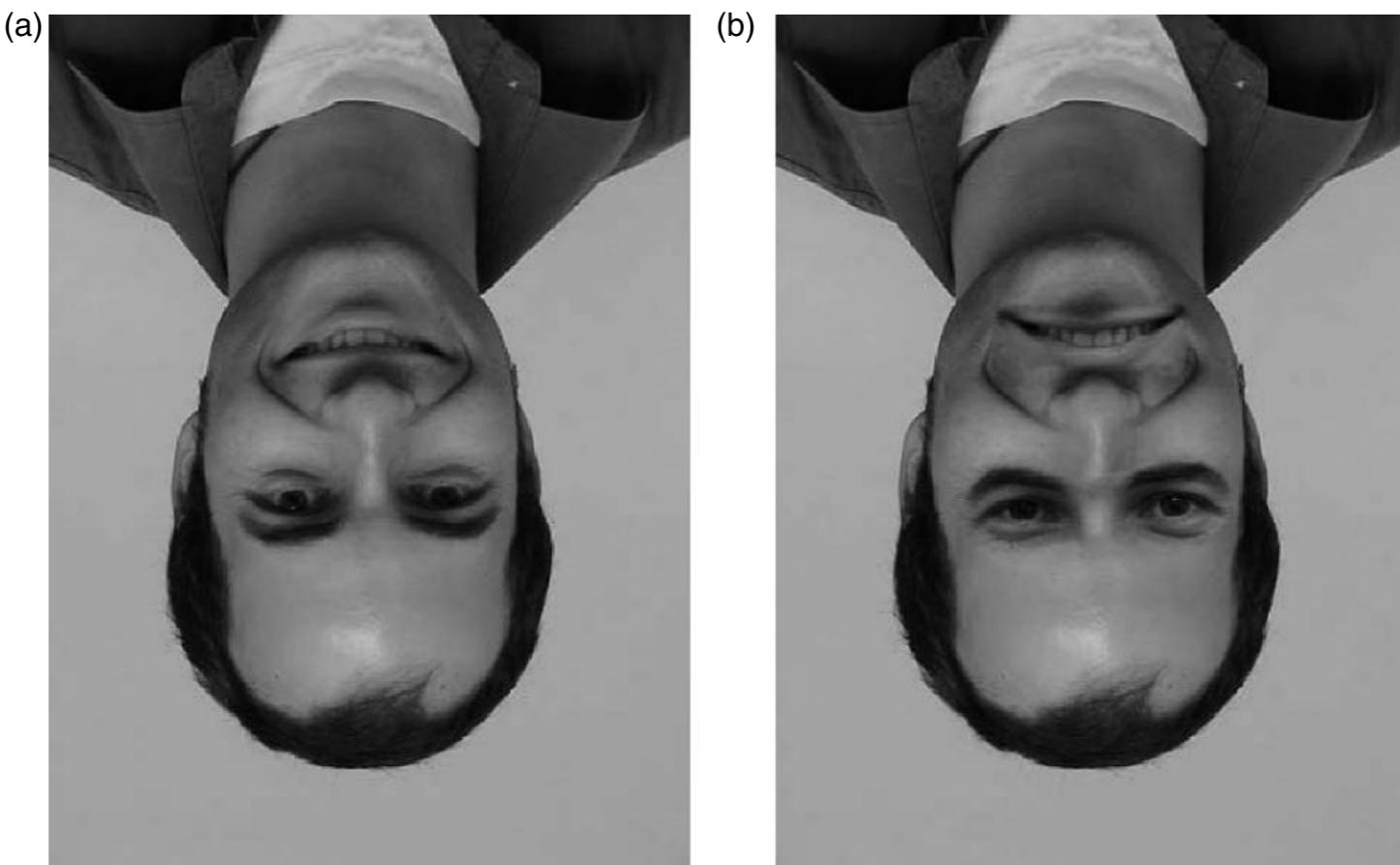
**Object
Recognition
is local**

**Face
Recognition
is special!**

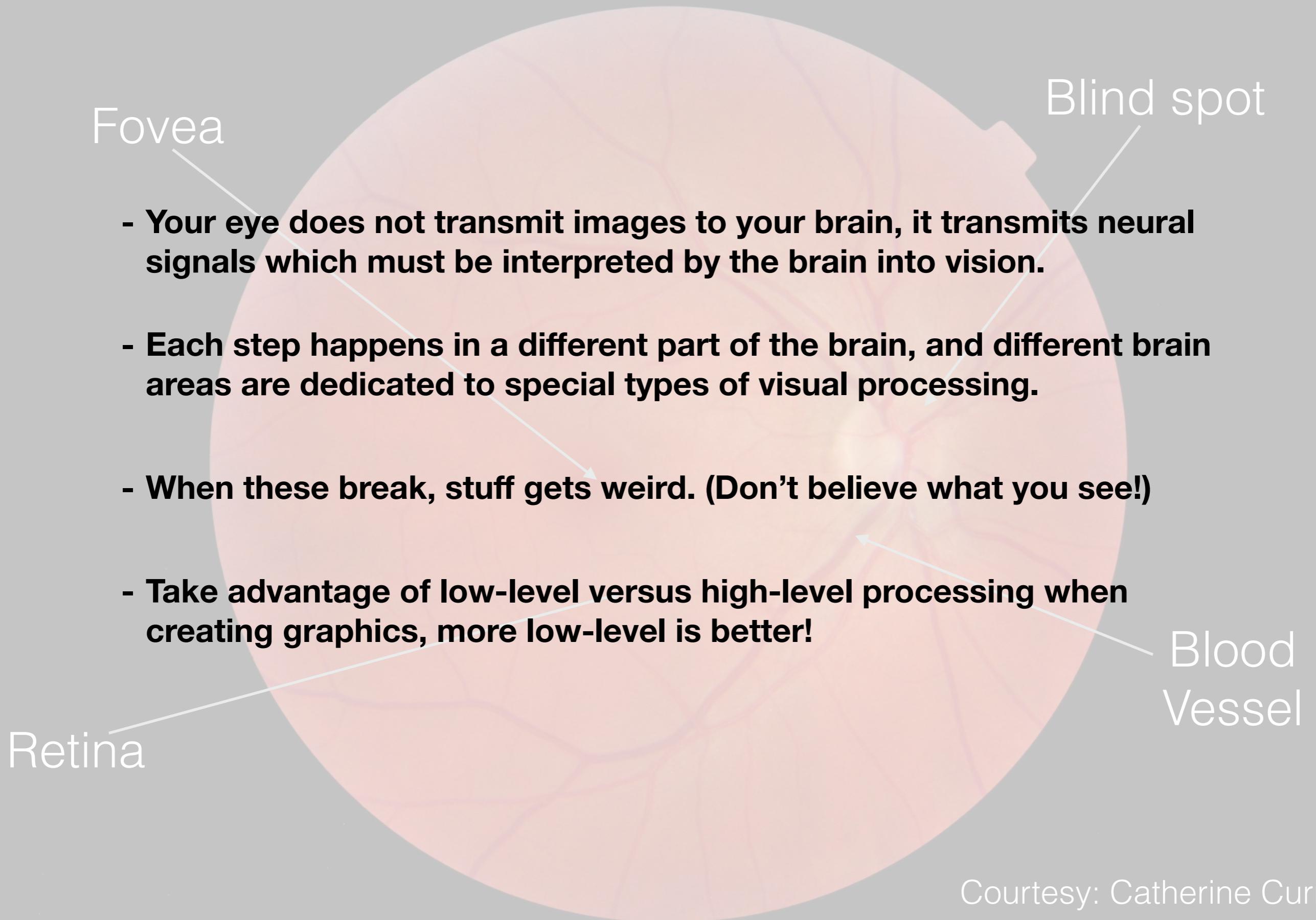


**Object
Recognition
is local**

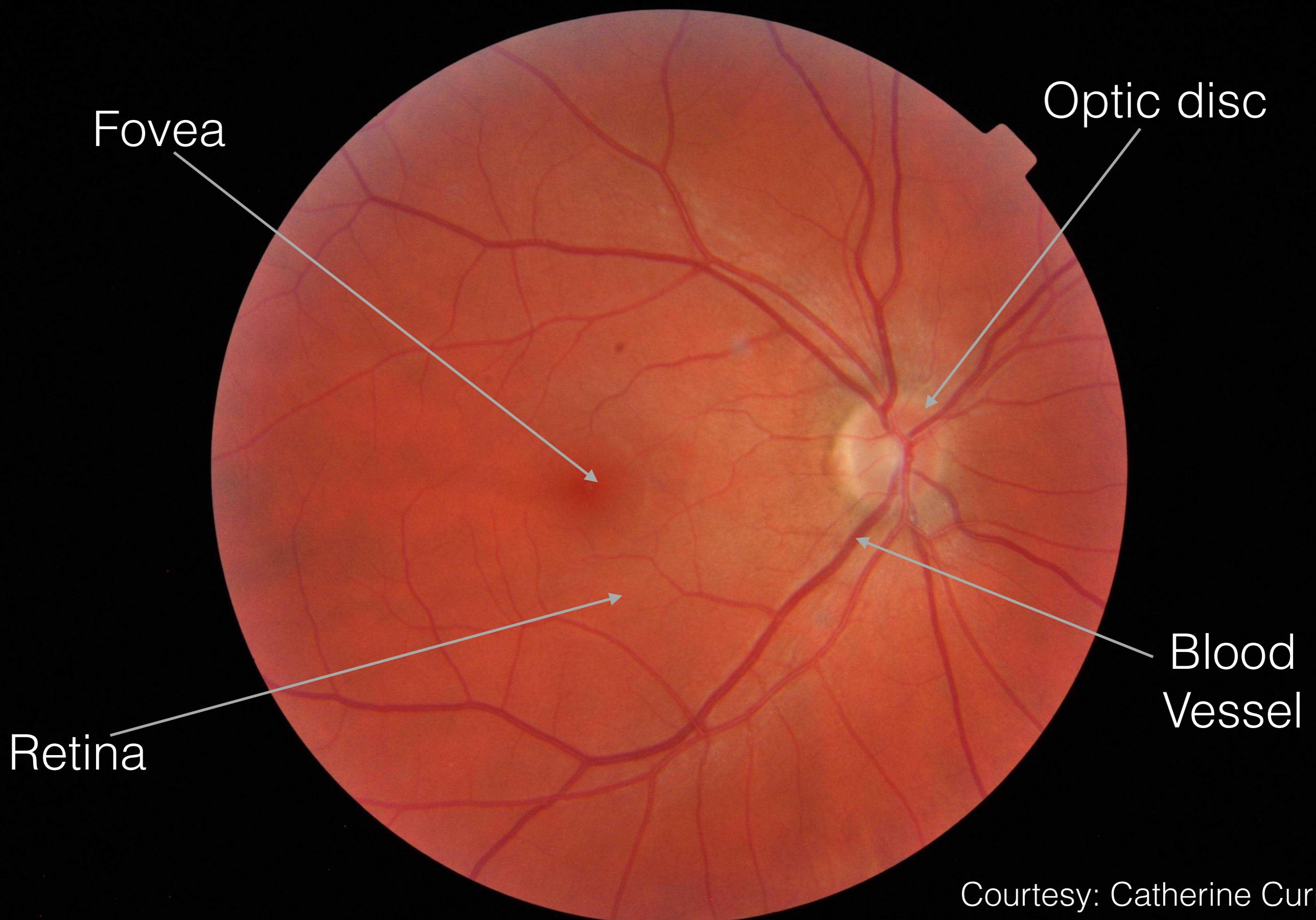
**Face
Recognition
is special!**



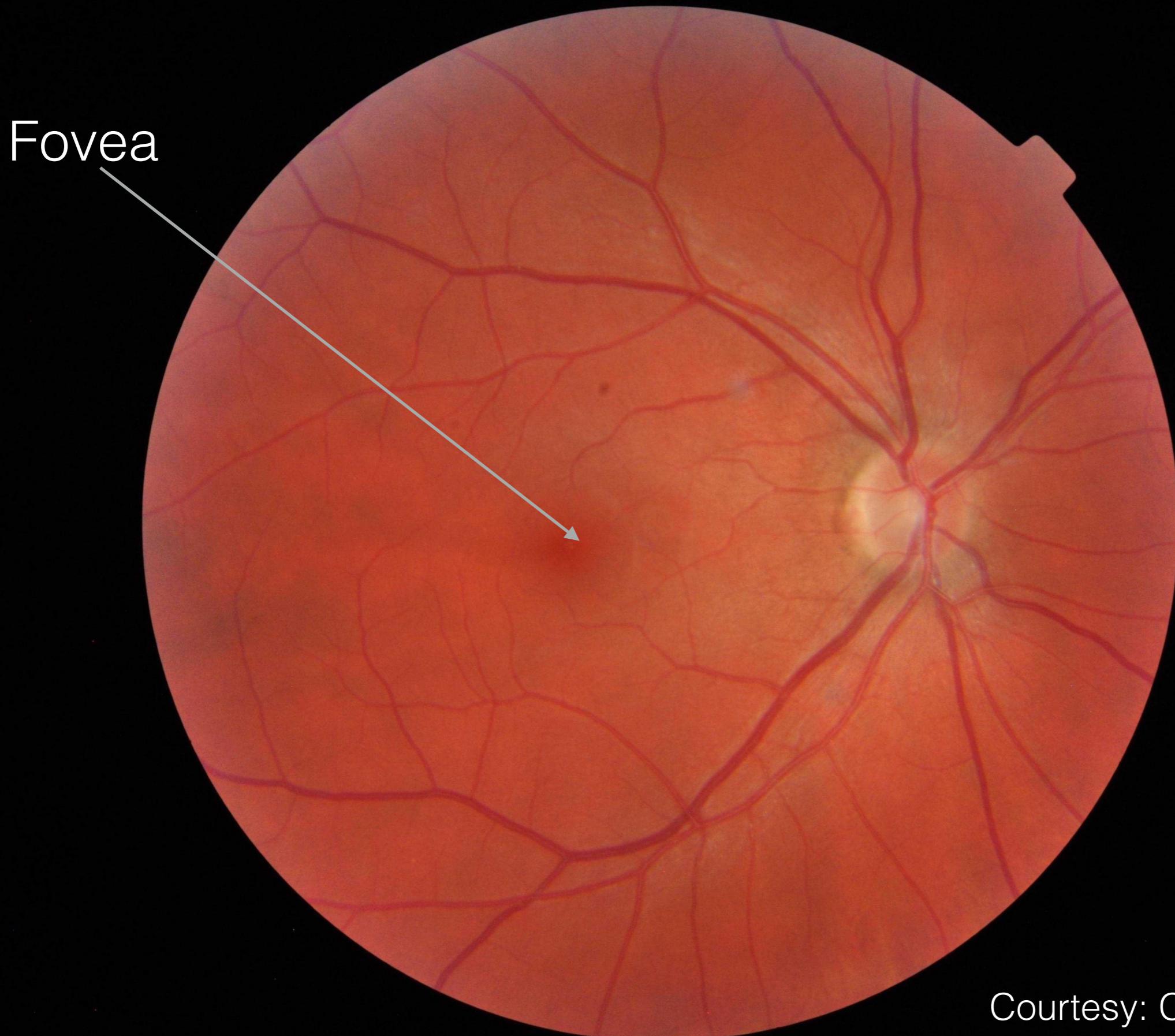
