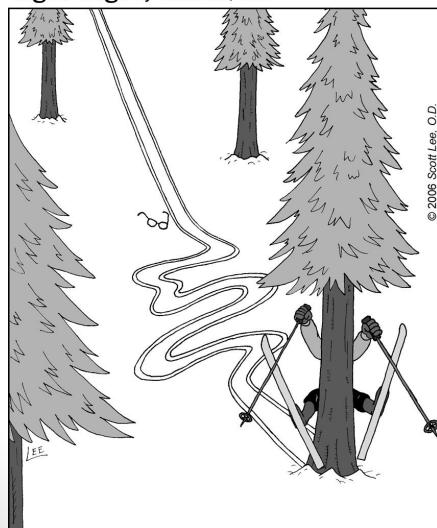


## SECO 2020 Board Review

Sight Gags by Scott Lee, O.D.



\*used with Permission from Dr. Lee

### Visual Perception, Accommodation, Vergence, and Oculomotor Function

Jennifer S. Simonson, OD, FCOVD  
Boulder Valley Vision Therapy, P.C.  
[www.bouldervt.com](http://www.bouldervt.com)

[ 1 ]

#### (Section A. 6.)

Q1: Your patient is unable to follow the target smoothly or accurately when completing the Broad-H Test. Head movement is significant. The patient refuses to play foosball with his brother. You diagnose the following:

- A. Fixation disparity
- B. Saccadic eye movement deficiency
- C. Convergence insufficiency
- D. Pursuit oculomotor deficiency

[ 2 ]

(Section A. 6.)

Q1: Your patient is unable to follow the target smoothly or accurately when completing the Broad-H Test. Head movement is significant. The patient refuses to play foosball with his brother. You diagnose the following:

- A. Fixation disparity
- B. Saccadic eye movement deficiency
- C. Convergence insufficiency
- D. Pursuit oculomotor deficiency**

[ 3 ]

## Eye Movements: Look, Follow, Scan

”Fixations = Maintain steady gaze on a single location



[ 4 ]

## Eye Movements:

- ” Pursuits = Follow the MOVING dot smoothly (maximum speed is 30°/second)



[ 5 ]

## Eye Movements:

- ” Saccades = Jump between targets
- ” Speeds 500°/s, last 100ms



[ 6 ]

## Eye Movements:

”Saccades = Jump between the dots



[ 7 ]

## Eye Movements:

”Saccades = Jump between the dots



[ 8 ]

## Eye Movements:

”Saccades = Jump between the dots

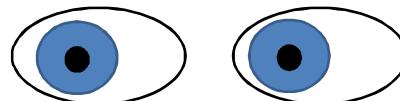


[ 9 ]

## Eye Movements:

”Version: Eyes move same direction

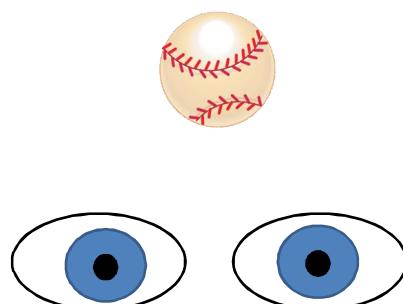
”Vergence: Eyes move toward or away from the midline



[ 10 ]

## Eye Movements:

- “Version: Eyes move same direction
- “Vergence: Eyes move toward or away from the midline



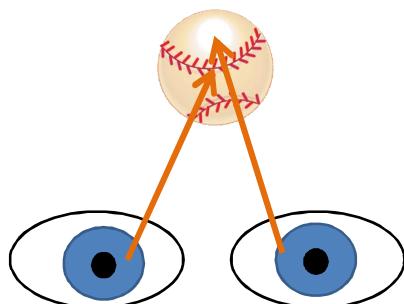
## Convergence



[ 12 ]

## Fixation Disparity

“Vision is fused, but both eyes are not pointing exactly to the same place.



[ 13 ]

(Section A. 6.)

Q1b: Your patient is unable to follow the target smoothly or accurately when completing the Broad-H Test. The patient has a hard time hitting and catching a baseball. Double vision is experienced when looking at near distances.

You diagnose the following:

- A. Fixation disparity
- B. Saccadic eye movement deficiency
- C. Convergence insufficiency
- D. Pursuit oculomotor deficiency

[ 14 ]

(Section A. 6.)

