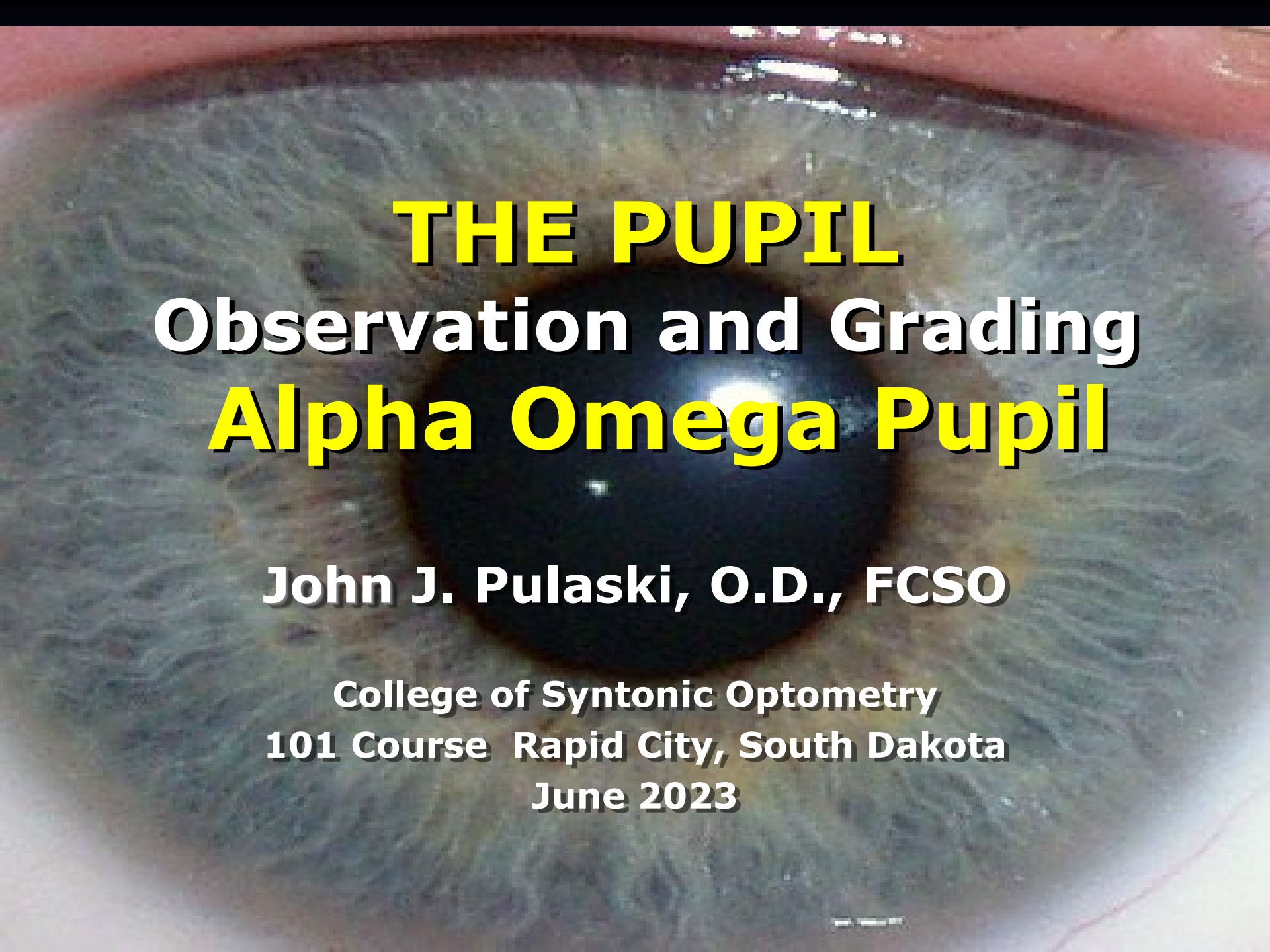

THE PUPIL
Observation and Grading
Alpha Omega Pupil

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College of Syntonic Optometry
101 Course Rapid City, South Dakota
June 2023

The Pupil And Syntonics

How do you know if a person needs Syntonic Treatment?

The Pupil And Syntonics

Three keys elements in Syntonic Clinical evaluation and treatment application.

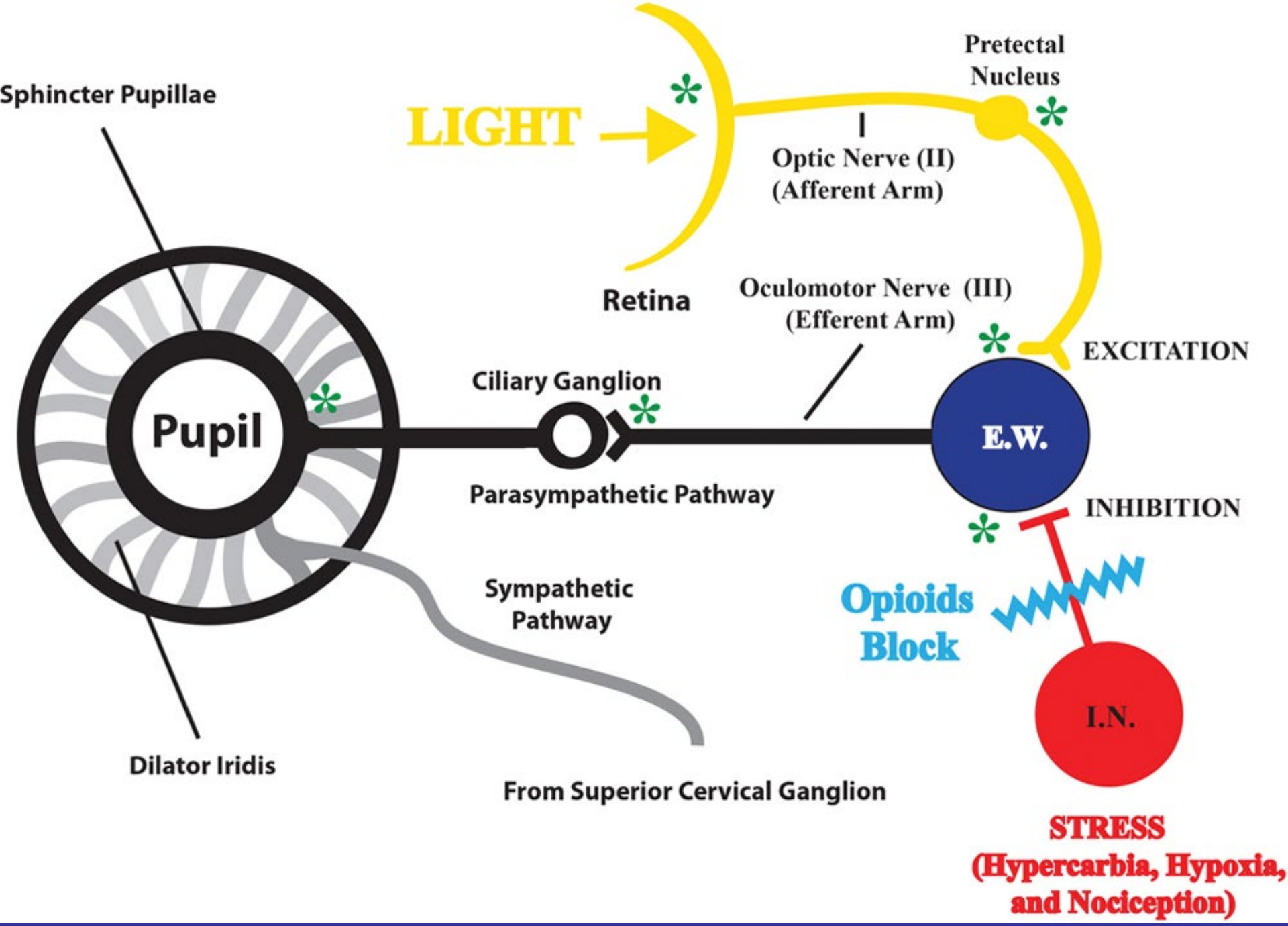
1. The Pupil - AO
2. The Field - Kinetic
3. The Patient History

The Pupil

One of the most sensitive measures of ANS activity.

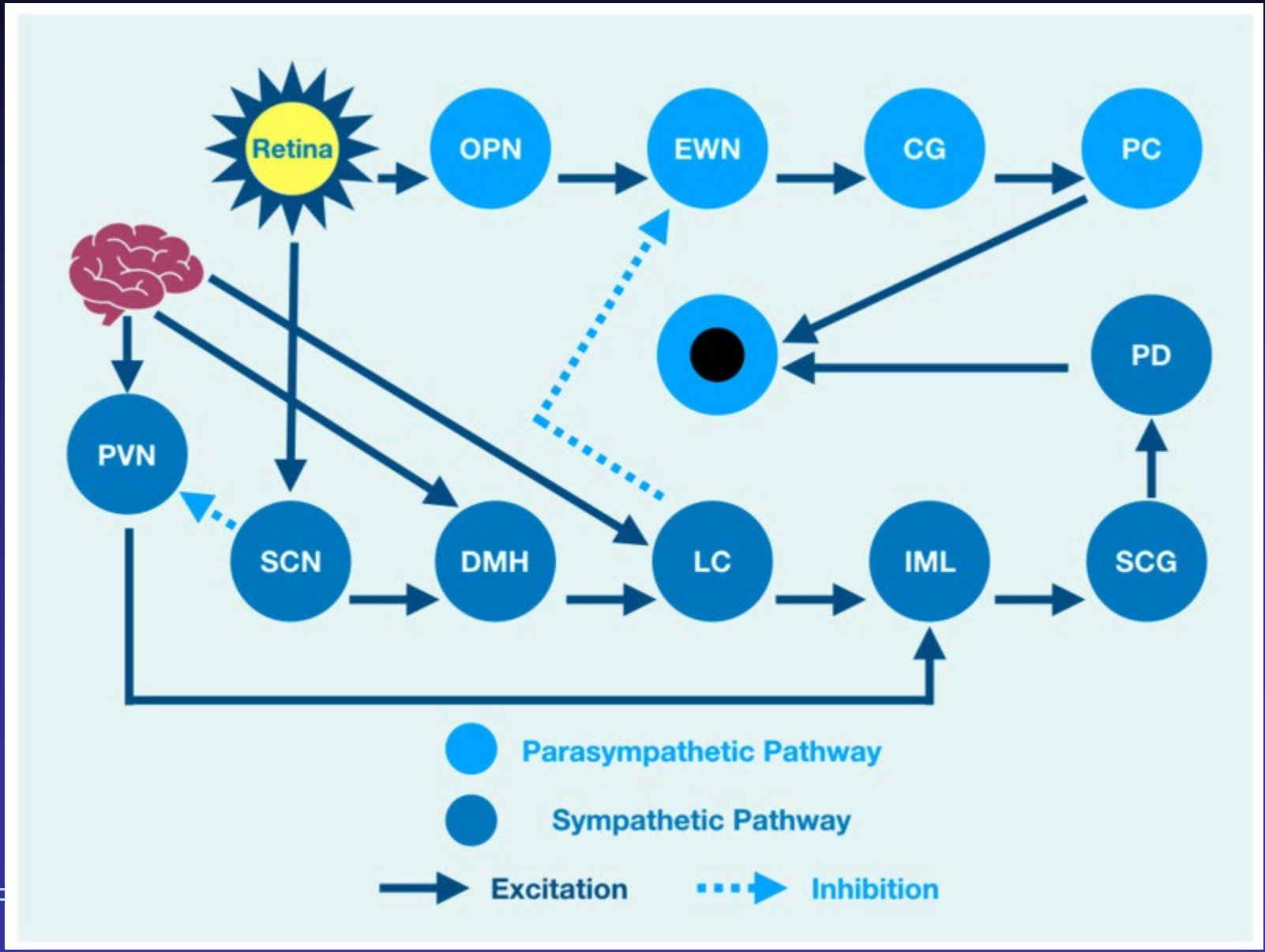
- ANS/Brainstem function
- "Eyes are the Window to the Soul" The Pupils are the Windows.
- Portal of Energy Reception and Projection. Portal through which we interact with our world.
- Non-verbal Communication and strong emotional indicator.
- Reception of "nutrition" - LIGHT

Pulaski AO Pupil


Sphincter Pupillae
LIGHT
Pretectal Nucleus
Optic Nerve (II)
(Afferent Arm)
Retina
Oculomotor Nerve (III)
(Efferent Arm)
EXCITATION
Ciliary Ganglion
Pupil
E.W.
Parasympathetic Pathway
INHIBITION
Sympathetic Pathway
Opioids Block
I.N.
Dilator Iridis
From Superior Cervical Ganglion
STRESS
(Hypercarbia, Hypoxia, and Nociception)

The Pupillary Light Reflex as a Biomarker of Concussion

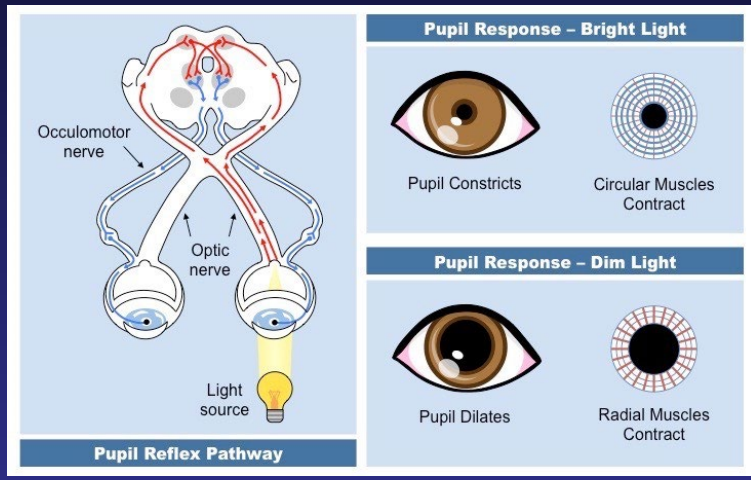
Frederick Robert Carrick[1,2,3,4,5], Sergio F Azzolino[5], Melissa Hunfalvay[5], Guido Pagnacco[5,6], Elena Oggero[5,6], Ryan C N D'Arcy[7,8,9], Mahera Abdulrahman[10], Kiminobu Sugaya[1,2]

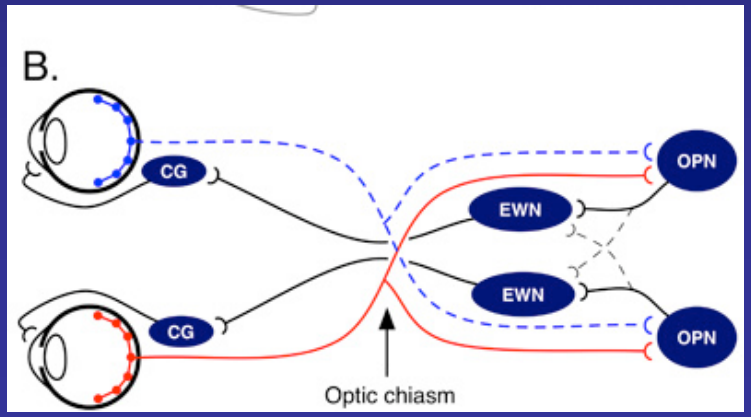


The Pupil
Neurological Pathways

Parasympathetic - Constriction
- The Pupillary Light Reflex (PLR)
- Influence on Iris Sphincter
- Light-Inhibited Sympathetic Path
- Trigeminal Nerve – sensory stimulation to eye/iris

Sympathetic – Dilation
- Direct stimulation of Iris Dilator through 3 neuron arc
- Inhibition of EW nucleus

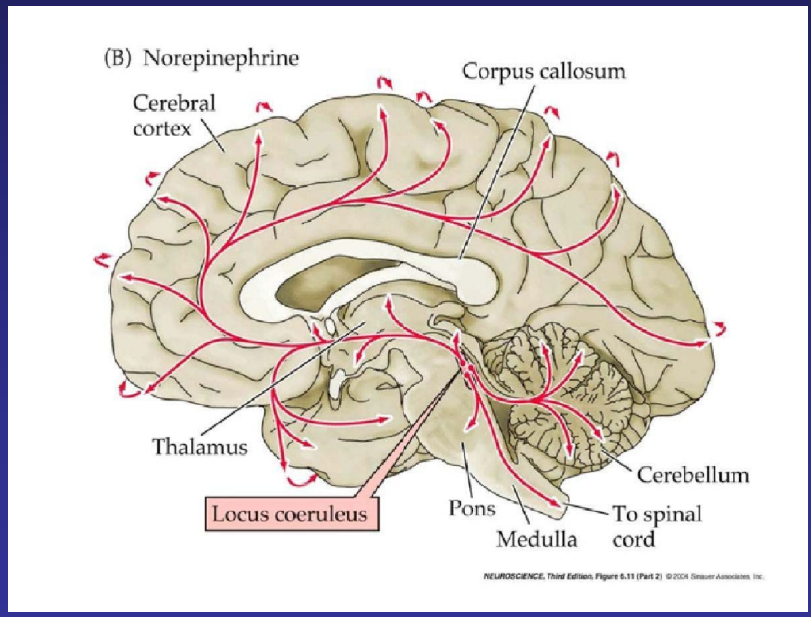




The Pupil
Neurological Pathways

Pathway of Dilation

- Direct Stimulatory - Iris dilator
  - Hypothalmus
  - Nucleus Coeruleus
  - Superior Colliculus
  - Frontal Eye Fields
- Inhibitory – EW nucleus
  - Nucleus Coeruleus
  - Superior Colliculus
  - Supernuclear Inhibition from the Reticular Activating Formation in brainstem



The Pupil
In Syntonics

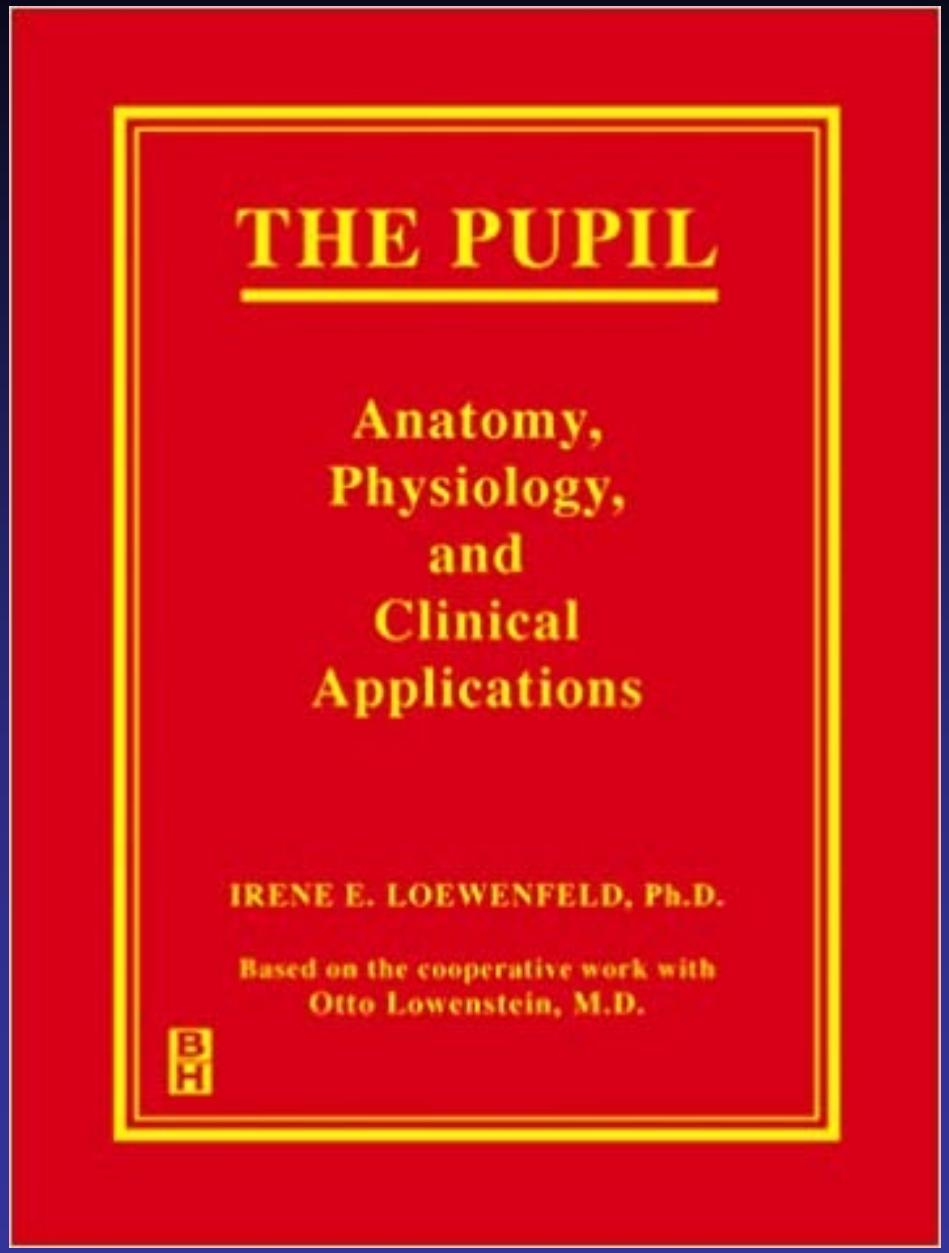
In Syntonics we are interested in the pupil as an indication of the well being of our patient particularly in regards to the state of the ANS. The two major reactions observed are:

- Alpha Omega Pupil
- Pupillary Light Reflex

The Pupil
Reactions
Alpha Omega Pupil

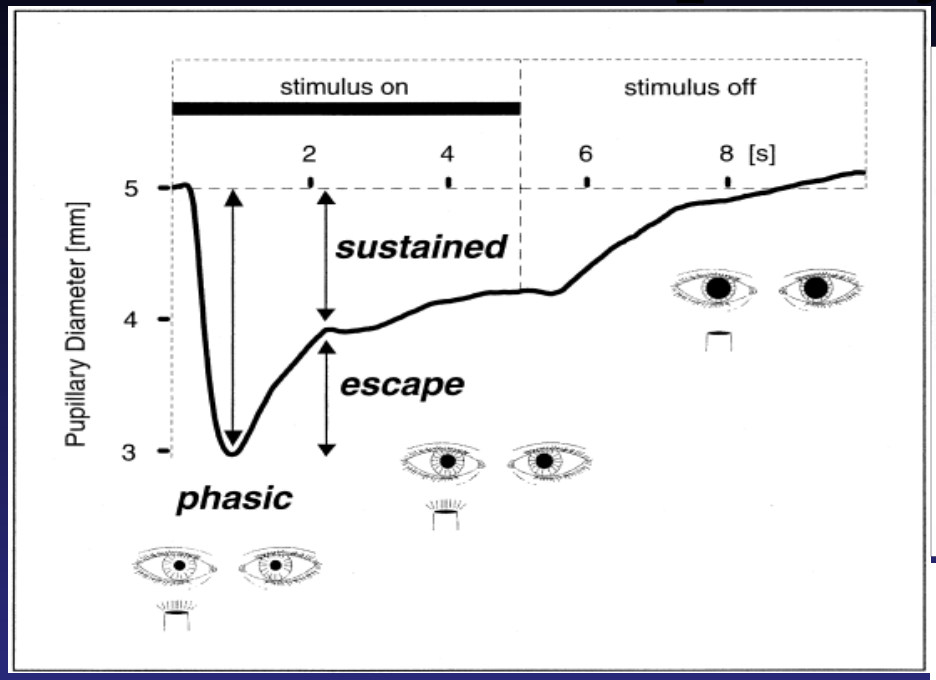
- An Alpha Omega Pupil is the abnormal re-dilation of the pupil during direct, constant light stimulation.
- Unique to the practice of Syntonics
- First suggested as a term by Dr. Paul Johnson in 1934.
- The abnormality is brought to normalcy with phototherapy treatment
- There is an inverse relation between the size of the functional visual field and the degree of the AO Pupil.