2. You don't see by transmitting images



3. Acuity drops from the center of vision



3. Acuity drops from the center of vision

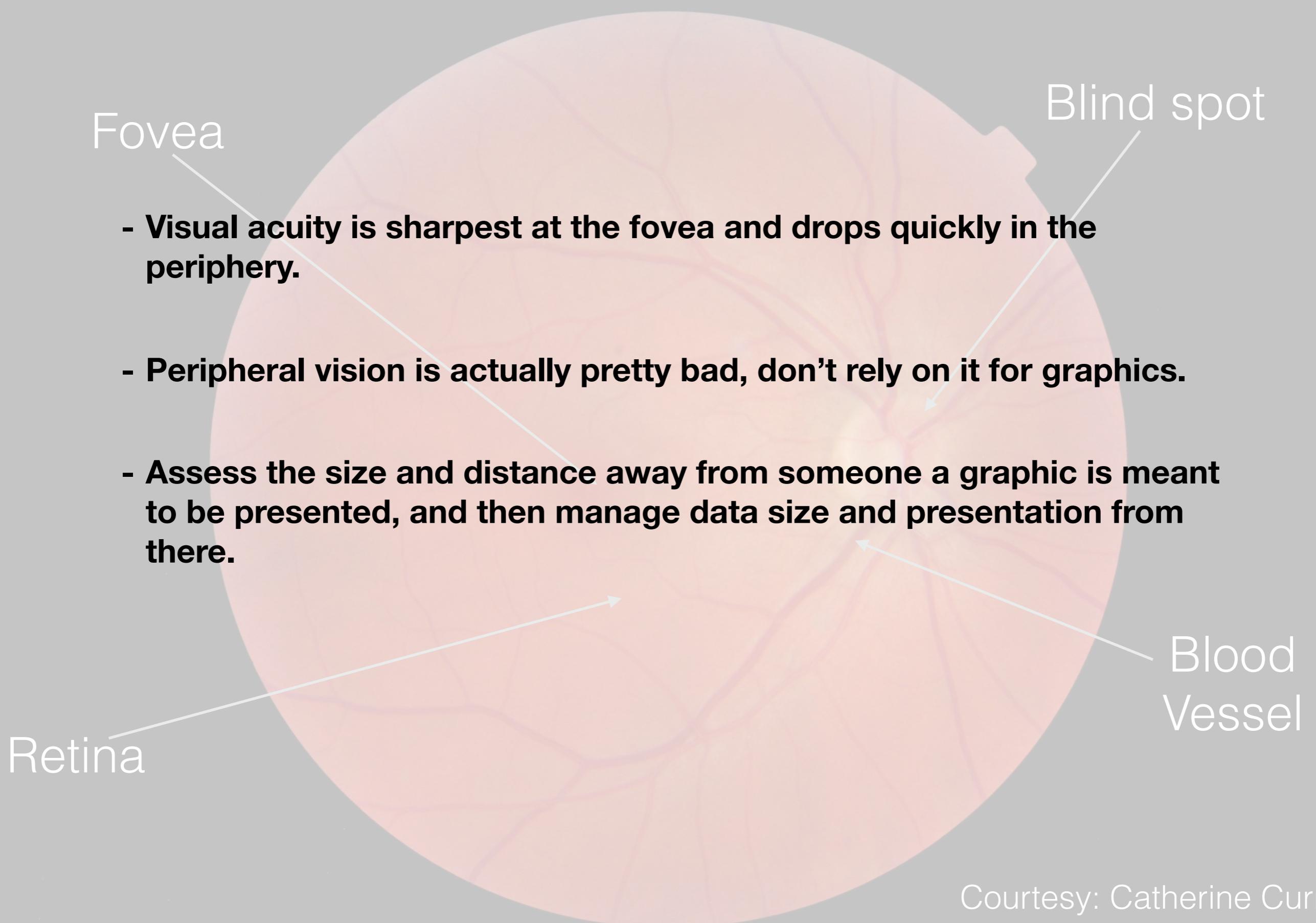


Courtesy: Catherine Currie

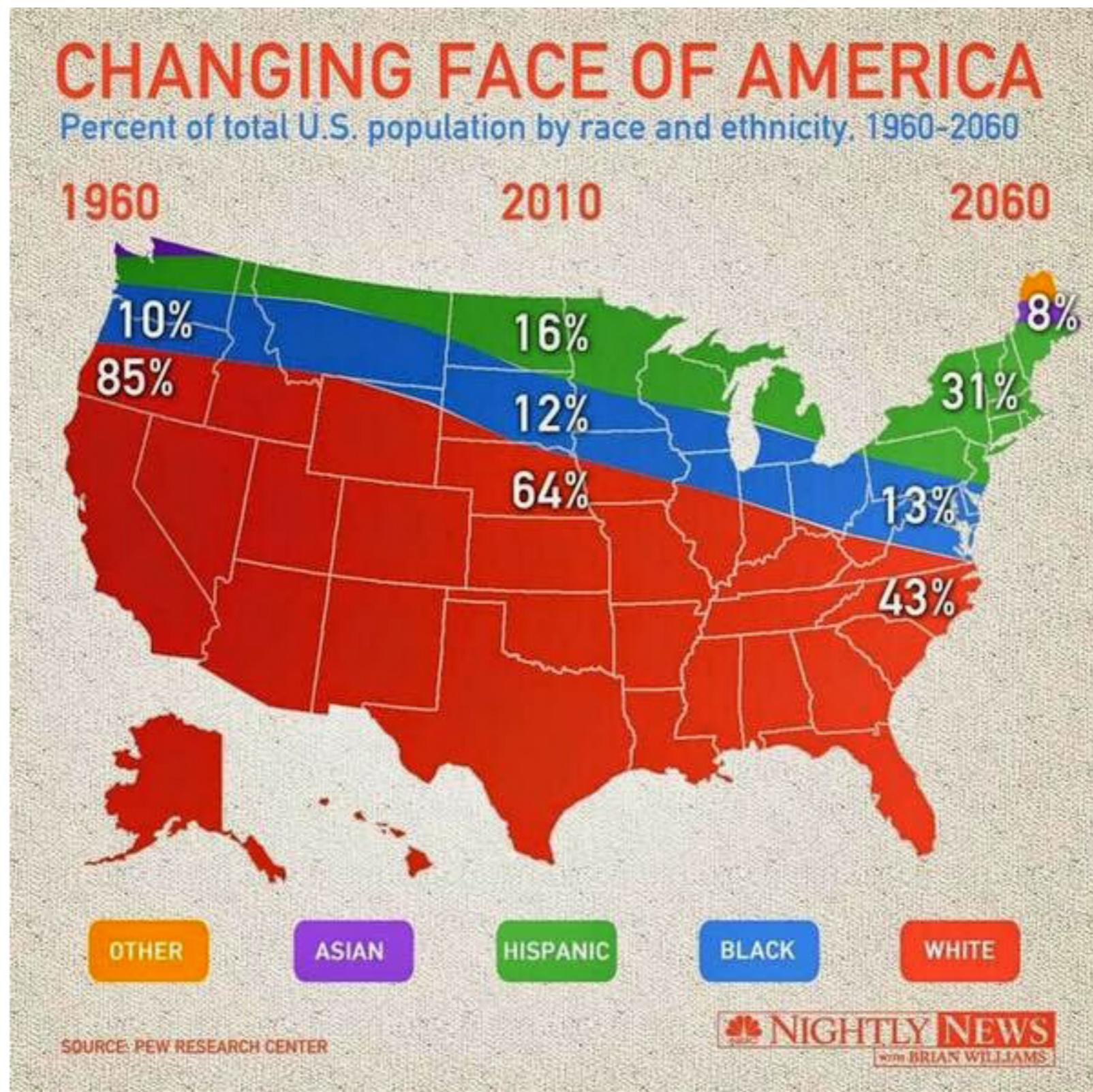
Acuity is high centrally and drops off peripherally.