Q1b: Your patient is unable to follow the target smoothly or accurately when completing the Broad-H Test. The patient has a hard time hitting and catching a baseball. Double vision is experienced when looking at near distances.

You diagnose the following:

- A. Fixation disparity
- B. Saccadic eye movement deficiency
- C. Convergence insufficiency**
- D. Pursuit oculomotor deficiency

[ 15 ]

(Section A. 6.)

Q1c: Your patient is unable to follow the target smoothly or accurately when completing the Broad-H Test. Many undershoots and overshoots are noted during the testing. The patient skips and repeats words when reading. He still uses his finger to keep his place on the page at age 11. You diagnose the following:

- A. Fixation disparity
- B. Saccadic eye movement deficiency
- C. Convergence insufficiency
- D. Pursuit oculomotor deficiency

[ 16 ]

## (Section A. 6.)

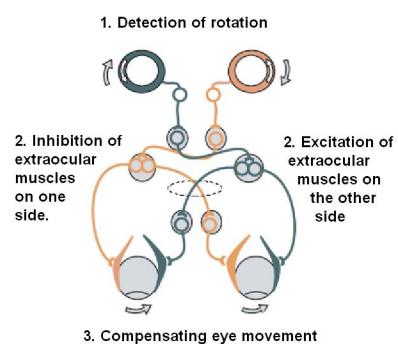
Q1c: Your patient is unable to follow the target smoothly or accurately when completing the Broad-H Test. Many undershoots and overshoots are noted during the testing. The patient skips and repeats words when reading. He still uses his finger to keep his place on the page at age 11. You diagnose the following:

- A. Fixation disparity
- B. Saccadic eye movement deficiency**
- C. Convergence insufficiency
- D. Pursuit oculomotor deficiency

[ 17 ]

## Reflexive Eye Movements

### Vestibulo-ocular Reflex



### Optokinetic Nystagmus



[ 18 ]

(section B.2.b.)

Q2: You are performing the alternating cover test. When uncovering the right eye, you note that the right eye moves up and in. When uncovering the left eye, the left eye moves down and in. Which of the following deviations is present?

- A. Right Hypertropia, Exotropia
- B. Right Hypertropia, Esotropia
- C. Left Hypertropia, Exotropia
- D. Left Hypertropia, Esotropia

[ 19 ]

(section B.2.b.)

Q2: You are performing the alternating cover test. When uncovering the right eye, you note that the right eye moves up and in. When uncovering the left eye, the left eye moves down and in. Which of the following deviations is present?

- A. Right Hypertropia, Exotropia
- B. Right Hypertropia, Esotropia
- C. Left Hypertropia, Exotropia**
- D. Left Hypertropia, Esotropia

[ 20 ]

## Alternating Cover Test



[ 21 ]

(section B.2.e.)

Q3: A head tilt toward the right shoulder is most likely due to a paresis of the left:

- A. inferior oblique
- B. superior oblique
- C. inferior rectus
- D. superior rectus

[ 22 ]

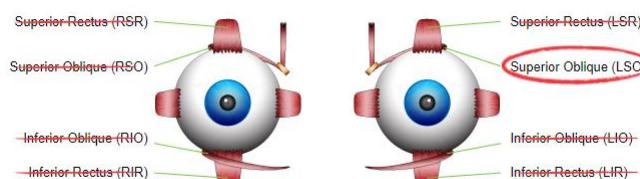
(section B.2.e.)

Q3: A head tilt toward the right shoulder is most likely due to a paresis of the left:

- A. inferior oblique
- B. superior oblique**
- C. inferior rectus
- D. superior rectus

[ 23 ]

## Parks 3-Step Test



Which eye is hyper deviated in primary gaze?

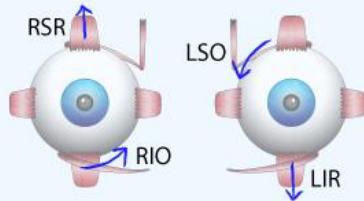
Is the vertical deviation greater in right gaze or left gaze?

Is the vertical deviation greater with right head tilt or left head tilt?

<https://www.eyedock.com/parks-3-step>

[ 24 ]

Which eye is hyper deviated in primary gaze?