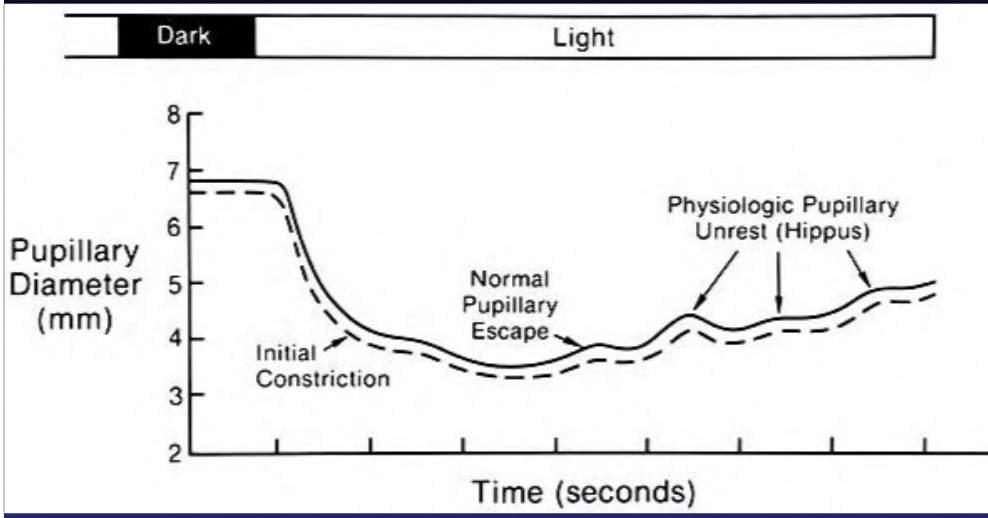
THE NORMAL PUPIL

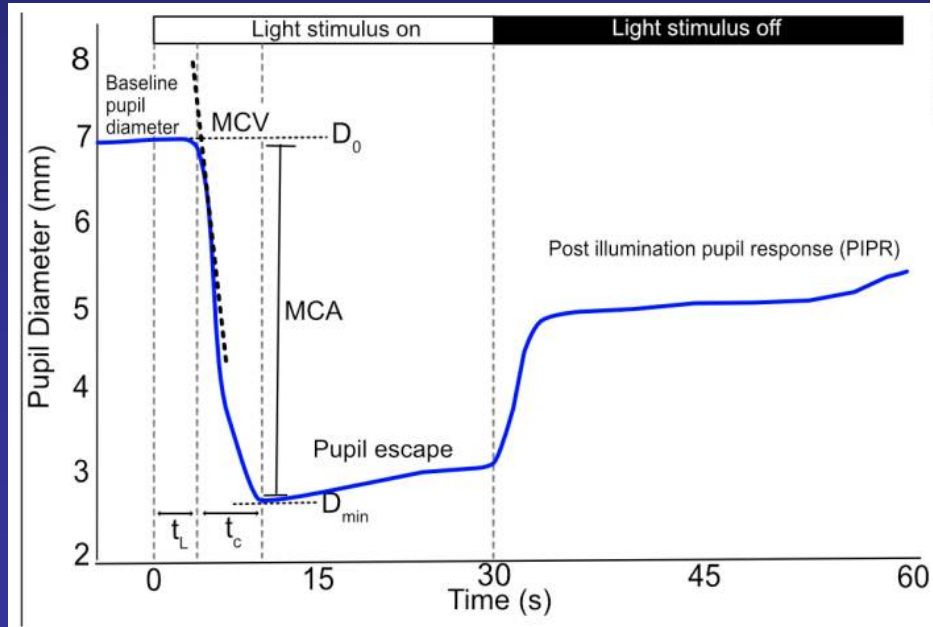


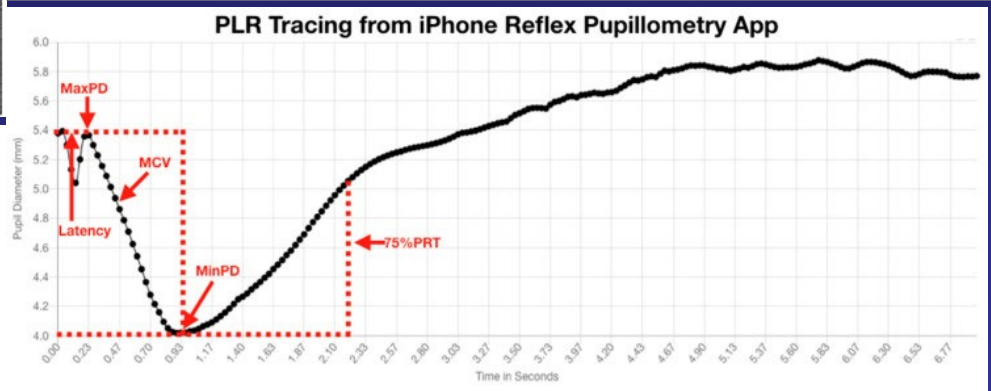
Pulaski AO Pupil

Pupillary Reactions







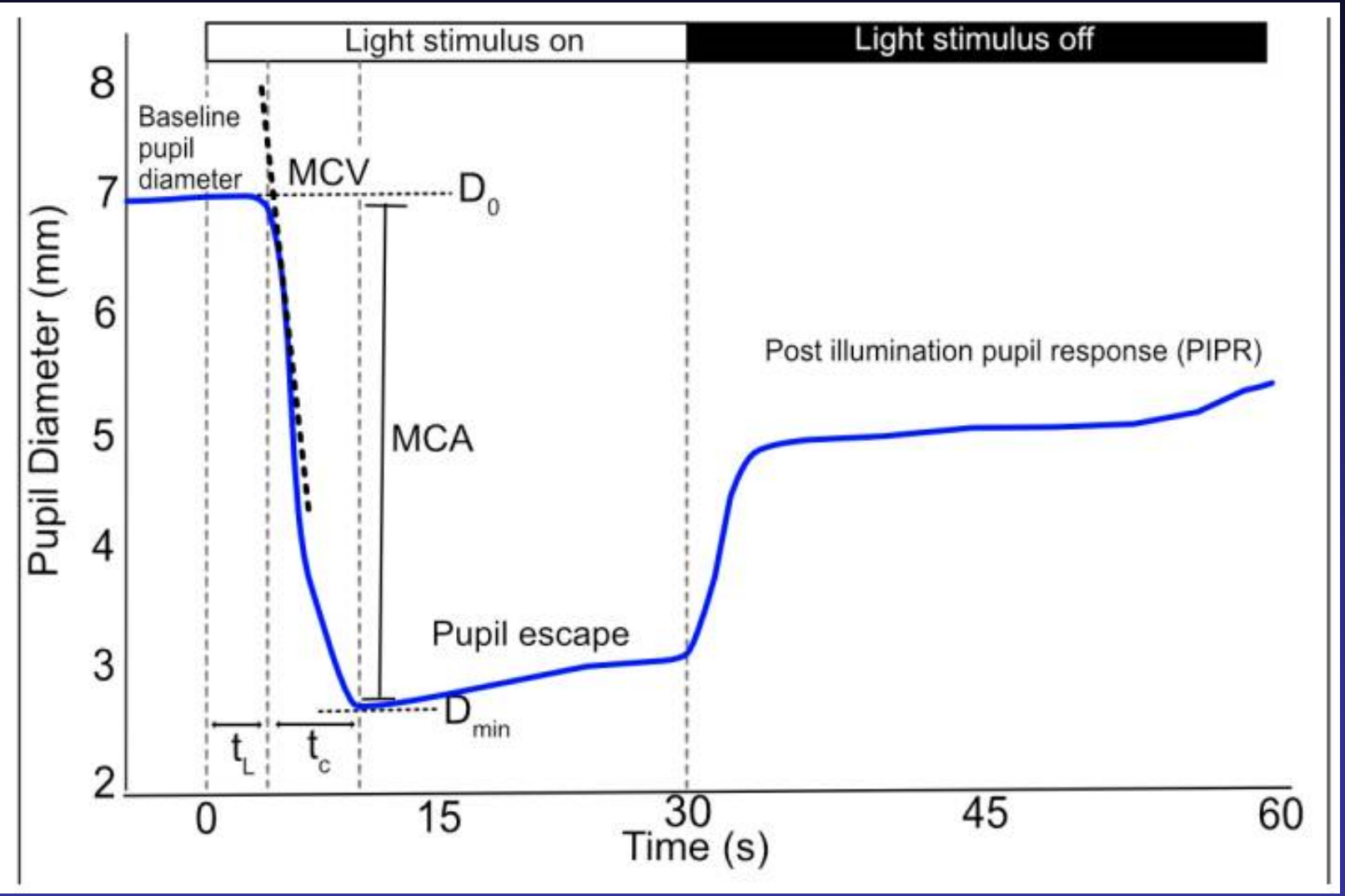


Latency	Time from light flash to pupil constriction
MaxPD	The maximum diameter of pupil before light flash
MinPD	The minimum diameter of pupil after light flash
MCV	The maximum constriction velocity of pupil constriction after light flash
75% PRT	The time for redilation of pupil to 75% of its previous maximum diameter after light flash

The Pupil
The "Normal" Pupil

- Steady state size
- Dynamic, transient response
- Neurons in E-W Nucleus generate steady firing rate even when no external inputs are involved. Balanced by cortical inhibition.
- Slight latent period before contracts
- Maximum contraction is reached in about 2 sec.
- When stimulus removed pupil re-dilates much slower than it contracted – Recovery response
- Under prolonged stimulation there are normal oscillations

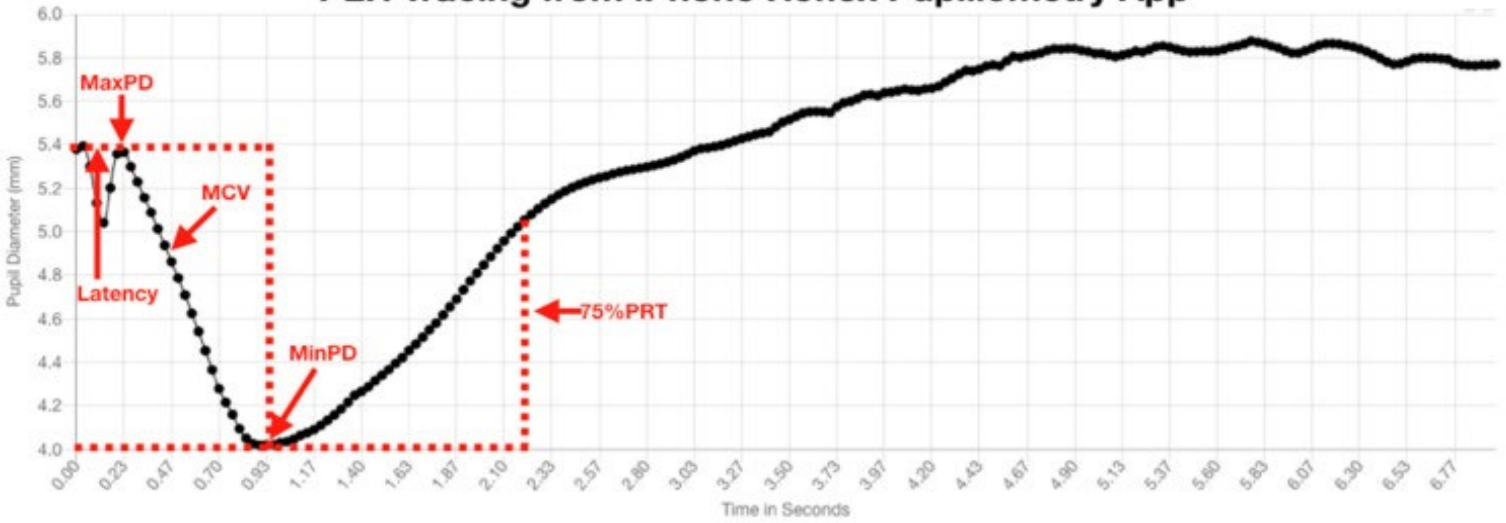
Pupillary Reactions



Pulaski AO Pupil

Pupillary Reactions
Bright Lamp

Carrick et al Life (Basel). 2021 Oct; 11(10): doi: 10.3390/life11101104



Latency	Time from light flash to pupil constriction
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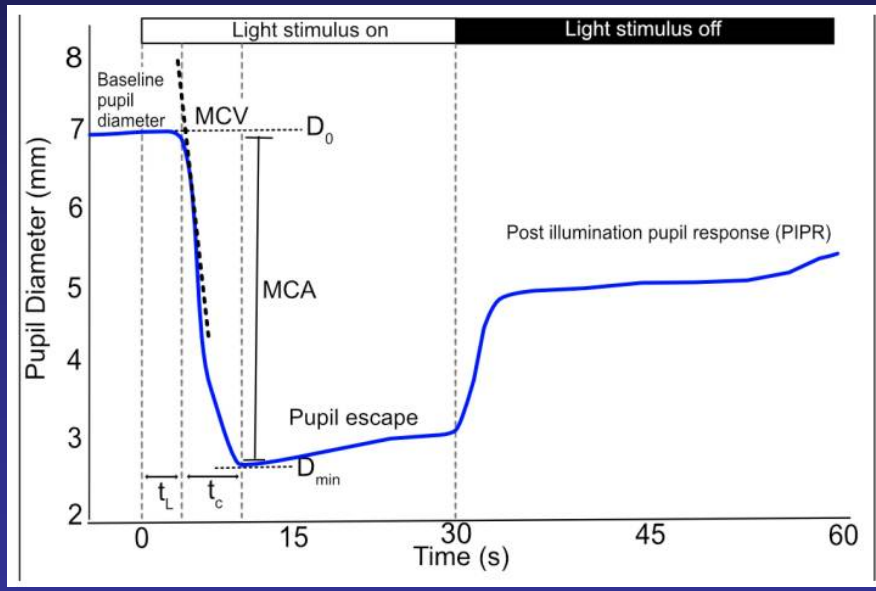
75% PRT	The time for redilation of pupil to 75% of its previous maximum diameter after light flash

Pula

The Pupil
Pupillary Light Reflex

MCA, MCV best predictors for Parasympathetic Dysfunction

- Alzheimer's
- Parkinson's
- ABI/TBI
- Autism
- Drugs/Alcohol
- Infection
- ADD – increased MPD and MCV

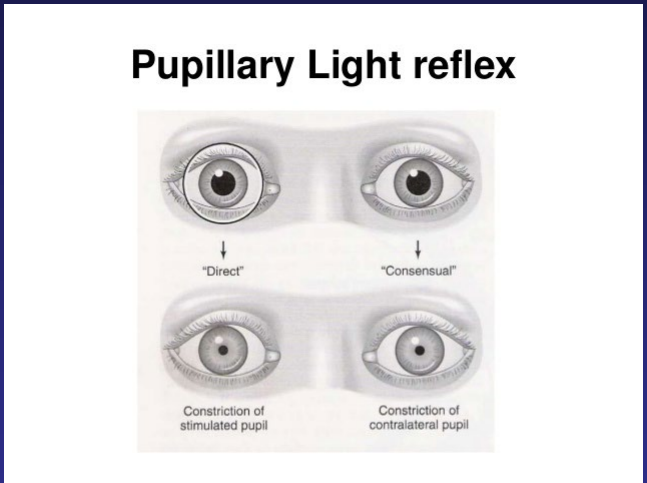


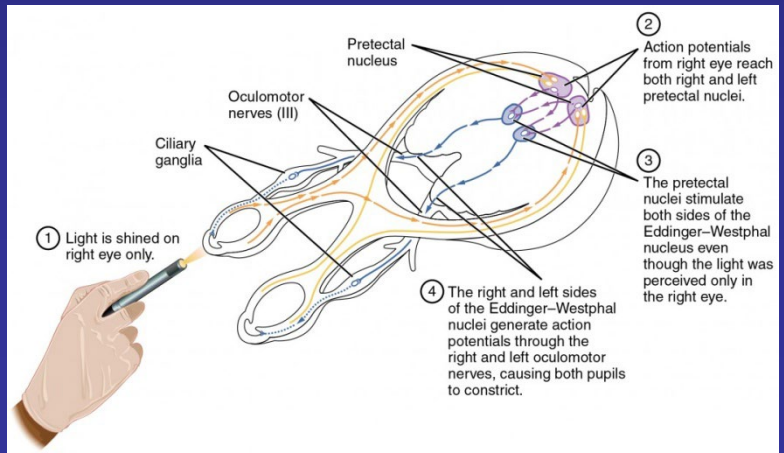
The Pupil

Reactions

Pupillary Light Reflex

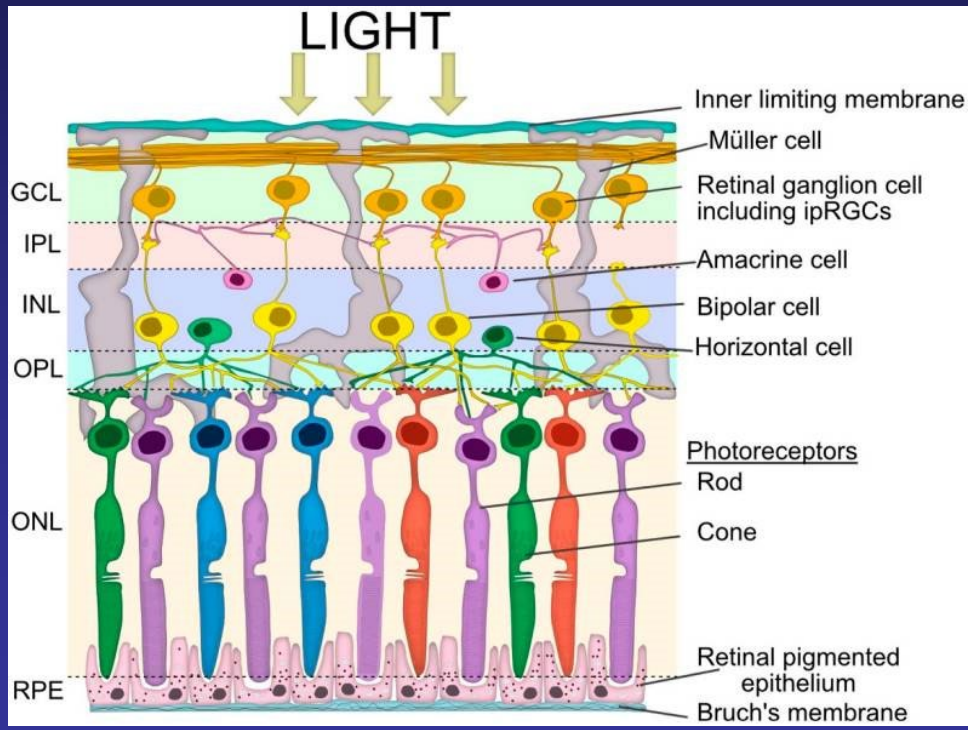
- 10-20% of RGC axons relate to PLR
- 1% of ipRGC's
- Speed/Strength of contraction
- Coma, TBI, Stroke
- Excited Patient
- Relation to ANS