3. Acuity drops from the center of vision



How can we make this visualization better?



References:

- OpenStax. 2017. *Anatomy and Physiology*. OpenStax Publishing. ISBN-10: 1-947172-04-2
- Behrman M, Kimchi R. 2003. What does visual agnosia tell us about perceptual organization and its relationship to object perception? *J Exp Psych Human Perception Performance*. 29(1): 19-42.
- Grüter T, Grüner M, Carbon C-C. 2008 Neural and genetic foundations of face recognition and prosopagnosia. *J Neuropsychology* 2: 79-97.
- Kuffler SW. 1953. Discharge patterns and functional organization of mammalian retina. *J Neurophysiol* 16: 37-68.
- Livingstone M. 2014. “What Can Art Tell Us about the Human Brain?” UC Irvine Lecture, Youtube: <https://www.youtube.com/watch?v=fwPqSxR-Z5E>
- McGee S. 2012. *Evidence-Based Physical Diagnosis*. 3rd ed. Elsevier Saunders Publishing.
- Muir D. 2012. H. Keffer Hartline and lateral inhibition: a brief biography of an influential idea. 30th Oct. dylan-muir.com.
- Wyttenbach RA. 2012. Exploring sensory neuroscience through experience and experiment. *J Under Neuro Ed* 11(1): A126-A131.