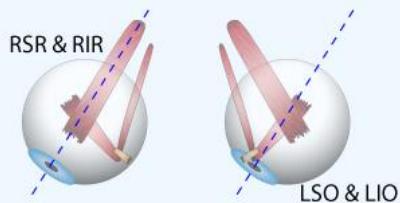
If the left eye is the hyperdeviated eye we know that the muscle that is failing is either responsible for pulling the left eye down or for pulling the right eye up. Our suspects in the right eye are the RSR or RIO. In the left eye it's the LSO or LIR. We can eliminate all others as possibilities.

**A head tilt to the right shoulder physically places the left eye higher than the right eye to fuse.**

[ 25 ]

= Left hyperphoria

Is the vertical deviation greater in right gaze or left gaze?

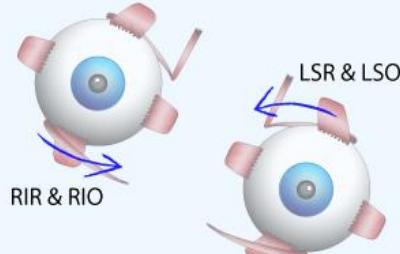


When we look in right gaze the muscles most responsible for the eyes' vertical position are the right rectus muscles and the left oblique muscles. Therefore our suspects are RSR, RIR, LSO, LIO.

The other four can be eliminated.

[ 26 ]

Is the vertical deviation greater with right head tilt or left head tilt?



When the head is tilted to the left, the right eye needs to turn outward (excyclotorsion) and the left eye needs to turn inward (incyclotorsion). The muscles responsible for these movements are the RIO, RIR and the LSO, LSR. One of these could be malfunctioning.  
The other four can be eliminated.

[ 27 ]

**Result:** The only EOM to not be eliminated is the Left Superior Oblique

Muscle	Primary Action	Secondary Action	Tertiary Action
Medial rectus	Adduction		
Lateral rectus	Abduction		
Superior rectus	Elevation	Incyclotorsion	Adduction
Inferior rectus	Depression	Excyclotorsion	Adduction
Superior oblique	Incyclotorsion	Depression	Abduction
Inferior oblique	Excyclotorsion	Elevation	Abduction

[ 28 ]

Muscle	Primary Action	Secondary Action	Tertiary Action
Medial rectus	Adduction		
Lateral rectus	Abduction		
<b>Superior</b> rectus	Elevation	<b>Incyclotorsion</b>	Adduction
Inferior rectus	Depression	Excyclotorsion	Adduction
<b>Superior</b> oblique	<b>Incyclotorsion</b>	Depression	Abduction
Inferior oblique	Excyclotorsion	Elevation	Abduction

**SINRAD = superior muscles intort  
(incyclotorsion)**

[ 29 ]

Muscle	Primary Action	Secondary Action	Tertiary Action
Medial rectus	Adduction		
Lateral rectus	Abduction		
<b>Superior</b> rectus	Elevation	<b>Incyclotorsion</b>	<b>Adduction</b>
Inferior <b>rectus</b>	Depression	Excyclotorsion	<b>Adduction</b>
<b>Superior</b> oblique	<b>Incyclotorsion</b>	Depression	Abduction
Inferior oblique	Excyclotorsion	Elevation	Abduction

**SINRAD = recti muscles ADDuct the eye  
(move toward the nose)**

[ 30 ]



**Cover Test** [ 31 ]

(section C.2.)

Q4: You complete a refraction which results in +1.00 DS OU. This does not match the autorefractor results which were -1.00 DS OU. What would account for this difference?

A. Tonic Accommodation  
B. Fusional Accommodation  
C. Accommodative Convergence/Accommodation ratio (AC/A)  
D. Proximal Accommodation

[ 32 ]

(section C.2.)

Q4: You complete a refraction which results in +1.00 DS OU. This does not match the autorefractor results which were -1.00 DS OU. What would account for this difference?

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- B. Fusional Accommodation
- C. Accommodative Convergence/Accommodation ratio (AC/A)
- D. Proximal Accommodation**

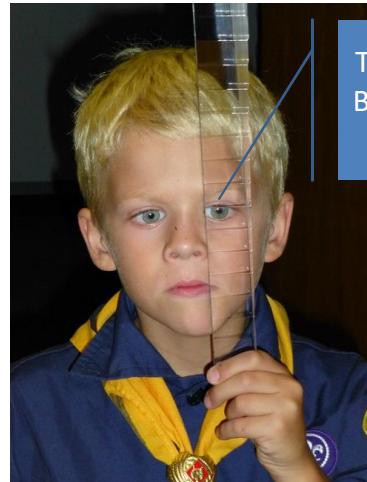
[ 33 ]



**TONIC accommodation**

= Underlying muscle tone

[ 34 ]



This is why we have a  
BLUR first, then break  
on fusion testing.