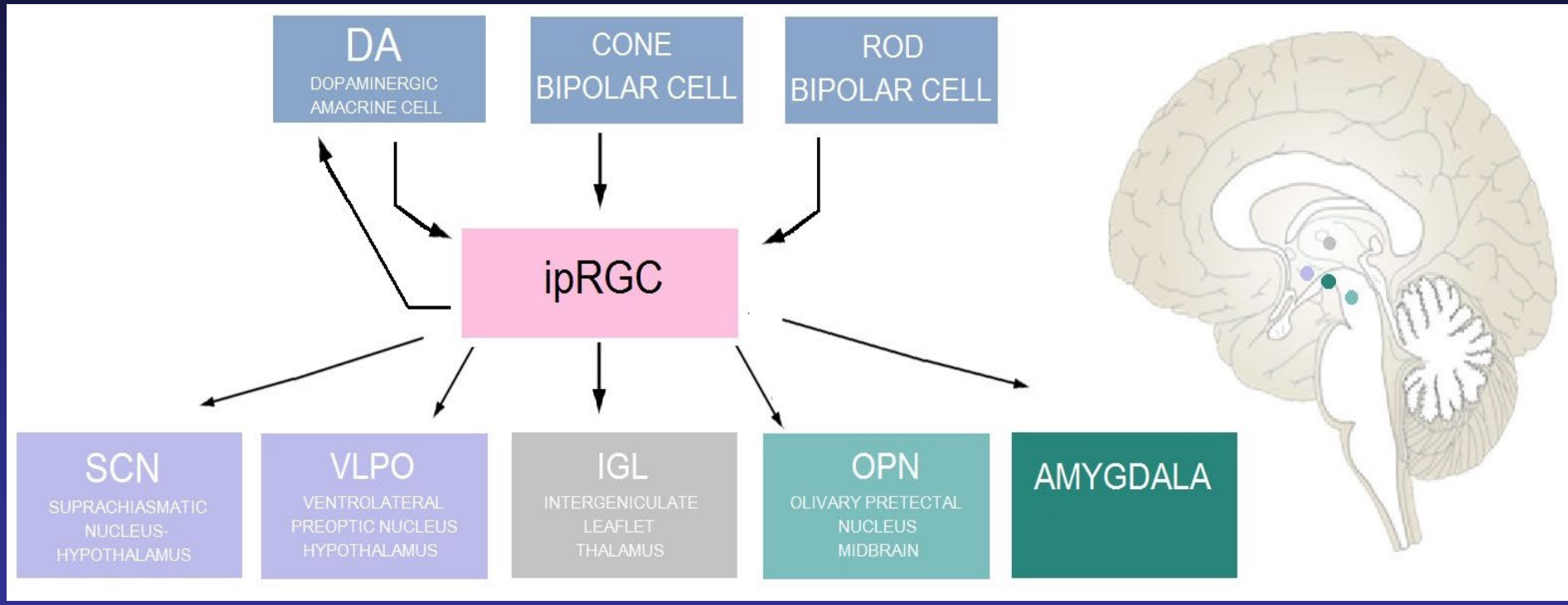


The Pupil
Reactions
Pupillary Light Reflex

- ipRGC's very important in recovery phase (PIPR)
- Pupil both inhibited and activated by different wavelength sensitive cones
- Important in sustained constriction



Synaptic Input/Output ipRGC



The Pupil

The "Normal" Pupil

Pupillogram – 24 y.o. healthy male

•From Loewenfeld, "The Pupil"

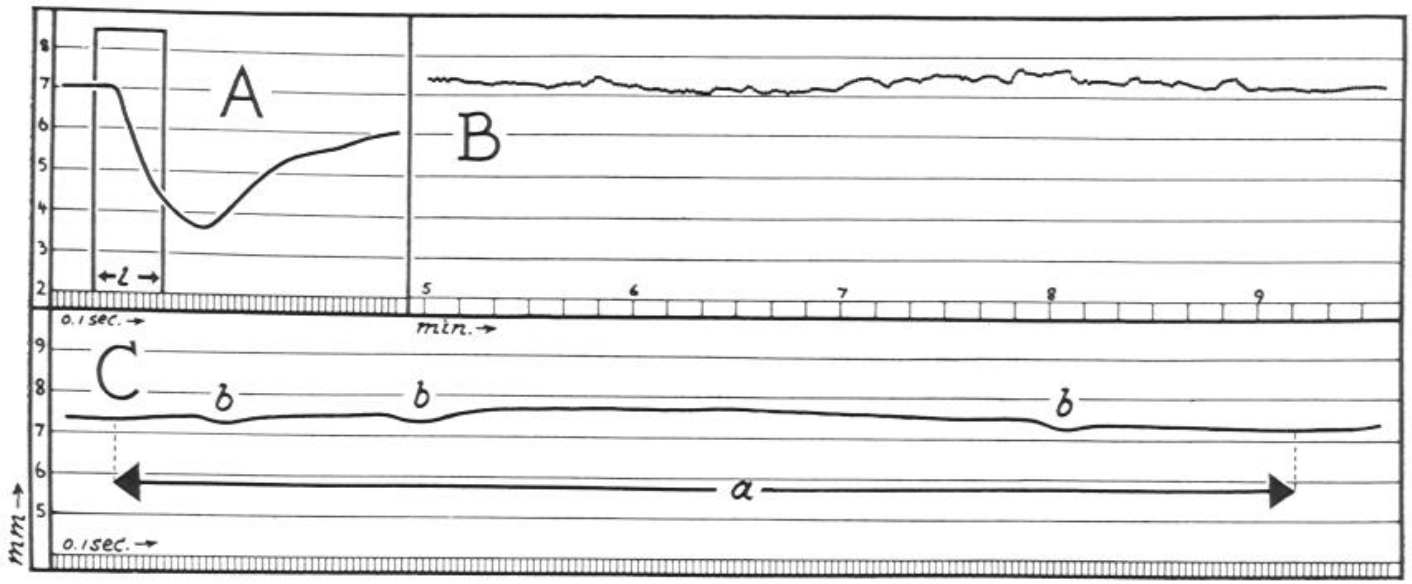


Figure 10-1. Spontaneous pupillary movements in a healthy 24-year-old man. The pupillograms of the right eye are shown. **A** and **C** were original records. In **B,** the time axis of the graph was compressed in the following manner: the pupillary diameter at the beginning of each successive second was taken from the original record, and was plotted as a single measurement (small rectangles); sixty such measurements thus show the pupillary movements that occurred within each minute. **A:** Normal light reflex; **B:** Diameter during the fifth to ninth minute in darkness. The pupil was large and quiet. The subject was not tired, and was able to continue the test for more than 2 hours without remarkable changes in pupillary behavior. **C:** Slow (**a**) and fast (**b**) pupillary oscillations of small extent (see text). (From O. Lowenstein, R. Feinberg, and I.E. Loewenfeld, *Invest. Ophthal.,* 2 [1963]:138)

The Pupil
The "Normal" Pupil

- Pupillary Unrest
- Pupillary Fatigue
- Pupillary Escape

The Pupil

The "Normal" Pupil

Pupillary Unrest

- Defined by Lowenfeld as "normal pupillary oscillations brought on by steady light and absent in darkness."
- They are continuous, constant rippling and pumping, rapid and irregular movements of the pupil in a **lighted** environment that cease when the light is turned off.
- Can vary from one individual to another but the pattern is the same for that individual over time. Postulated that it is unique due to our genetic make-up.
- Their cause remains unknown although it is Lowenfeld's opinion that they originate in the neurons of the midbrain.

The "Normal" Pupil

Pupillary Unrest

Pupillogram of normal 24 y.o. female under sustained light (Loewenfeld, "The Pupil")

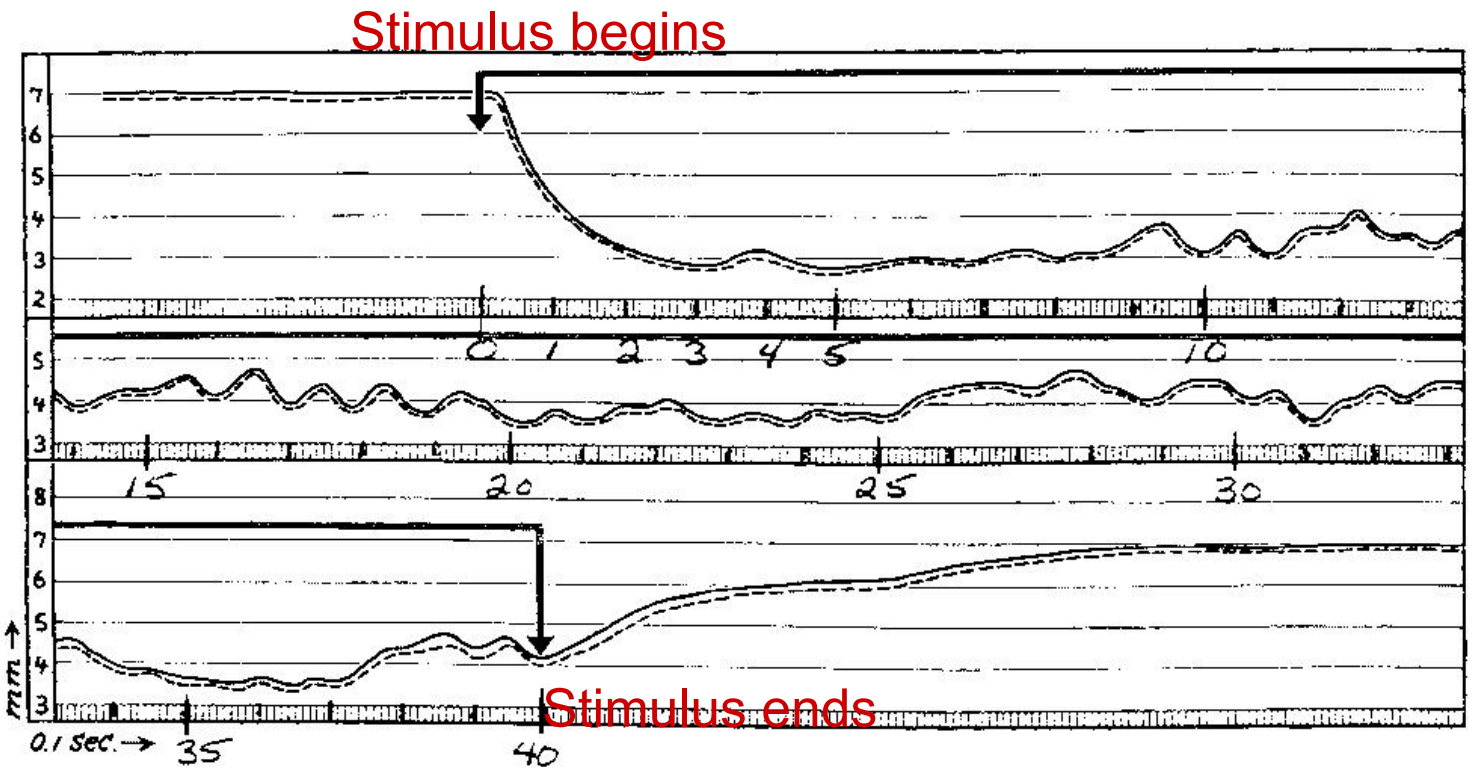


Figure 3-67. Pupillary oscillations during unilateral adaptation to a bright, steady light. Pupillogram of a normal 24-year-old woman. The solid line represents the right, the broken line the left pupil. **First line:** The pupils were large and quiet in darkness. When the right eye was exposed to a steady, bright light, both pupils contracted, then redilated somewhat and began to oscillate. **Second line:** Pupillary oscillations after the right eye had been light was turned off (arrow), the pupils enlarged and the oscillations disappeared. The movements of the right and left pupils remained equal throughout the experiment, even though the right eye alone was stimulated, while the left eye remained in darkness. (From O. Lowenstein and I.E. Loewenfeld, *Amer. J. Ophthal.*, 48, II [1959]:536; published with permission of *The American Journal of Ophthalmology*, ©The Ophthalmic Publishing Company)

The Pupil

The "Normal" Pupil

Fatigue Waves

- They originate from fluctuation in central nervous system integration.
- They begin to occur with a decrease in sympathetic discharges and inhibitory influences on the EW nucleus causing increased constriction of the pupil.
- Causes include boredom, sleepiness, illness and ageing.
- They decrease during periods of arousal, when the person is mentally active.
- The reflex becomes well integrated after a good night's rest.
- **Adrenal Fatigue**

The Pupil

The "Normal" Pupil

Fatigue Waves

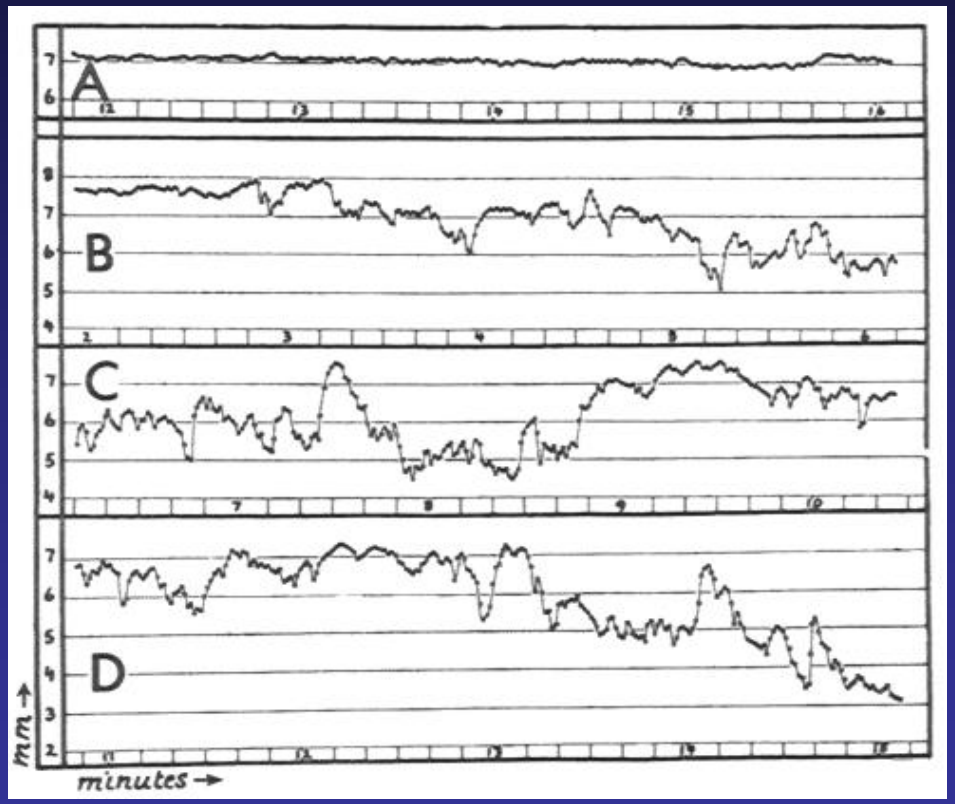
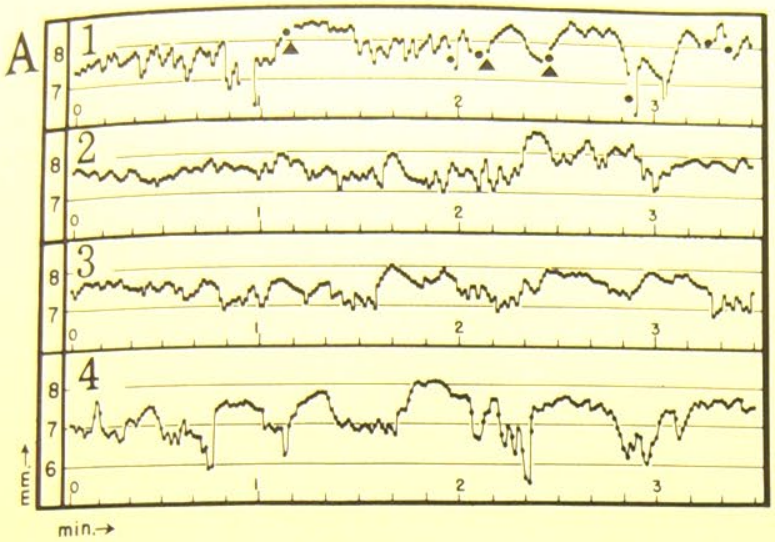
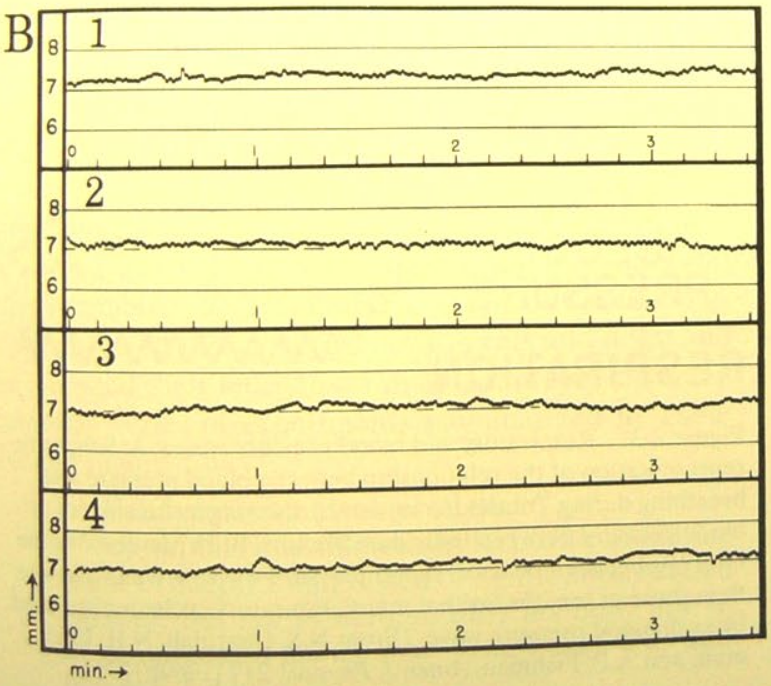


Figure 10-2. Pupillary "fatigue waves." In each line, the diameter of the subject's right pupil was plotted as the ordinate by the same method described for Figure 10-1. **A:** Record obtained from a normal, alert 24-year-old man. The pupils showed only little activity after many minutes in darkness. The graph shows the movements between the twelfth and sixteenth minute of the experiment. **B** to **D:** Pupillary movements of a healthy but very tired 38-year-old man. Less than 3 minutes after the beginning of the test the pupils began to become smaller. During the following minutes extensive, irregular waves of pupillary contraction and dilation appeared as the subject repeatedly drifted toward sleep and roused himself spontaneously (lines **B** and **C**). Finally, the periods of arousal became shorter and shorter and less and less complete. Immediately before he fell asleep, the pupils were very small (end of line **D**). (From O. Lowenstein and I.E. Loewenfeld, *Annls N.Y. Acad. Sci.*, 117 [1964]:142)

- From Loewenfeld, "The Pupil"





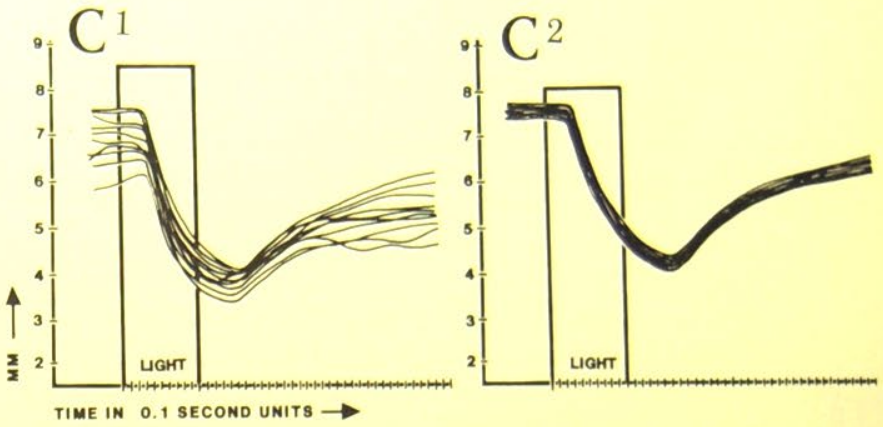
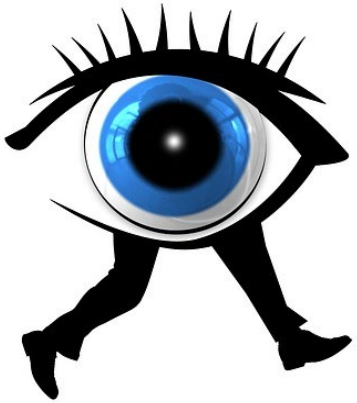


Figure 2-1. Spontaneous pupillary movements in darkness. **A** and **B:** Pupillary behavior of two healthy young men during 3½ minutes in darkness on four different days, at intervals of 1 week (lines **1** to **4**). The records were taken between 5 and 6 P.M. Both subjects were conscientious dental students who had worked hard in the clinic all afternoon. The first subject (**A**) quickly became sleepy as he sat in the dark. The second (**B**) did not. The records show pupillary diameter (in mm) plotted against time (in minutes). They were obtained by contracting the usual time axis of the pupillograms to one-twentieth of its usual length, by measuring the pupillary size at the beginning of each successive second of the original record, and plotting each measurement as a small square on the graph. Subject **A**'s pupils became unsteady already within the first minute of the experiment. In contrast, subject **B**'s pupils never showed more than the slightest variations. The longest test run on **B** was 90 minutes, but even then his pupils did not waver. C^1 and C^2: Light reflexes of the students, elicited by ten consecutive 1-second bright light flashes, with 2-minute rest periods interposed (white light, 5° retinal area, centrally fixated, 7.5 log units above the subjects' scotopic visual threshold). The individual reflexes were superimposed. Note the marked variability in reactions for **A** (C^1), and the tight bundle of curves for **B** (C^2).

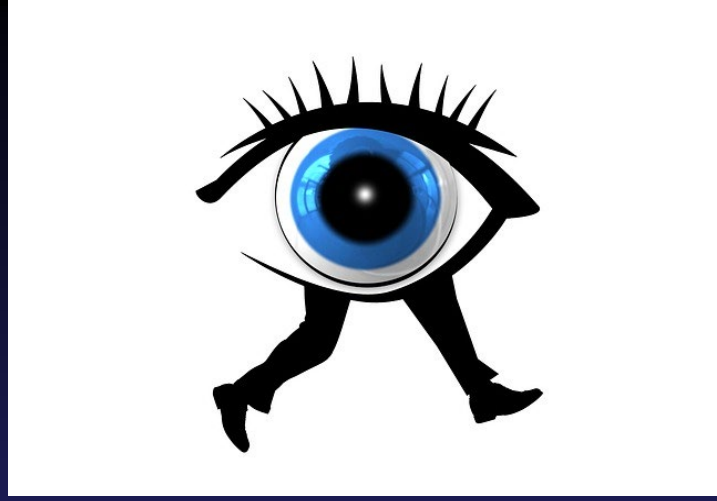
(Loewenfeld "The Pupil")

The Pupil
Reactions
Pupillary Escape



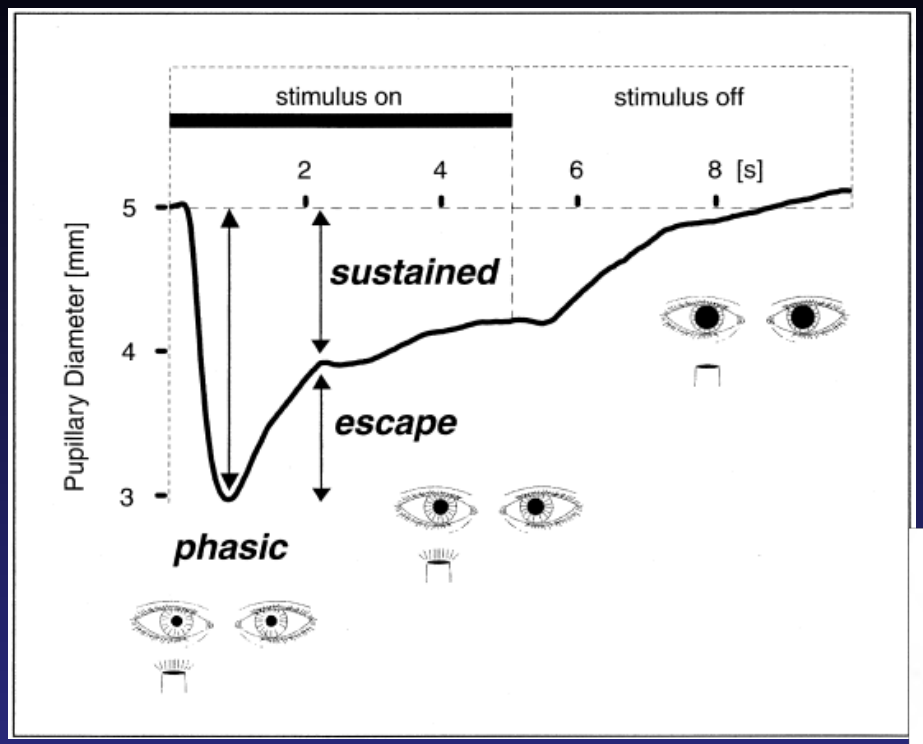
- Re-dilation of the pupil after exposure to a moderate light source.
- Stated that the re-dilation is due to retinal adaptation
- Pupillary "Unrest" follows
- The Alpha Omega pupil might be considered as a form of pupillary escape by non-light therapists

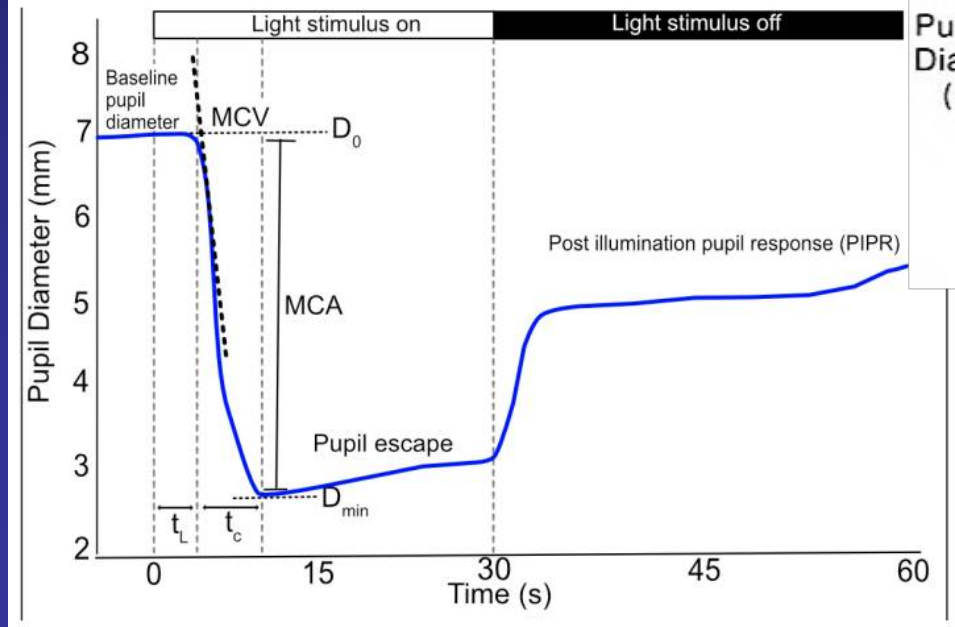
The Pupil
Reactions
Pupillary Escape

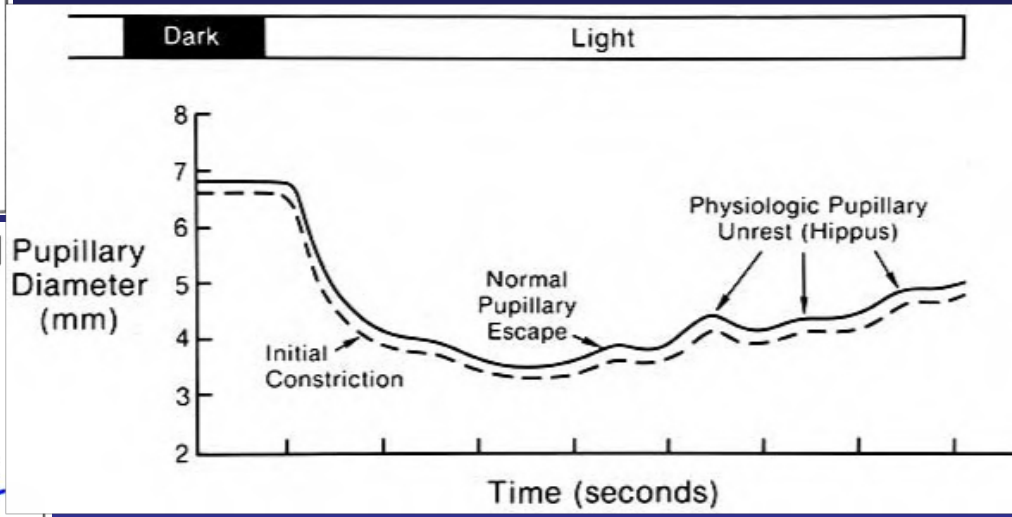


- Duke-Elder,[1] in 1959 discussing the clinical picture of optic neuritis, mentions "a peculiar pupillary reaction common to all forms of conduction interference, wherein, although both the direct and consensual reactions are present the contraction is not maintained under bright illumination so that the pupil slowly dilates again while the light is still kept upon the eye.“
- “**Pupillary escape**” is an abnormal **pupillary** response to a bright light, in which the **pupil** initially constricts to light and then slowly redilates to its original size. **Pupillary escape** can occur on the side of a diseased optic nerve or retina, most often in patients with a central field defect.

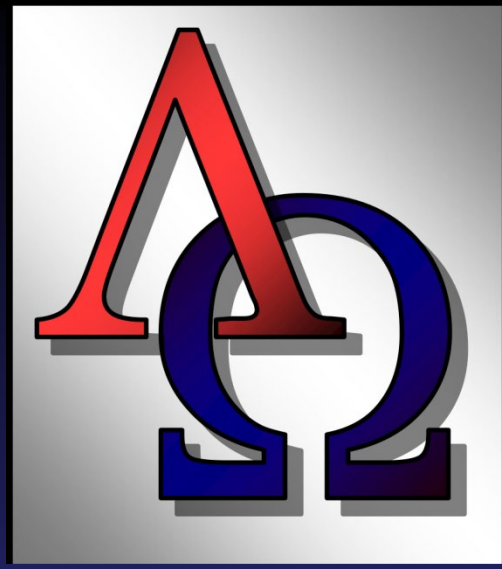
The Pupil
Reactions
Pupillary Escape







The Pupil
Reactions
Alpha Omega Pupil



- An Alpha Omega Pupil is the abnormal re-dilation of the pupil during direct, constant light stimulation.
- An Alpha Omega Pupil differs from Pupillary Unrest in that its occurrence happens before 8-9 seconds have elapsed. Its amplitude is greater than 1 mm in many cases.
- It's measurement or recording can be effected by the influence of "Fatigue Waves" in a very tired person and effect the variability of response during testing.
- It can be considered a form of pupillary "escape" but without pathology that is reversible with treatment. There are also differences in frequency and amplitude.
- Conclusion – The pupil reaction is extremely complex

The Pupil

Sympathetic

Influences on Pupillary Reflex Dilation

The Normal Pupillary Reflex Dilation

Any sensory, emotional, or mental stimulus elicits reflex dilation. Any sound, touch or pain, fear, joy or anger or spontaneous thoughts and intentional efforts all dilate the pupils.

The amplitude of reaction depends on the degree of arousal caused by the stimulus and the subject's physical and mental state at the time of stimulation.

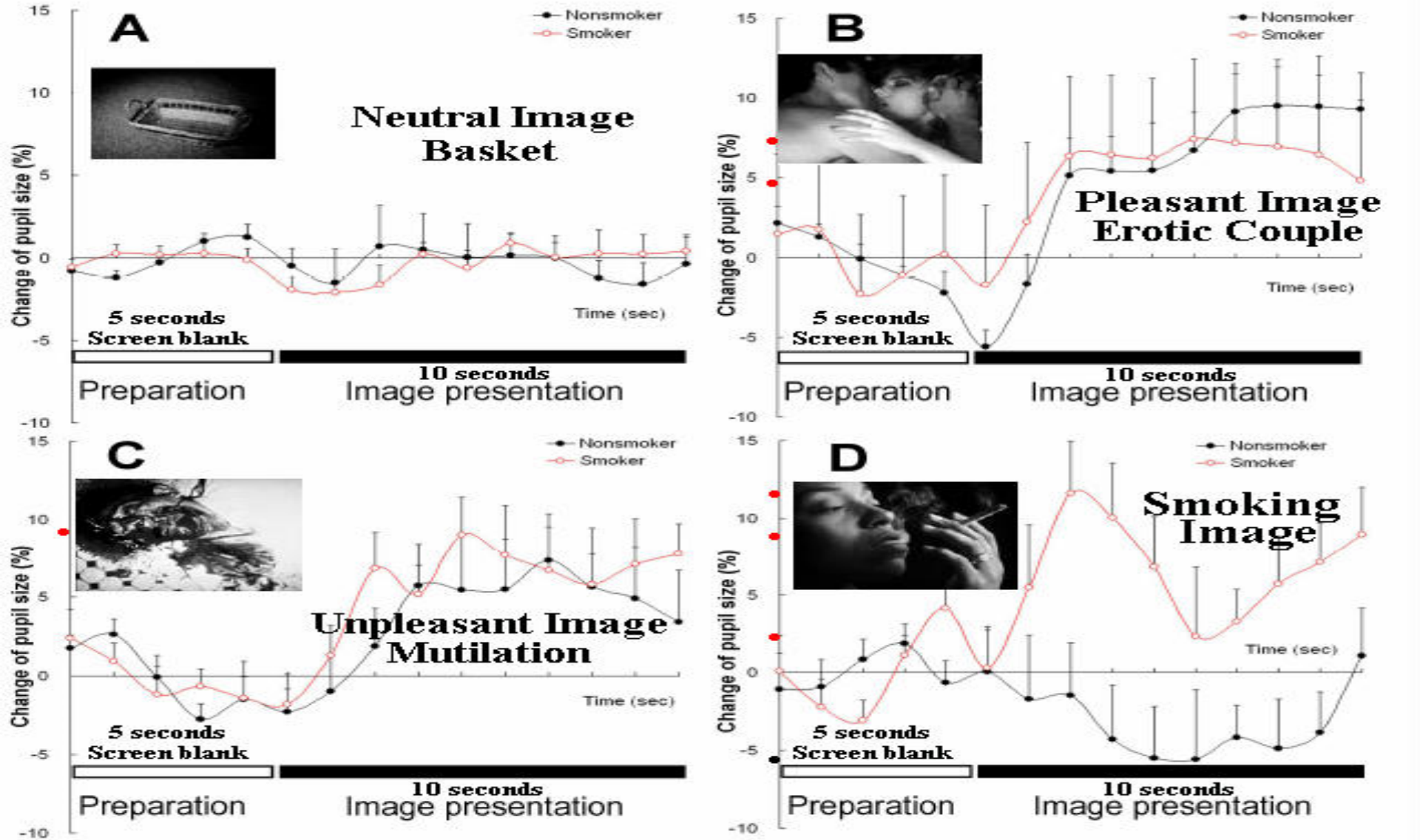
Loewenfeld

The Pupil

Influences on Pupillary Reflex Dilation

Increased Dilation	Increased Constriction
Increased attention	Mind wandering/Distraction
Orienting Reflex	Introspection
Increased mental effort	Poor task performance
Mental arithmetic	Disgust
Memory formation	Images of the sun
Pleasant sounds	High level scene processing
Perception of odors	Memory retrieval
Sexual arousal	
Dishonesty, Lying	
Enjoy/Dislike what is seen	

Autonomic Changes in Pupil Size Upon Viewing Smoking Cue



Average change in pupil size in response to visual cues as measured by a pupillometer among 12 non-smokers, and 7 smokers who averaged 10.6 cigarettes per day, after 3 hours without smoking. Chae Y. et al, Subjective and Autonomic Responses to Smoking-Related Visual Cues, The Journal of Physiological Sciences, March 25, 2008 - Graphic compiled using study figures by WhyQuit.com

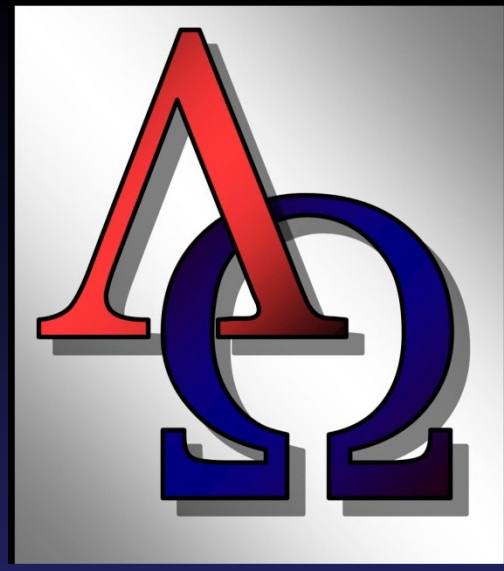
The Pupil

REACTIONS

The Pupil
Reactions

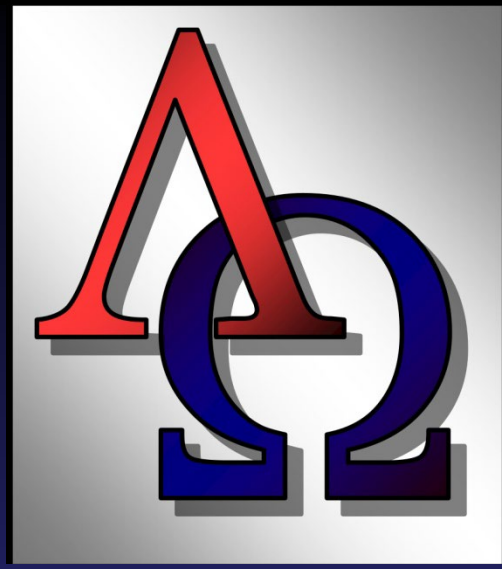
- Alpha Omega
- Hippus
- Afferent Pupillary Defect
- Pupillary Light Response (PLR)
- Near Reflex

The Pupil
Reactions
Alpha Omega Pupil



- Why is it not Hippus?
- Why is it not an APD defect?
- How do other reactions relate?
- How does the field relate?

The Pupil
Reactions
Alpha Omega Pupil



- An Alpha Omega Pupil is the abnormal re-dilation of the pupil during direct, constant light stimulation.
- It is related to imbalances within the ANS. Hypothalmus and Adrenal activity are important.
- The reaction reveals many aspects of the vitality of the human being.
- Rian Shah, N.D. states that oscillations are due to severe sodium depletion secondary to decreased adrenal function, specifically diminished aldosterone. Also called "rebound" pupil.