### Fusional Accommodation

CA/C ratio: the amount of accommodation (D) per  
unit of convergence ( $\Delta$ )

[ 35 ]



This is why we have  
Accommodative Esotropia and  
Convergence Excess.

### Accommodative Convergence

AC/A ratio: the amount of convergence ( $\Delta$ )  
per unit of accommodation (D)

[ 36 ]



### Proximal Accommodation

[ 37 ]

It is close – I better focus more!

(Section A.2.e.)

Q5: A patient is wearing red/green glasses with the red lens over the right eye. They are looking at the Worth 4 dot flashlight and report that they see three green dots. This response indicates:

- A. right eye suppression
- B. left eye suppression
- C. sensory fusion
- D. anomalous correspondence

[ 38 ]

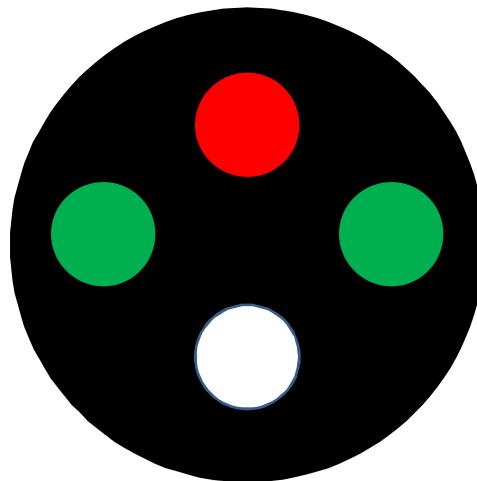
(Section A.2.e.)

Q5: A patient is wearing red/green glasses with the red lens over the right eye. They are looking at the Worth 4 dot flashlight and report that they see three green dots. This response indicates:

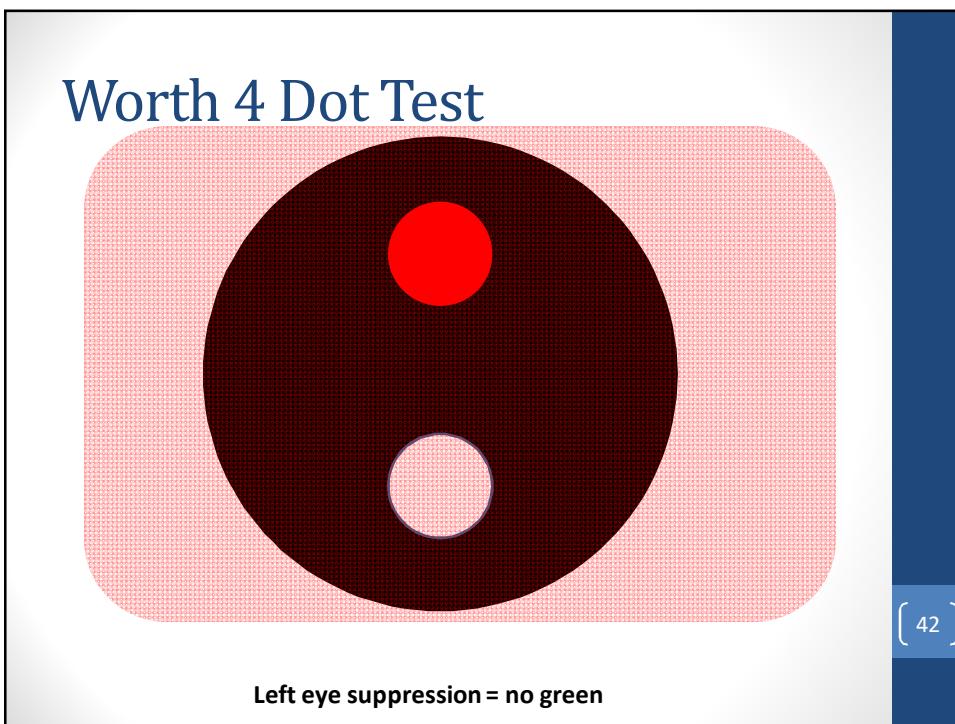
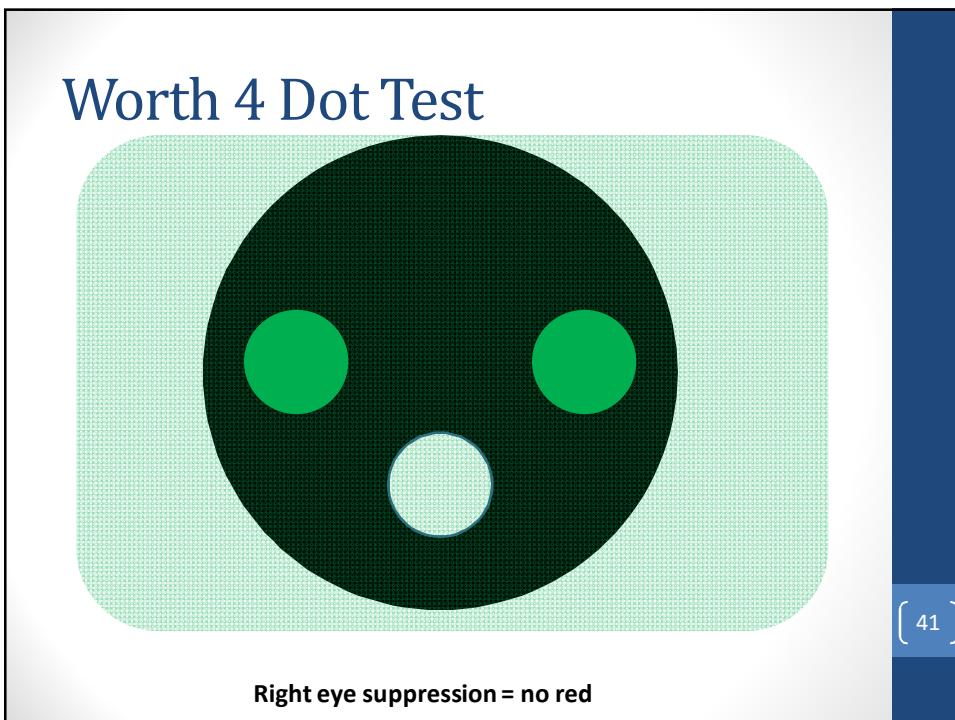
- A. right eye suppression
- B. left eye suppression
- C. sensory fusion
- D. anomalous correspondence