The Pupil

Testing Standards in Measurement

Alpha Omega Pupil

Pulaski, 2006

Observation and Recording of AO Pupil

1. Quickness of initial stimulation – PLR
2. Time to release
3. Amplitude of release
4. Reactions after initial release – fluctuations
5. Change in response with repeated stimulation
6. Sensory reactions – tearing, pain, etc

The Pupil

Grading Standardization

Alpha Omega Pupil

Alpha Omega Grading Standard
(Pulaski 2010)

Grade	Release Time	Fluctuations	Amplitude
Normal	≥ 9 seconds	Trace	Trace
1+ AO	4 – 6 sec	Moderate	Mild
2+ AO	2 – 3 sec	Marked	Mild-Moderate
3+ AO	1 – 2 sec	Mild-Moderate	Moderate
4+ AO	< 1 sec	Mild	Large

The Pupil
Grading Summary

OD			OS
0 1 2 3 4	PLR		0 1 2 3 4
0 1 2 3 4	Near Reflex		0 1 2 3 4
Yes No	Normal Direct		Yes No
Yes No	Normal Consensual		Yes No
_____	Pupillary Diameter		_____
_____	Time of Release		_____
_____	Amplitude of Release		_____
0 1 2 3 4	Fluctuations		0 1 2 3 4
0 1 2 3 4	AO Pupil		0 1 2 3 4

_____ Change in repeated stimulation _____

_____ Sensory reactions _____

Pulaski AO Pupil

Field / Progress Evaluation

DATE ___/___/____ **NAME** _____ **Filter** AO/MD MU UO/MU _____
Copay _____ Total Weeks _____ Since LastOV_____

HX Compliance + - _____ Changes in Health/Medication None _____

_____

_____

_____

_____

Field Testing **Tested by KL JP** **Reliability 1 2 3 4** _____

VA sc cc OD 20____ **Pupils** Size SS/Lt PLR αΩ APD Near **NPC** ____/____
OS 20_____ **OD** ___/___mm 1 2 3 4+ 0 1 2 3 4+ - + + -
OS ___/___mm 1 2 3 4+ 0 1 2 3 4+ - + + -
Photophobia None 1 2 3 4+ Other _____

Fields White Green Red Blue BS **EOM's** **Pursuits** **Saccades** Hypo/Hypermetric
OD_____% ____% ____% ____% ____% SAFE 1 2 3 4+ ____% Rt 1 2 3 4+ ___ ___
OS_____% ____% ____% ____% ____% SAFE 1 2 3 4+ ____% Lt 1 2 3 4+ ___ ___
Jerky___1 2 3 4+ Fixation Loss 1 2 3 4+ Sac Int__+

Dynamic OD _____ **Impression** ☐ Visual Field Contraction **Plan** ☐ Continue Current Filters
OS _____ ☐ Improving W C ☐ Same W C ☐ FUp_____Weeks
☐ Worse OD OS ☐ Asymmetric

Externals OD OS ☐ Pursuit / Saccadic Dysfunction ☐ Change Tx _____
Lid/Lash _____ _____ ☐ Pupillary Abnormality _____
Conjunctiva_____ _____ ☐ Convergence Insufficiency _____
_____ _____ Signed _____

The Pupil
Reactions

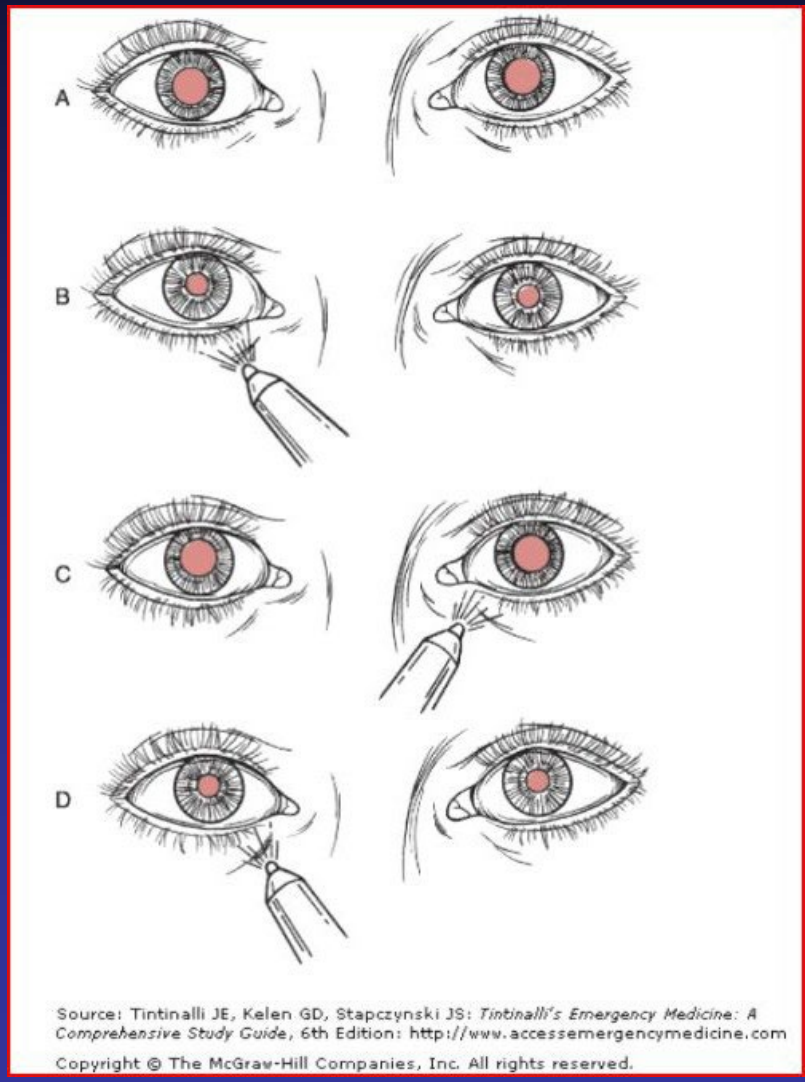
Hippus

Per Lowenfeld it is a very confusing term

- Nystagmus in ancient times
- Lid fluttering
- 18th Century – wave-like pupillary movements
- Nine categories (see addendum – pupillary oscillations)
- Loewenfeld suggests that the name be dropped or defined as "vigorous pupil oscillations of various types"
- Of interest are
  - » Pupillary Unrest
  - » Fatigue Waves
  - » Pupillary Escape Waves

The Pupil
Afferent Pupillary Defect

1. Confusion with Alpha Omega
2. RAPD due to Unilateral Optic Nerve Neuropathy. Indication of retinal disease or optic nerve pathology
2. Re-dilation referred to in literature as "Pupillary Escape"
3. Normal consensual with subnormal direct. Decreased PLR. Anisocoria at times
4. Swinging Flashlight Test
5. Characteristic observation is "release" or re-dilation of both pupils when the light is moved from the normal to the affected eye.



Source: Tintinalli JE, Kelen GD, Stapczynski JS: *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*, 6th Edition: http://www.accessemergencymedicine.com

Afferent Pupillary Defect vs. Normal (Loewenfeld "The Pupil")

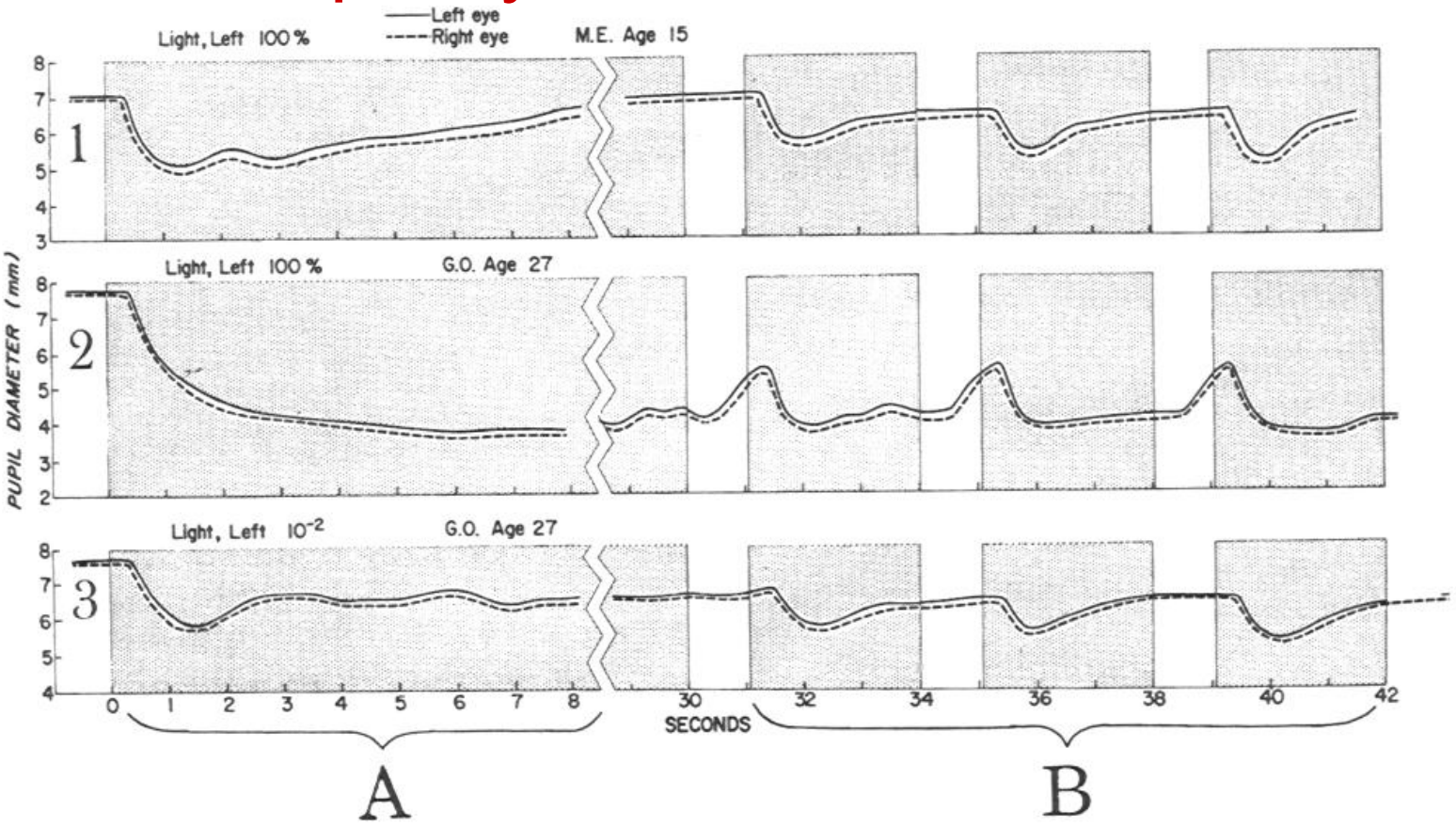


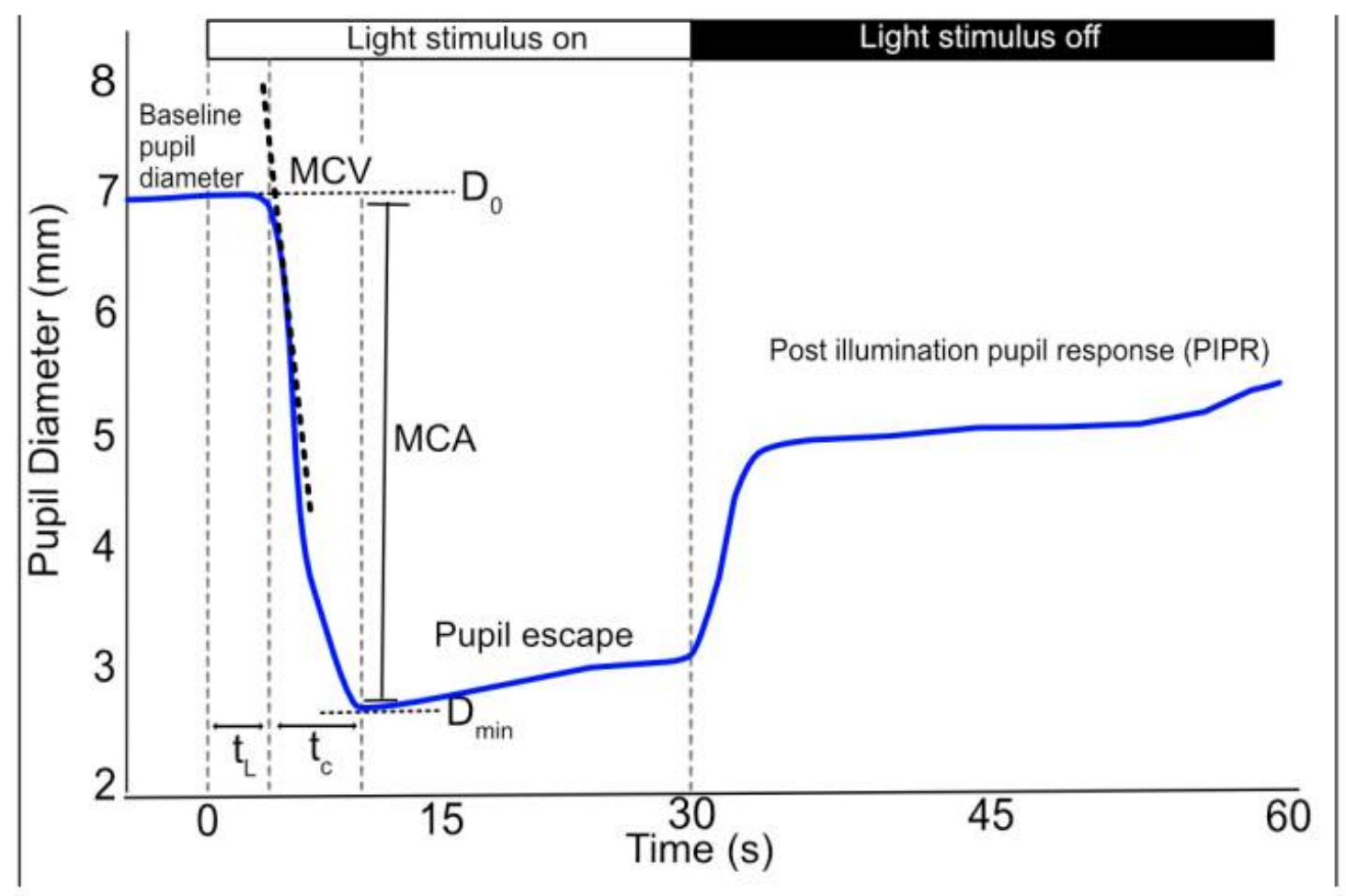
Figure 17-4. Pupillary "escape" in a patient with afferent impairment (line 1), compared with a normal subject (lines 2 and 3). The patient was an obese 15-year-old girl who complained of severe headaches. She was found to have bilateral papilledema and increased intracranial pressure. Extensive diagnostic investigation failed to reveal the cause of her trouble. During the next months the working diagnosis was pseudotumor cerebri. She was treated with steroids and the papilledema receded. About 2 months later her headache recurred and her vision was reduced to light perception. One month later a craniotomy was done for decompression, and the cortex and meninges were found to be studded with nodules of metastatic melanoma. The patient died about 2 months later; and since only the brain was examined, the location of the primary tumor remained unknown. The neuropathologist's report stated that "micro-

the patient's reactions to bright light (**A**) and to darkness (**B**). Line **2** shows a normal person's reactions under the same conditions. In line **3** light of reduced intensity was used in the normal person (attenuated by neutral grey filter of 10^{2} density). Note the "escape" of the patient's light reflex, compared to the firm, extensive contraction of the normal subject's pupils. With 2 log units of neutral grey filter interposed between the normal eye and the light the same pupillary "escape" was produced in the normal subject as in the patient with bright light. In the darkness reflexes the normal pupil dilated well to one-second interruptions of the light (white bars); and they recontracted quickly when the light was readmitted. In contrast, both the patient's eye and the normal eye with attenuated light had "low intensity" darkness reflexes: the dark-dilations were missing and the secondary contractions were shallow and short-lasting. (From H.S.

The Pupil

Reactions

Pupillary Light Reflex



The Pupil
Reactions

Near Reflex

1. Observed reaction of Pupil when the patient looks from a distance to near object.

2. Record strength of constriction from 0 – 4+ for each eye.
3. Is a different pathway and can react even if no PLR

The Pupil

TESTING

The Pupil
TESTING

Conventional

Automated Pupillometry

The Pupil
Testing Standards in Measurement

Observation and Recording
General Observations and Questions (Loewenfeld "The Pupil")

1. Size - too large/small for age, illumination,etc
2. Direct and Consensual responses.
3. Are reactions to light and to near equally extensive
4. Are they equal in size
5. If unequal is difference greater in dim or bright
6. Do both constrict to light
7. Do both redilate as light removed
8. Is reflex to sensory stimuli intact on both sides
9. Are there other motor or sensory defects relating to the pupillary syndrome

The Pupil

Testing Constants in Measurement
Rigid Test Protocol

- Room Illumination
- Patient Fixation
- Light Source
- Distance and Location
- Duration

The Pupil
Testing Constants in Measurement

Room Illumination

- Dimly lit room in dark adapted state

Patient Fixation

- At distance (non-accommodative to avoid near reflex)
- Non-descript target – no cognition

The Pupil

Testing Constants in Measurement

Light Source

- Small, bright, concise, with ability to adjust the light intensity

The Pupil

Testing Constants in Measurement

Distance and Location

- Approximately 6-8” from eye
- Light source turned on and below or temporal to eye being tested
- Light should be swung directly to a location straight into the line of sight
- Lag of 2-3 seconds between eyes

The Pupil

Testing Constants in Measurement

Duration

Normally up to 2-3 seconds in front of eye. Needs to be at least 1 second to get full constriction.

Alpha Omega evaluation

- Observe the pupil under constant light stimulation for at least ten seconds or until first sustained release.
- Test right eye first and then immediately left eye
- Observe time to release, fluctuations and amplitude
- Repeat at least three times observing changes with fatigue

The Pupil
TESTING

Automated Pupillometry

Testing - Pupillometry

Conventional

- Subjective with many areas of variability. Slow reactive pupils less than 0.3mm and anisocoria.

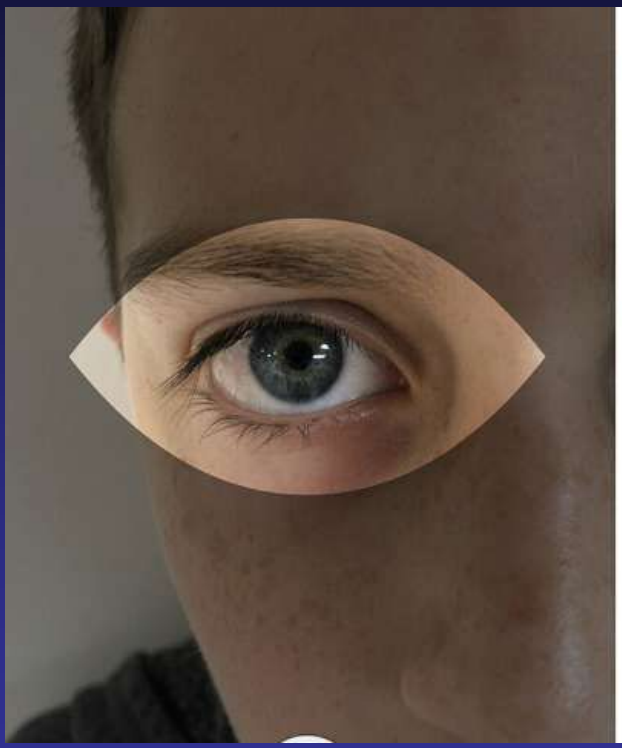
Automated Pupillometry

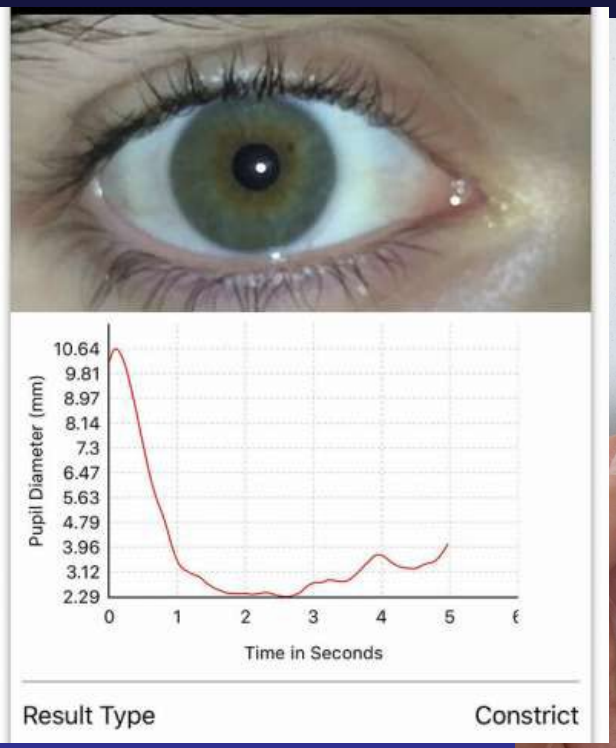
- Reliable, quantitative, objective testing
- Reproducible needed for comparative tesing over time especially important in monitoring our treatments and for research.
- Accurate immediate assessment of patient.
- More sensitive with smaller inter-examiner discrepancies.

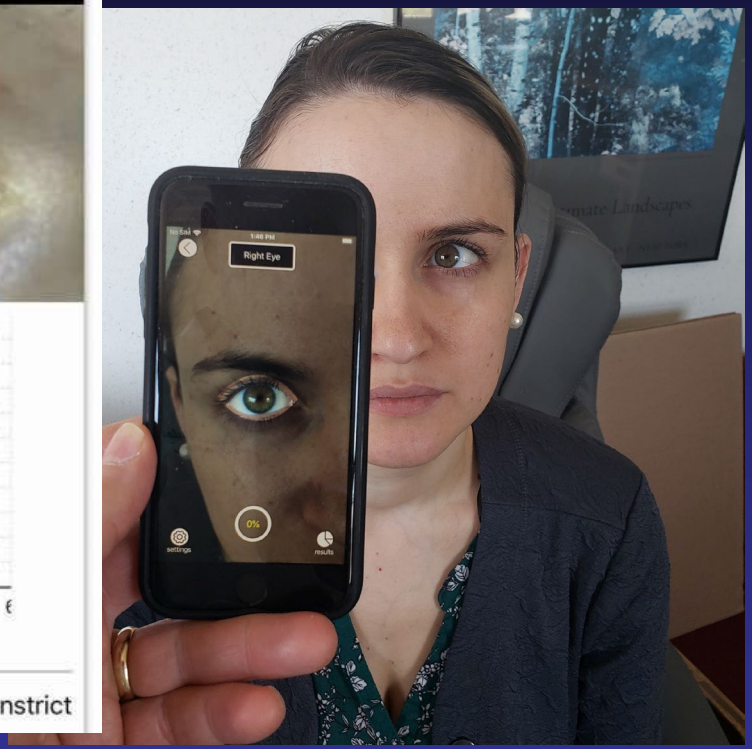
The Pupil

Testing – Pupillometry

Bright Lamp







The Pupil
Testing – Pupilometry
Bright Lamp

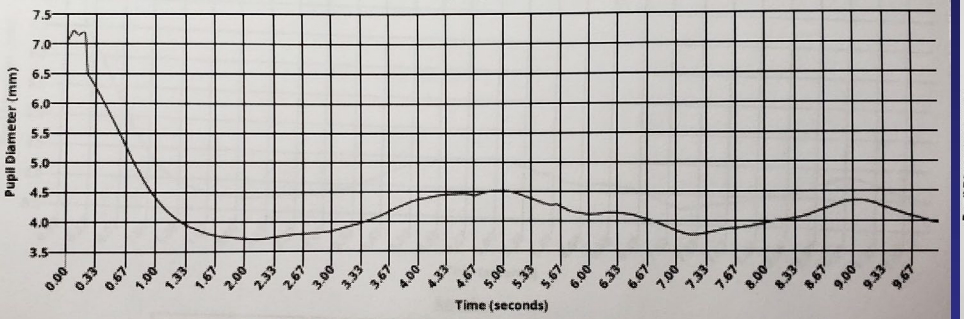
Patient Information

Birth Date	05/09/2008
Sex	Female
Eye Location	Left
Concussion Date	N/A
Asymptomatic?	Yes

Test Information

Test Date & Time	03/12/2020 05:27:57 PM
Test Administrator	John PulaskiOD
Test Type	Full Spectrum w/Torch
Torch Level	50%
Flash Status	Off
Video Duration	10.5 sec
Torch Duration	10 sec

Pupillogram



Results

Metric	Results (red values are 2σ > mean normative range)	Normative Data
(Beta) Reflex Score	Error: 3	0 - 5
Avg. Constriction Speed	**1.762 mm/sec**	0.45 - 1.159 mm/sec
Avg. Diameter	**4.259 mm**	3.169 - 3.816 mm
Avg. Dilation Velocity	N/A	0.888 - 2.699 mm/sec
Constriction Time	2.1 sec	1.178 - 2.217 sec
Latency	0.233 sec	0.138 - 0.279 sec
Max. Constriction Speed	8.4 mm/sec	4.013 - 9.136 mm/sec
Max. Diameter	**7.229 mm**	3.662 - 5.186 mm
Min. Diameter	**3.703 mm**	2.861 - 3.317 mm
75% Recover Time	N/A	3.945 - 4.54 sec

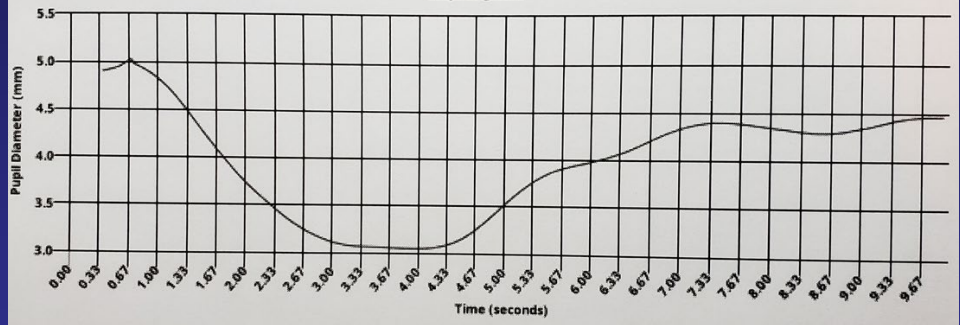
Patient Information

Birth Date	03/11/2006
Sex	Male
Eye Location	Left
Concussion Date	N/A
Asymptomatic?	Yes

Test Information

Test Date & Time	03/13/2020 09:10:42 AM
Test Administrator	John PulaskiOD
Test Type	No Light
Torch Level	0%
Flash Status	Off
Video Duration	10.5 sec
Torch Duration	10 sec

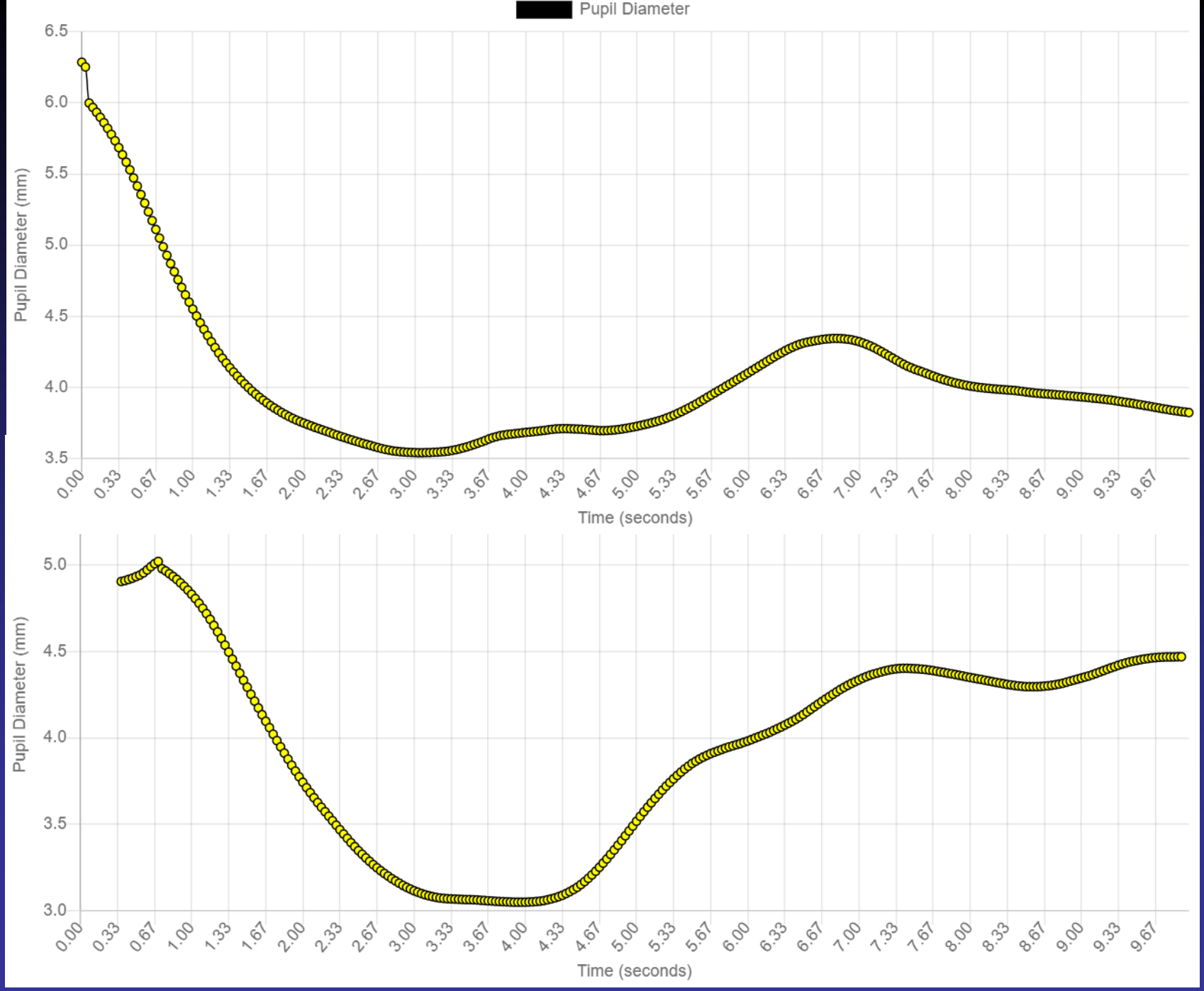
Pupillogram

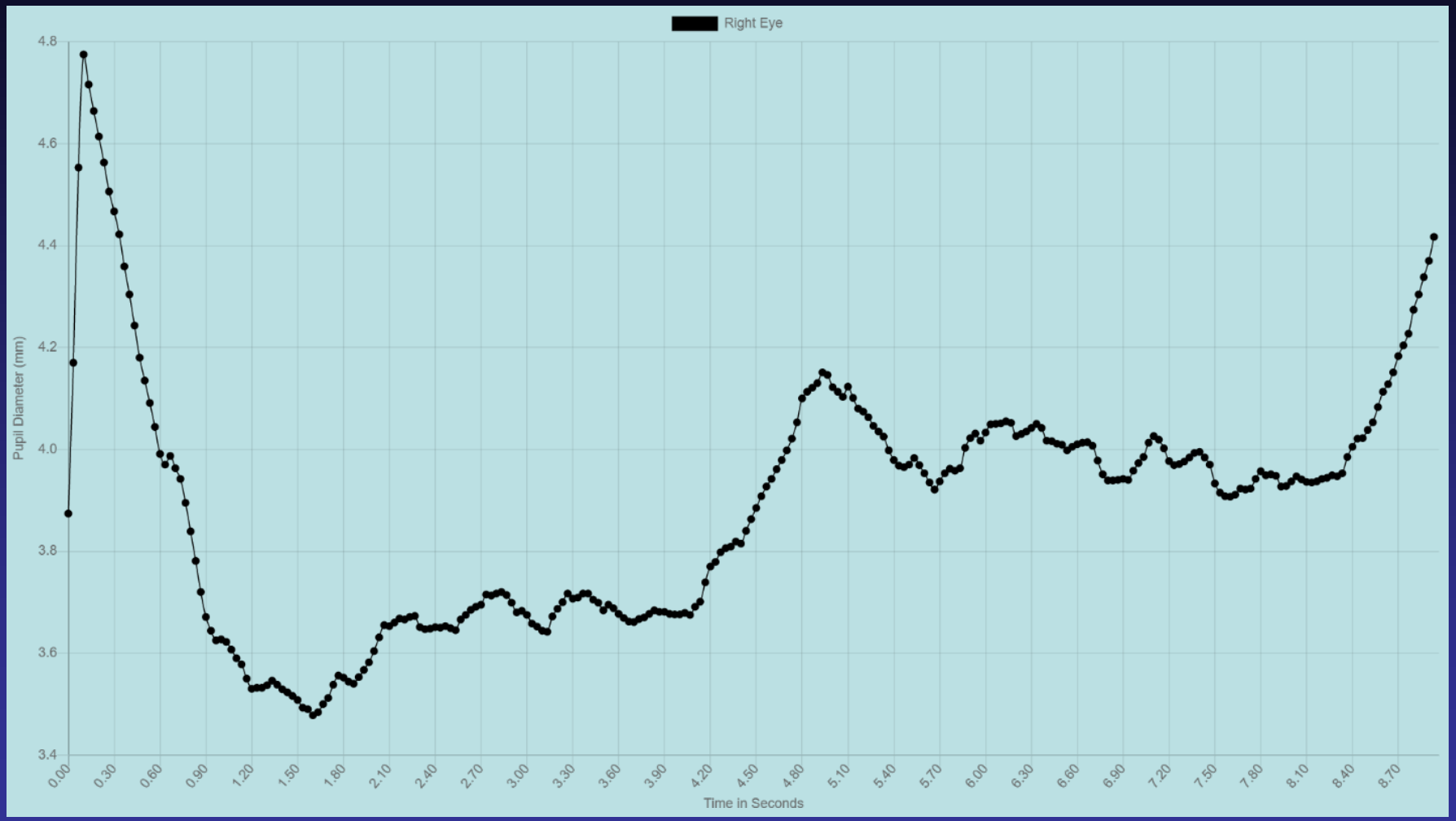


Results

Metric	Results (red values are 2σ > mean normative range)	Normative Data
Avg. Diameter	3.958 mm	3.626 - 5.161 mm
Max. Diameter	5.02 mm	3.825 - 5.545 mm
Min. Diameter	3.05 mm	3.427 - 4.847 mm

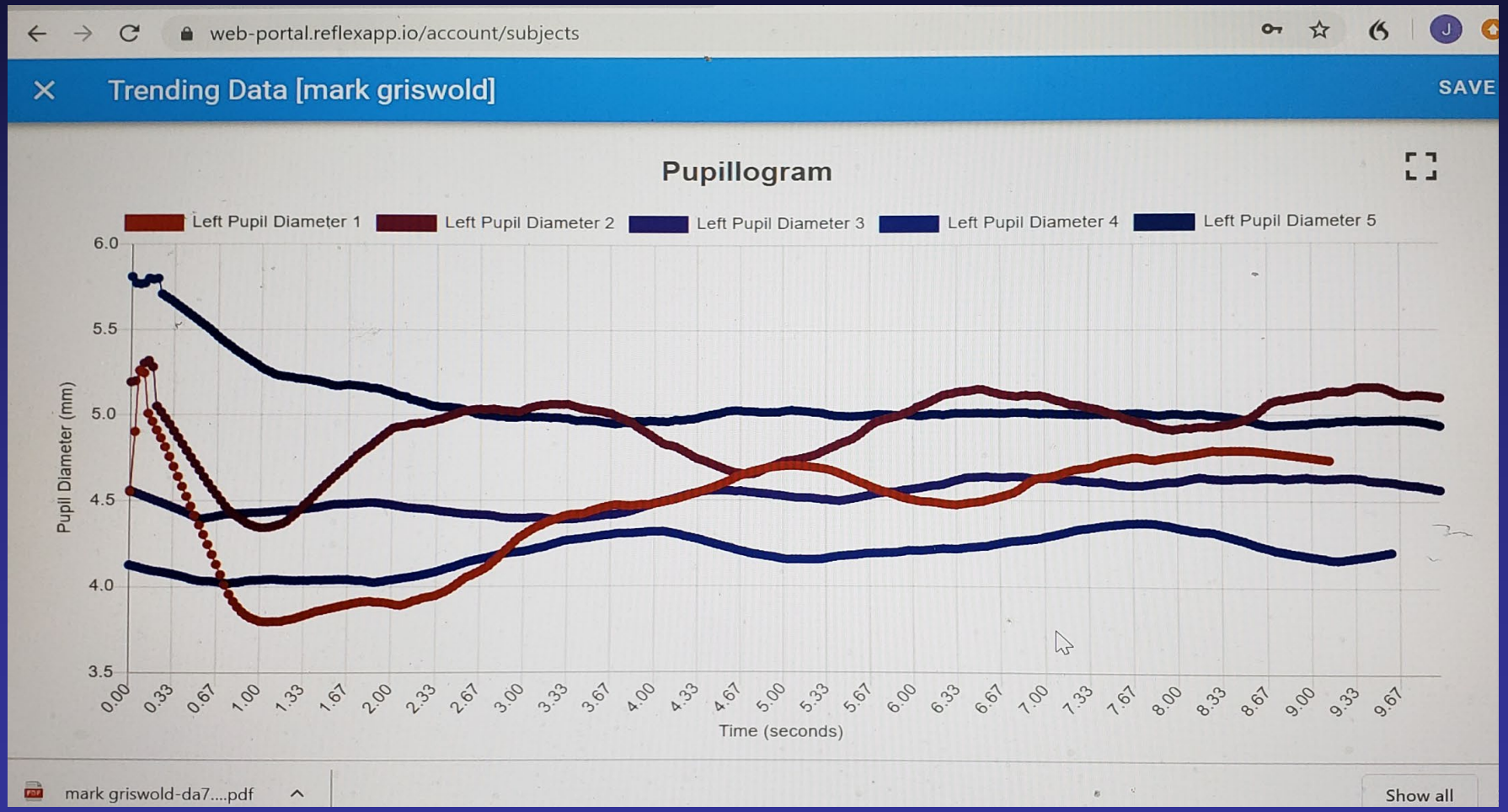
Reflex - PLR Analyzer is designed to help assess and monitor cognitive and neuro-ocular function by providing quantitative data of the Pupillary Light Reflex (PLR). This data can be used by health care professionals to assist in diagnostic decisions and treatment/recovery management. For more details regarding the clinical relevance of PLR, and for more information about Reflex, go to brightlamp.org.


Pupil Diameter
Pupil Diameter (mm)
6.5
6.0
5.5
5.0
4.5
4.0
3.5
0.00 0.33 0.67 1.00 1.33 1.67 2.00 2.33 2.67 3.00 3.33 3.67 4.00 4.33 4.67 5.00 5.33 5.67 6.00 6.33 6.67 7.00 7.33 7.67 8.00 8.33 8.67 9.00 9.33 9.67
Time (seconds)
Pupil Diameter (mm)
5.0
4.5
4.0
3.5
3.0
0.00 0.33 0.67 1.00 1.33 1.67 2.00 2.33 2.67 3.00 3.33 3.67 4.00 4.33 4.67 5.00 5.33 5.67 6.00 6.33 6.67 7.00 7.33 7.67 8.00 8.33 8.67 9.00 9.33 9.67
Time (seconds)



Pulaski AO Pupil

The Pupil
Testing – Bright Lamp



Pulaski AO Pupil

The Pupil

Testing – Bright Lamp

Pupil Parameter Normal Ranges

• Avg. Constriction Speed	0.45 - 1.159 mm/sec
• Avg. Diameter	3.169 - 3.816 mm
• Avg. Dilation Velocity	0.888 - 2.699 mm/sec
• Constriction Time	1.178 - 2.217 sec
• Latency	0.138 - 0.279 sec
• Max. Constriction Speed	4.013 - 9.136 mm/sec
• Max. Diameter	3.662 - 5.186 mm
• Min. Diameter	2.861 - 3.317 mm
• 75% Recovery Time	3.945 - 4.54 sec

The Pupil
Automated Testing – BrightLamp Reflex

The Pupillary Light Reflex as a Biomarker of Concussion

Frederick Robert Carrick,[1,2,3,4,5,*] Sergio F. Azzolino,[5] Melissa Hunfalvay,[5] Guido Pagnacco,[5,6] Elena Oggero,[5,6] Ryan C. N. D'Arcy,[7,8,9] Mahera Abdulrahman,[10] and Kiminobu Sugaya[1,2]
Gary Peh, Academic Editor

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Published online 2021 Oct 18. doi: 10.3390/life11101104
PMCID: PMC8537991
PMID: 34685475

The Pupillary Light Reflex as a Biomarker of Concussion

Frederick Robert Carrick et al 2021

- Looked at the parameters of the PLR in concussed versus non-concussed patients, presence of concussion symptoms, age and gender.
- Large Retrospective Study reviewing their clinical patient records – 01/2019 to 01/2020. Over 20,000 patients.
- Used of new automated pupillary testing – BrightLamp Reflex iPhone App. Reproducible diagnostic test.

Questions or Comments?

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Marketing Director
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Phone: (317) 763-0786

reflex

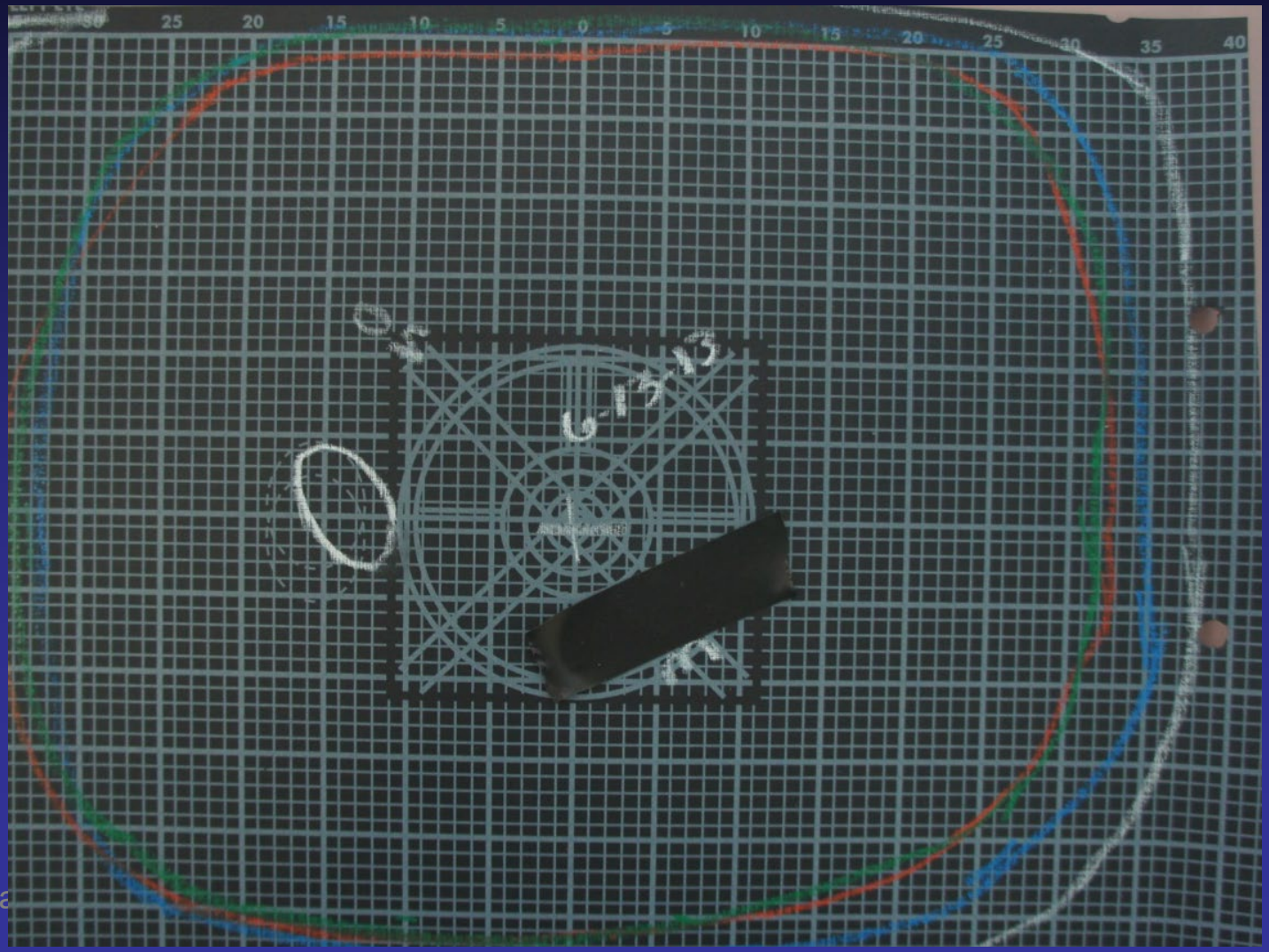
Try Reflex Free For 60-Days:
https://apps.apple.com/us/app/reflex-plr-analyzer/id1412154869