[ 39 ]

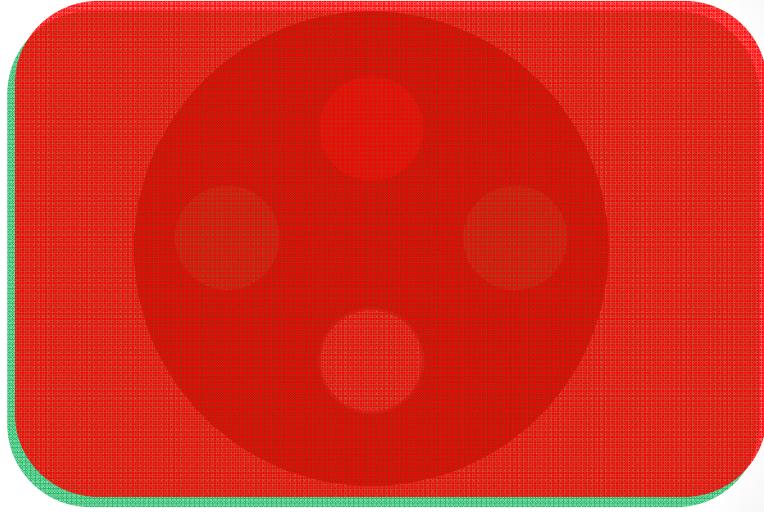
### Worth 4 Dot Test



[ 40 ]



## Worth 4 Dot Test



[ 43 ]

4 dots = Sensory fusion OR Harmonious anomalous correspondence  
(movement on cover test when fusion is reported)

(Section A.1.a.)

Q6: Your adult patient experienced a sudden-onset eye turn with double vision. You suspect a 6<sup>th</sup> nerve palsy to the right eye. Which finding supports your diagnosis?

- A. Concomitant esotropia
- B. Concomitant exotropia
- C. Nonconcomitant esotropia, with larger misalignment in right gaze
- D. Nonconcomitant esotropia, with larger misalignment in left gaze

[ 44 ]

(Section A.1.a.)