The Pupil

REACTIONS OF PUPIL RELATE TO SIZE OF FIELD

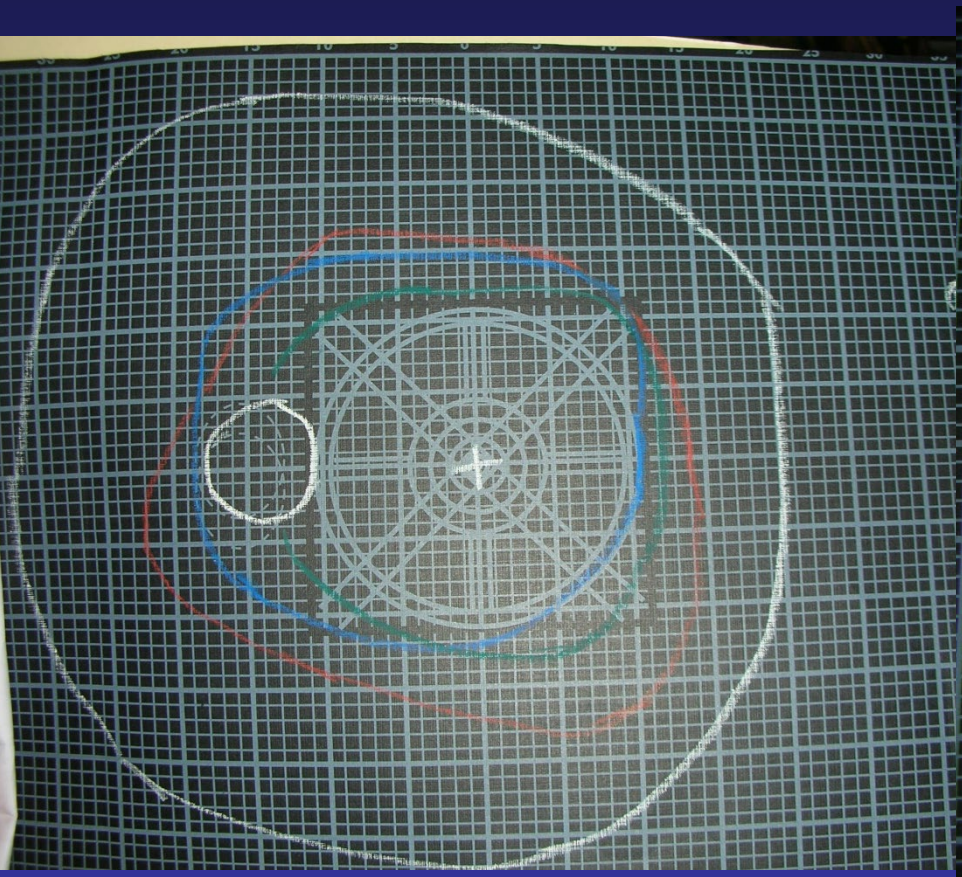
The Kinetic Visual Field

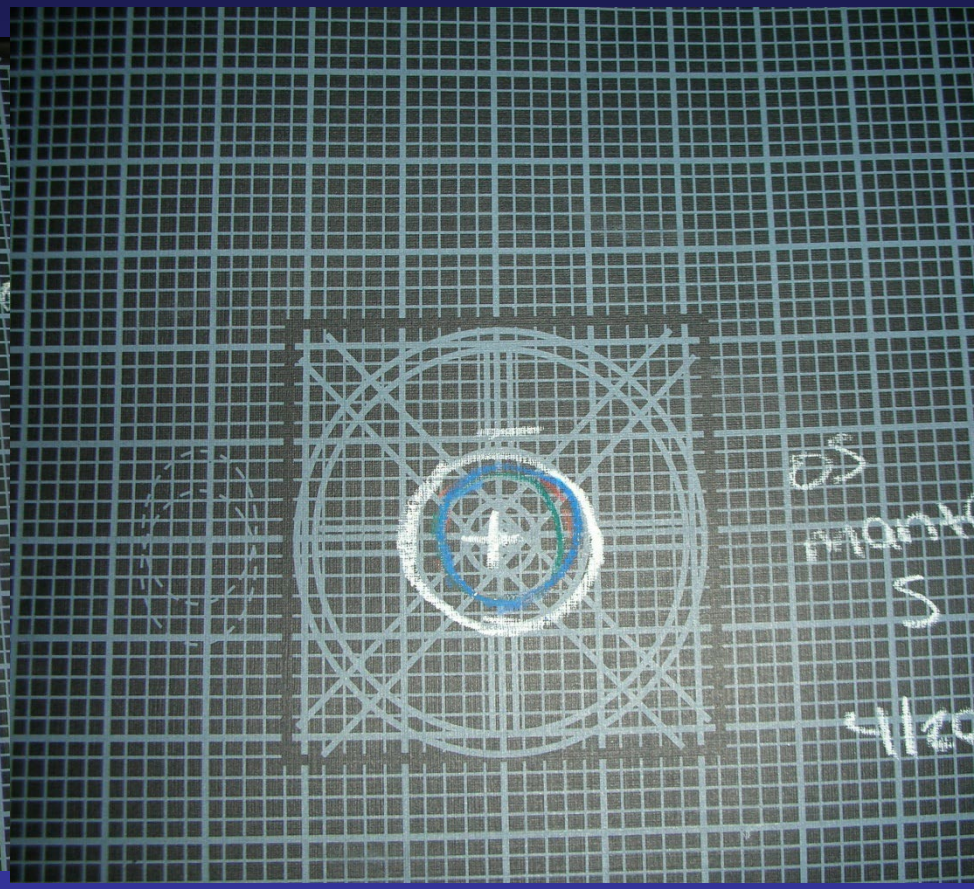
The Normal Visual Field

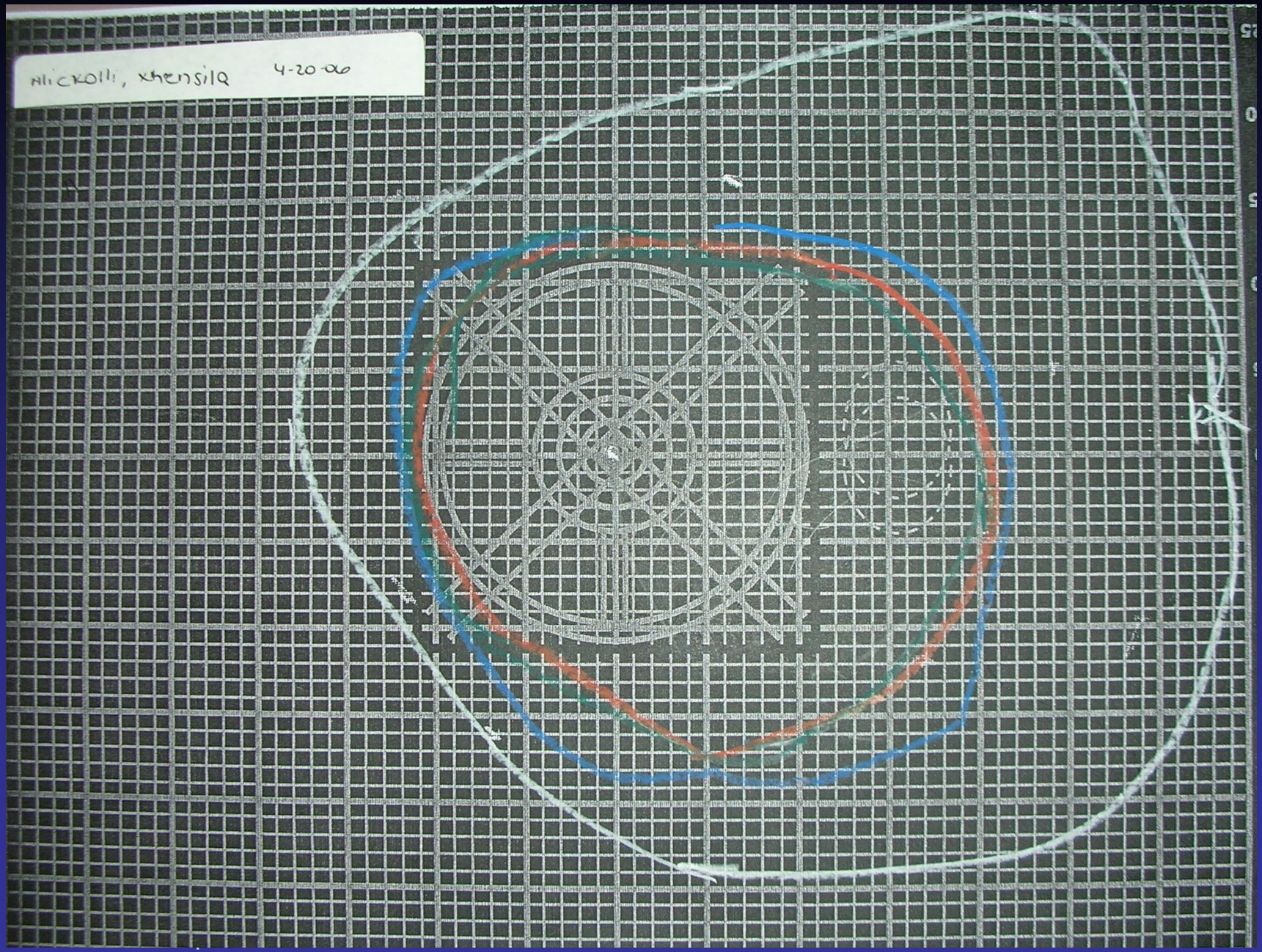


Kinectic (Functional) Visual Fields

Abnormal






Nickolli, Khensiq 4-20-06

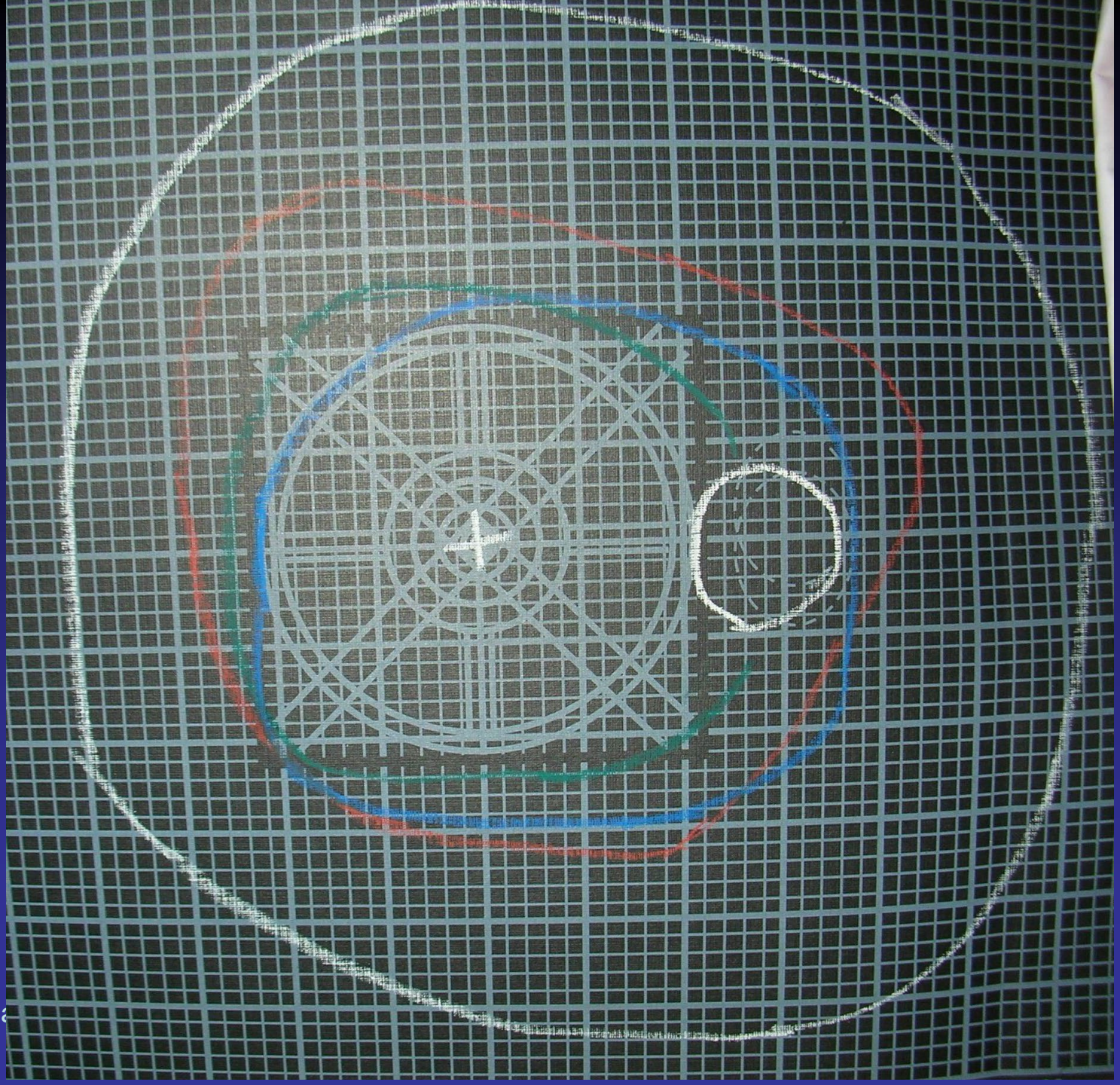
The Pupil

Grading Standardization

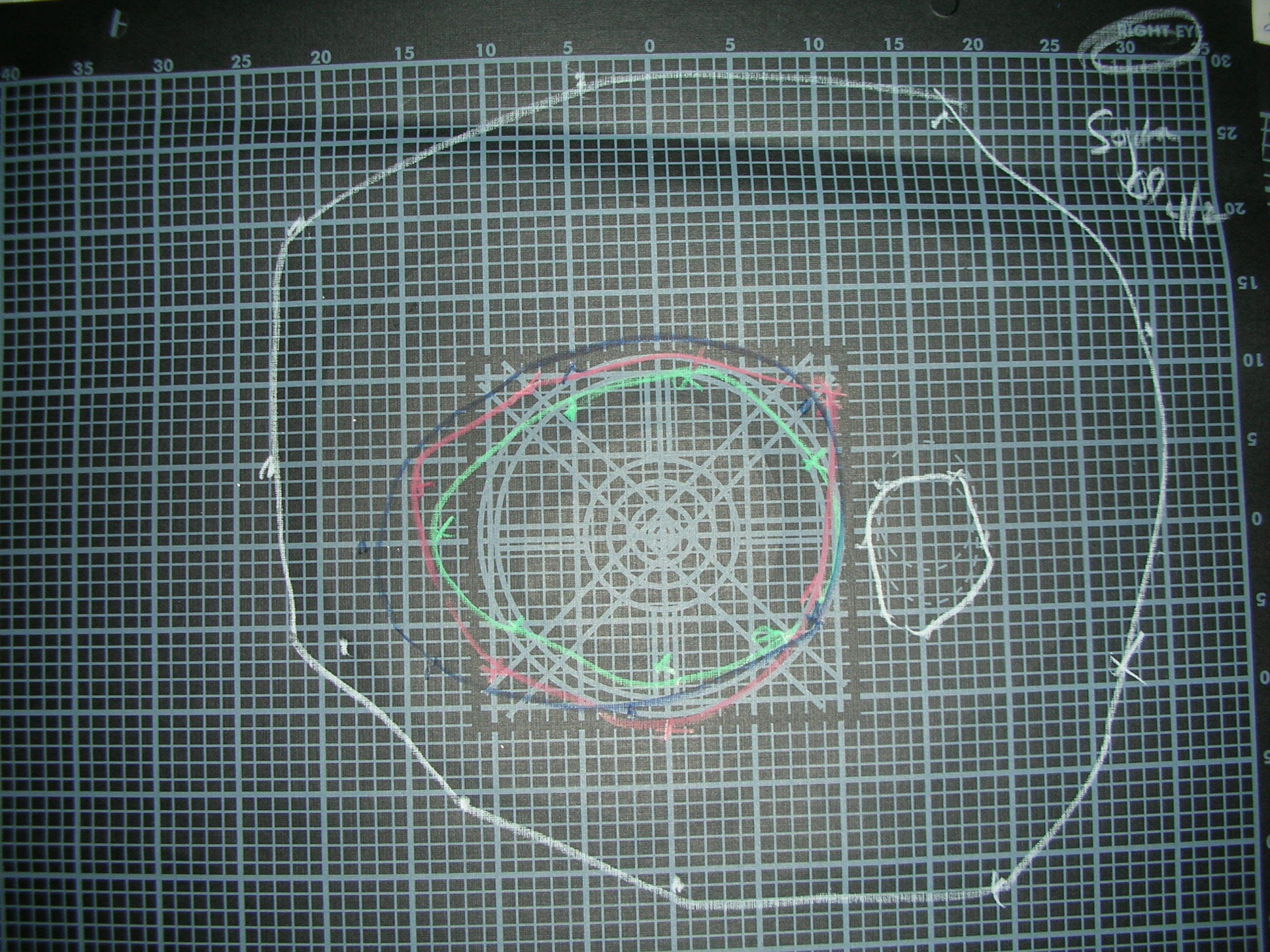
Alpha Omega Pupil

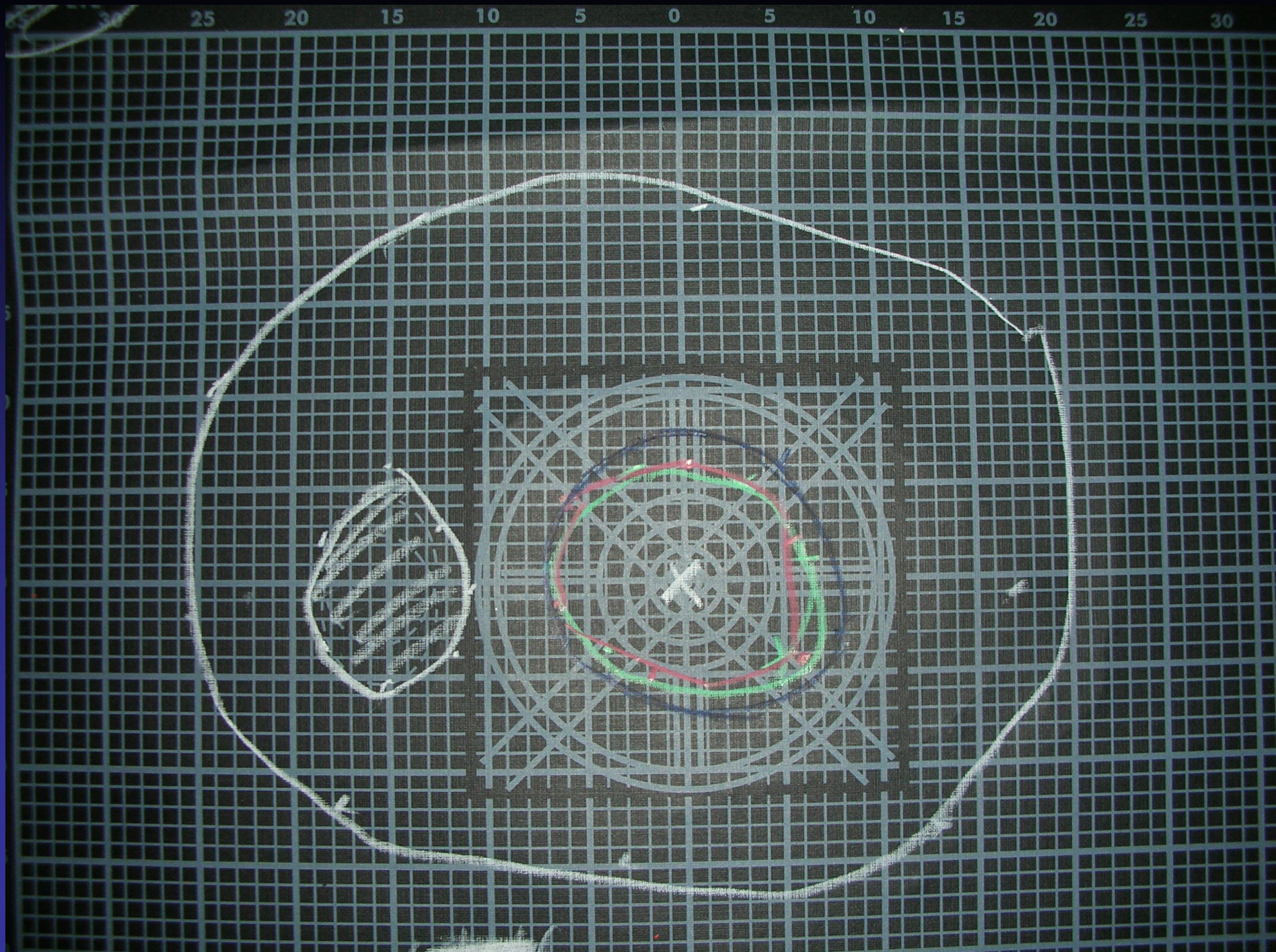
Alpha Omega Grading Standard
(Pulaski 2010)