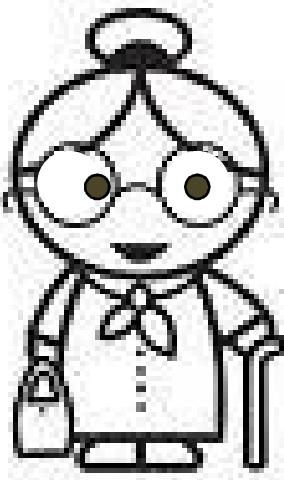
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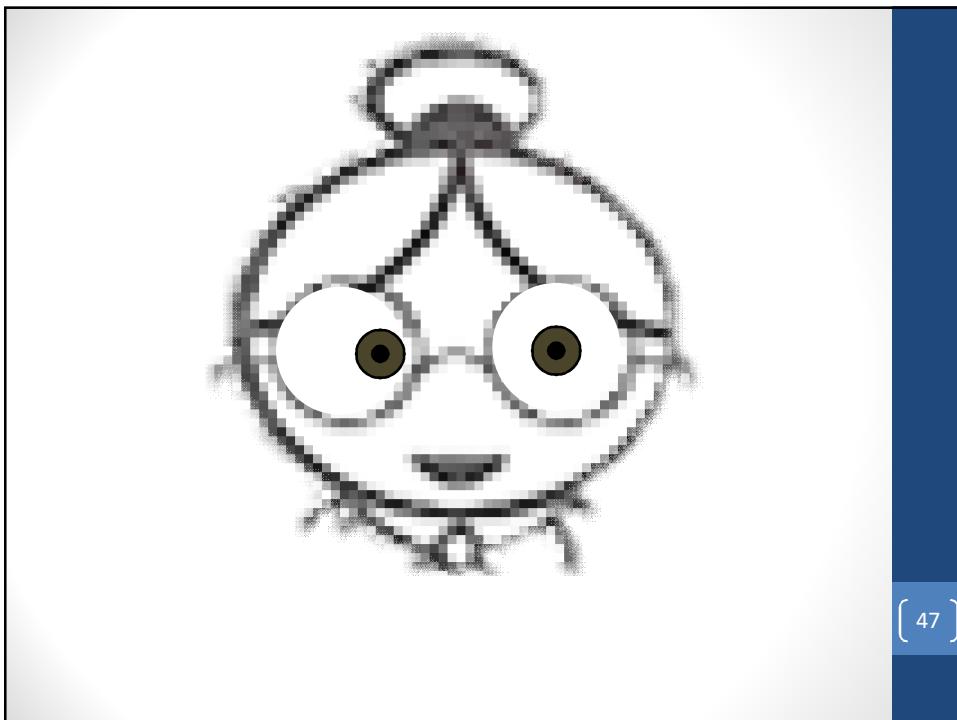
[ 45 ]

## 6<sup>th</sup> Nerve Palsy – Eso or Exo?

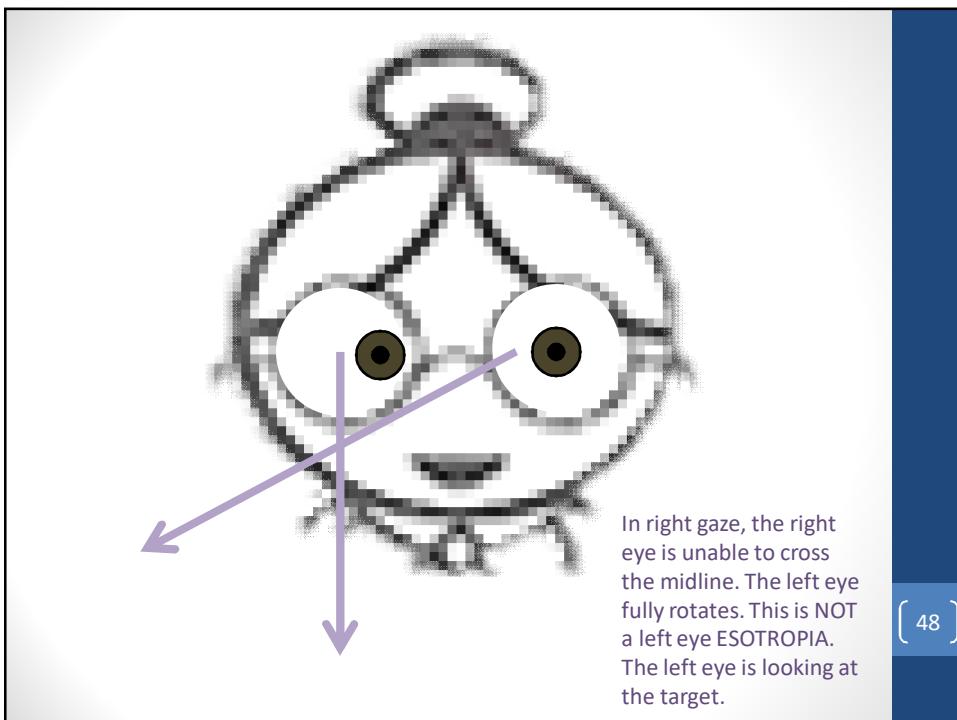
The 6<sup>th</sup> Cranial Nerve innervates the Lateral Rectus muscle which ABducts the eye. Without the action of this muscle, the Medial Rectus is unopposed, and the eye turns inwards.



[ 46 ]

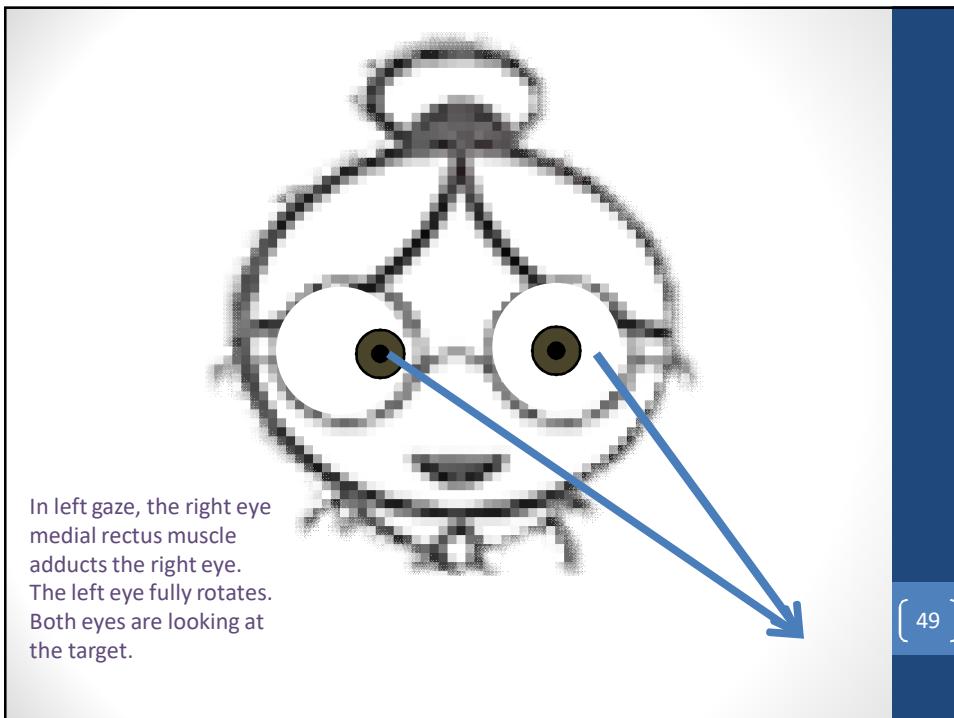


[ 47 ]



In right gaze, the right eye is unable to cross the midline. The left eye fully rotates. This is NOT a left eye ESOTROPIA. The left eye is looking at the target.

[ 48 ]



## Comitancy

### Comitant/Concomitant

- “Consistent” in different gazes
- More common: 85%
- Usually congenital
- No limit of eye movement

### Incomitant/Nonconcomitant

- “Inconsistent” or variable in different gazes
- 15% of cases
  - Paralytic: usually acquired and sudden. Typically a sign of neurological problem or disease
  - Mechanical: Brown’s tendon sheath syndrome, Grave’s Disease, orbital blow-out entrapment

[ 50 ]

(section B.3.)

Q7: Your patient is currently wearing glasses that are OD: +0.50 DS and OS: +3.50 DS. They test 20/20 acuity in both eyes, but are experiencing eye strain, headaches, and distortions of space. What diagnosis would you make?

- A. Refractive amblyopia of the right eye.
- B. Refractive amblyopia of the left eye.
- C. Fixation Disparity
- D. Aniseikonia**

[ 51 ]

(section B.3.)