Grade	Release Time	Fluctuations	Amplitude
Normal	≥ 7 seconds	Trace	Trace
1+ AO	4 – 6 sec	Moderate	Mild
2+ AO	2 – 3 sec	Marked	Mild-Moderate
3+ AO	1 – 2 sec	Mild-Moderate	Moderate
4+ AO	< 1 sec	Mild	Large



Pula


RIGHT EYE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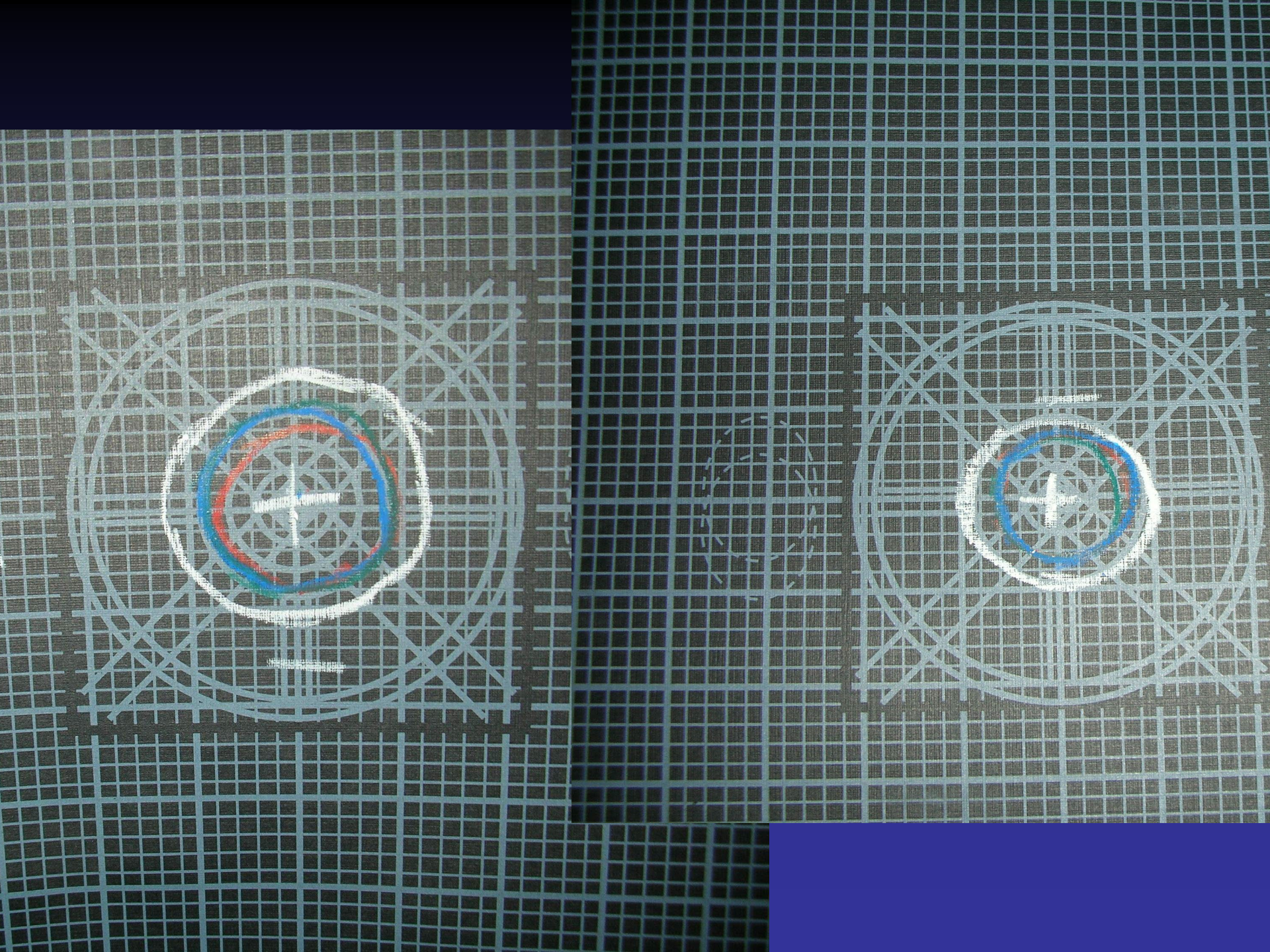
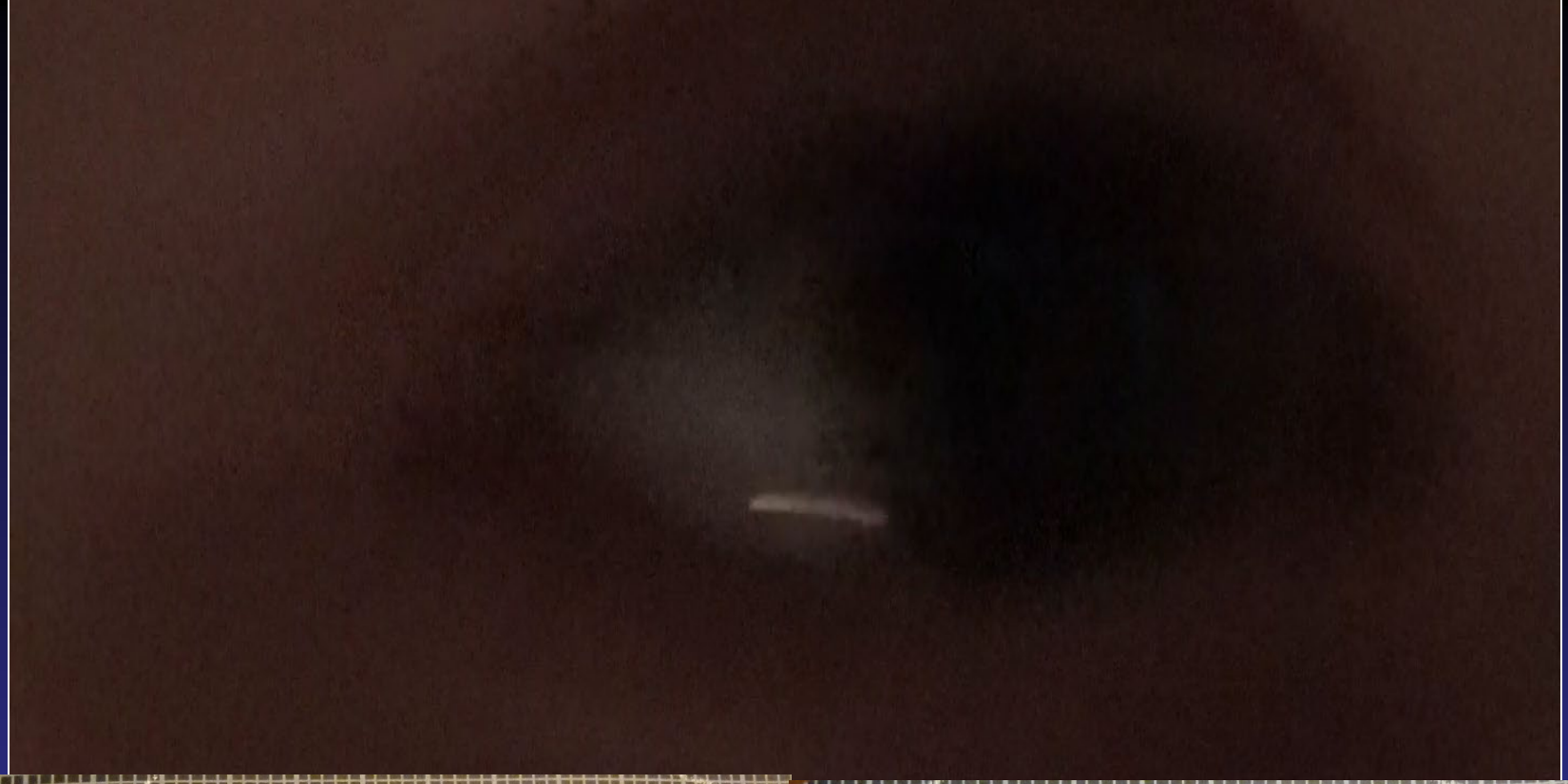
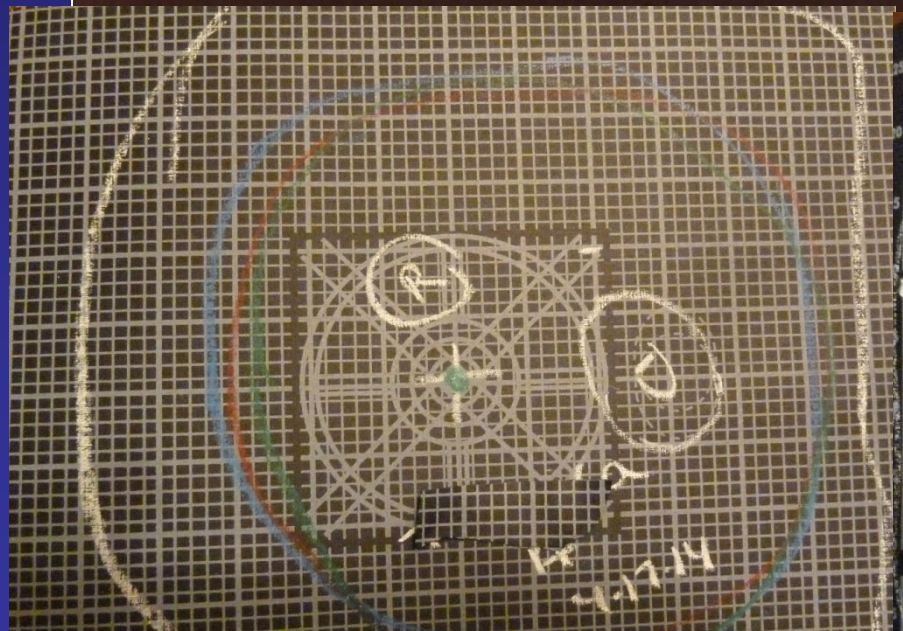
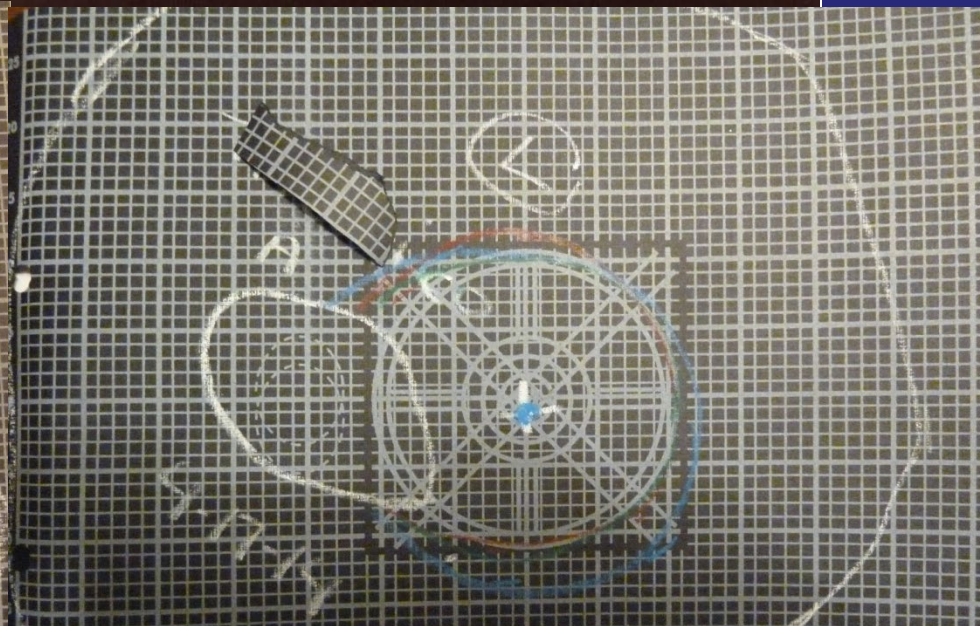
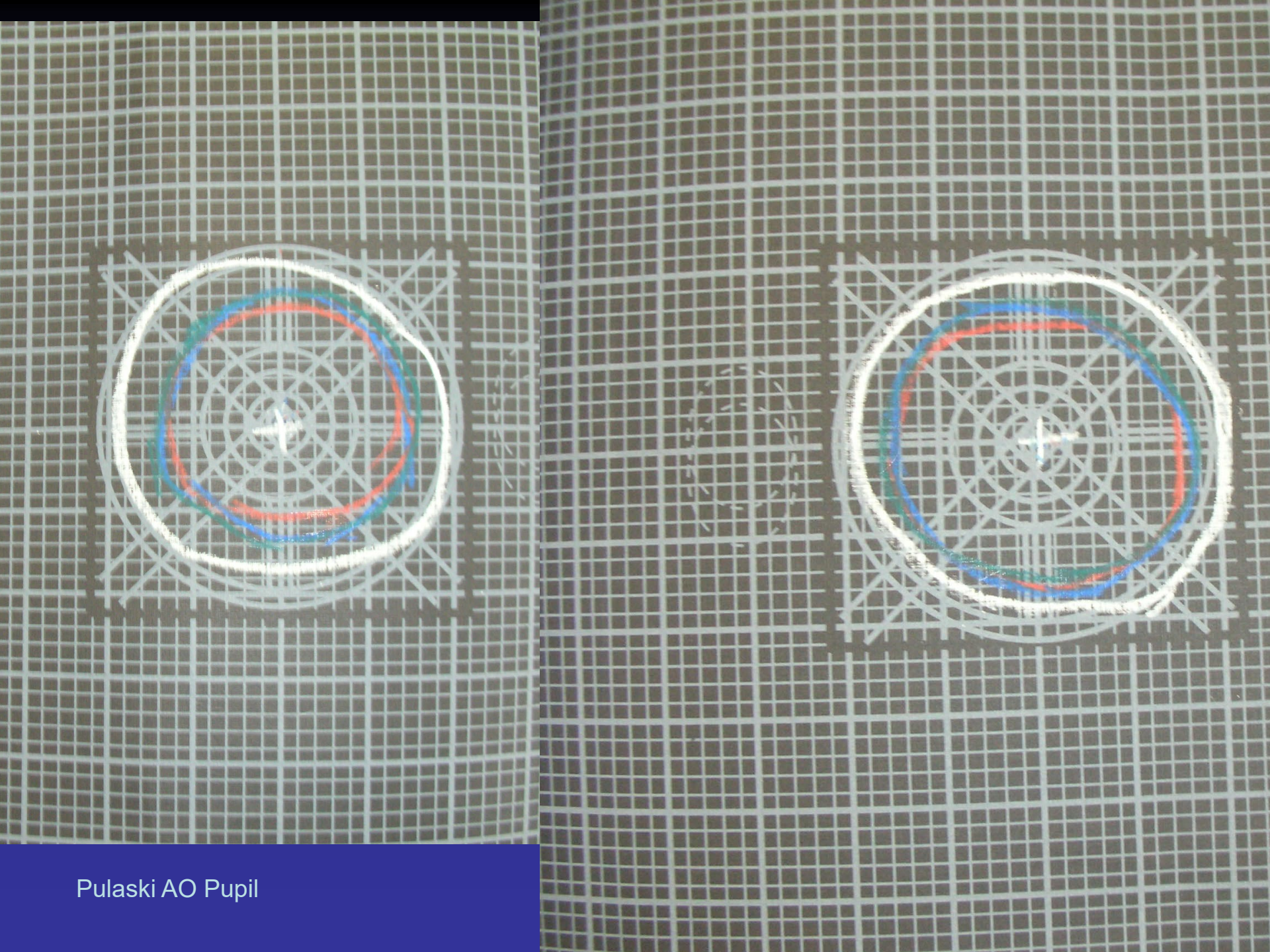


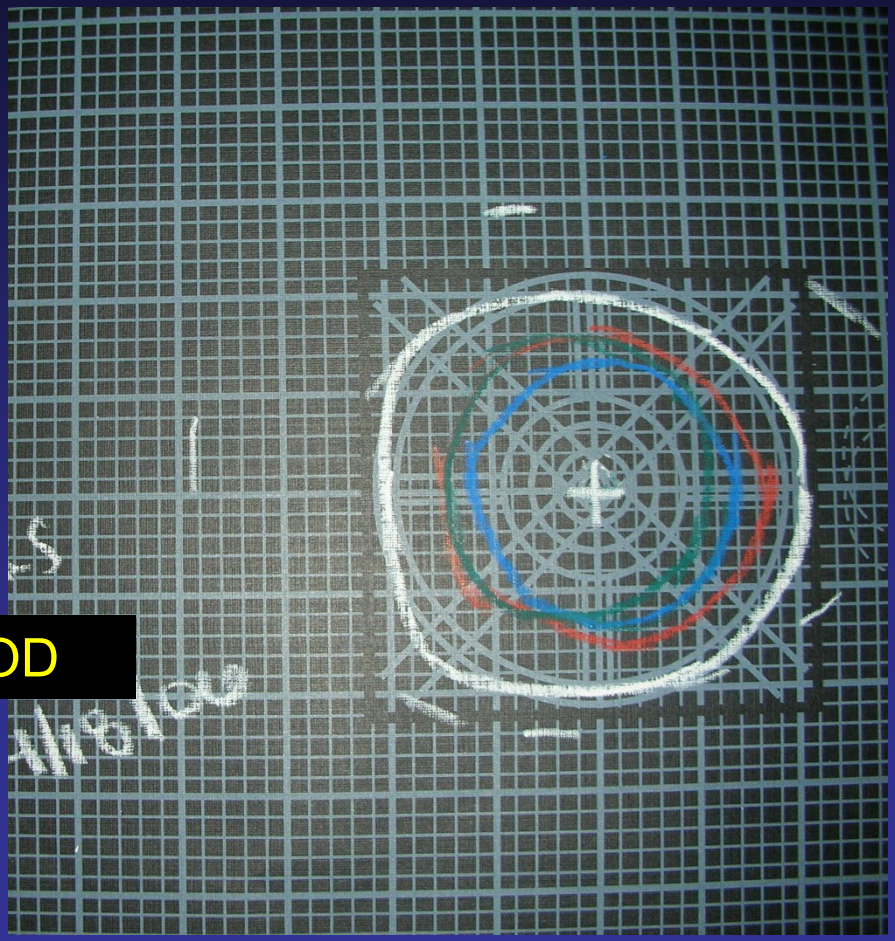


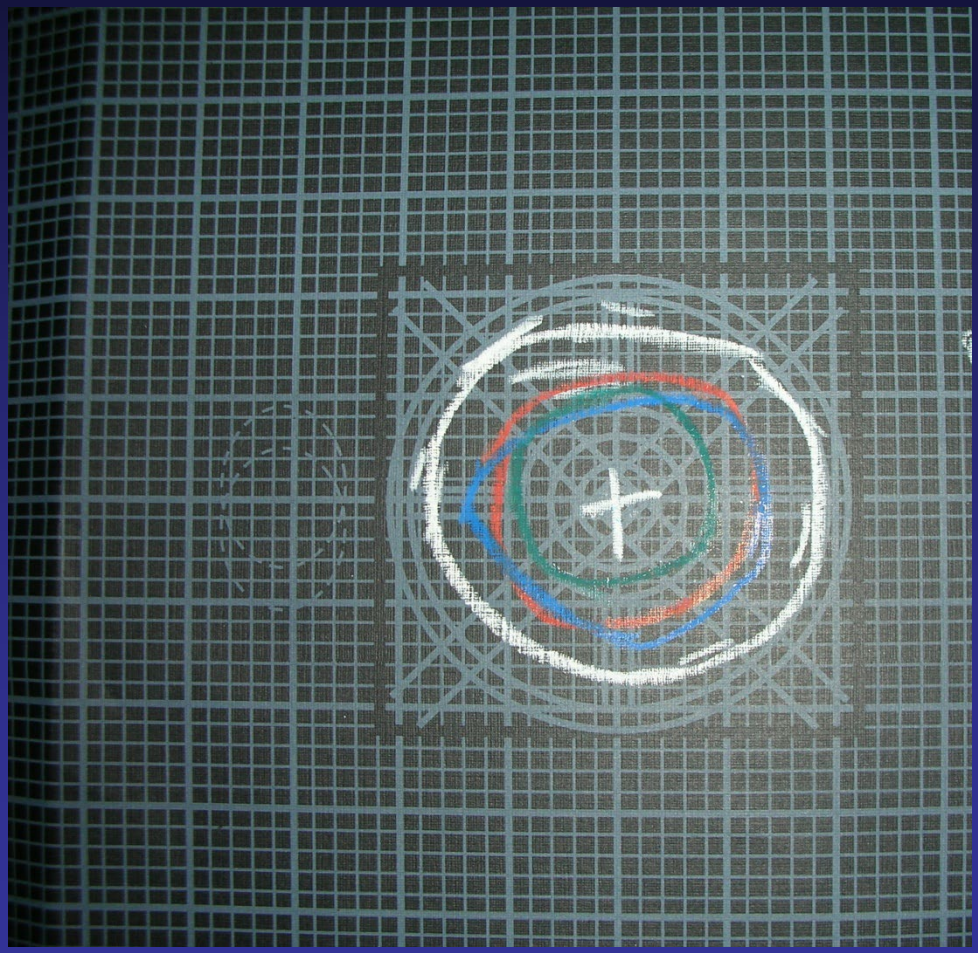






Pulaski AO Pupil





Pulaski AO Pupil

Thank you!