Q7: Your patient is currently wearing glasses that are OD: +0.50 DS and OS: +3.50 DS. They test 20/20 acuity in both eyes, but are experiencing eye strain, headaches, and distortions of space. What diagnosis would you make?

- A. Refractive amblyopia of the right eye.
- B. Refractive amblyopia of the left eye.
- C. Fixation Disparity
- D. Aniseikonia**

[ 52 ]

## Refractive Amblyopia

<https://www.aoa.org/documents/optometrists/CPG-4.pdf>

**Table 2**  
**Potentially Amblyopiogenic Refractive Errors**

<b>Isoametropia</b>	<b>Diopters</b>
Astigmatism	>2.50 D
Hyperopia	>5.00 D
Myopia	>8.00 D
<b>Anisometropia</b>	
Astigmatism	>1.50 D
Hyperopia	>1.00 D
Myopia	>3.00 D

[ 53 ]

## Symptoms of Refractive Amblyopia:

- “ When one eye has good vision and the other does not, the vision of the child does not develop normally.
- “ This often results in the suppression of the foveal (central) part of the amblyopic eye.
- “ Acuity is reduced
- “ Binocular vision is reduced
- “ The patient may have no stereopsis “stereoblind”
- “ Reduced peripheral awareness
- “ Higher cognitive load
- “ Reduced visual perception
- “ Difficulty estimating distances and speeds
- Note: no headaches
- Note: no eyestrain

[ 54 ]

[https://shawlens.com/aniseikonia/causes\\_of\\_aniseikonia/](https://shawlens.com/aniseikonia/causes_of_aniseikonia/)

## Causes of aniseikonia

Every pair of lenses causes aniseikonia to some degree. The question is how much can the individual patient tolerate and would reducing it result in more comfort or better adaptation? Traditionally aniseikonia has been thought to be problematic only in extreme anisometropia. But that is only considering static aniseikonia (image size) that's created by the glasses.

Dynamic aniseikonia is much more uncomfortable and that can occur even when the refraction is equal. Dynamic aniseikonia describes the unequal demand on the movement of the eyes as they move left and right and up and down that is caused by the eye glasses.

Aniseikonia can also be treated with the SHAW™ lens in the following cases:

1. Spectacle-induced aniseikonia
2. Congenital anisometropia, which can lead to lazy eye
3. Axial length changes due to retinal detachment surgery
4. Refractive induced aniseikonia from cataracts
5. Cataract refractive surgery
6. Maculopathy

( 55 )

[https://shawlens.com/symptoms/symptoms\\_of\\_aniseikonia/#other\\_signs](https://shawlens.com/symptoms/symptoms_of_aniseikonia/#other_signs)

Distorted vision was the clinical hallmark of aniseikonia when I was in optometry school, but there are other symptoms which are more common – headaches and eyestrain!

( 56 )

1. R. E. Bannon, W. Triller, *Aniseikonia – a clinical report covering a ten year period*. Australas J Optom, 1944, 269-309.  
2. Eyecare Trust, 2011.

(section B. d.)

Q8: Your patient reports double vision when looking through a base-out prism. This indicates poor:

- A. Tonic convergence
- B. Proximal convergence
- C. Fusional convergence
- D. Accommodative convergence

[ 57 ]

(section B. d.)

Q8: Your patient reports double vision when looking through a base-out prism. This indicates poor:

- A. Tonic convergence
- B. Proximal convergence
- C. **Fusional convergence**
- D. Accommodative convergence

[ 58 ]

## Fusional convergence



[ 59 ]

(section F.1.)

Q9: Your patient is recovering from a recent concussion and notes that all overhead lights are flickering on and off causing a headache. Which perception has been altered by the injury?

- A. Critical flicker fusion frequency
- B. Troxler effect
- C. Saccadic suppression
- D. Contrast sensitivity

[ 60 ]

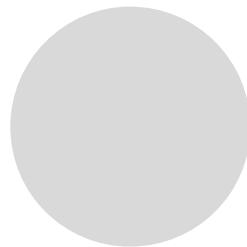
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Q9: Your patient is recovering from a recent concussion and notes that all overhead lights are flickering on and off causing a headache. Which perception has been altered by the injury?

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- B. Troxler effect
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- D. Contrast sensitivity

[ 61 ]

**Critical flicker fusion frequency**



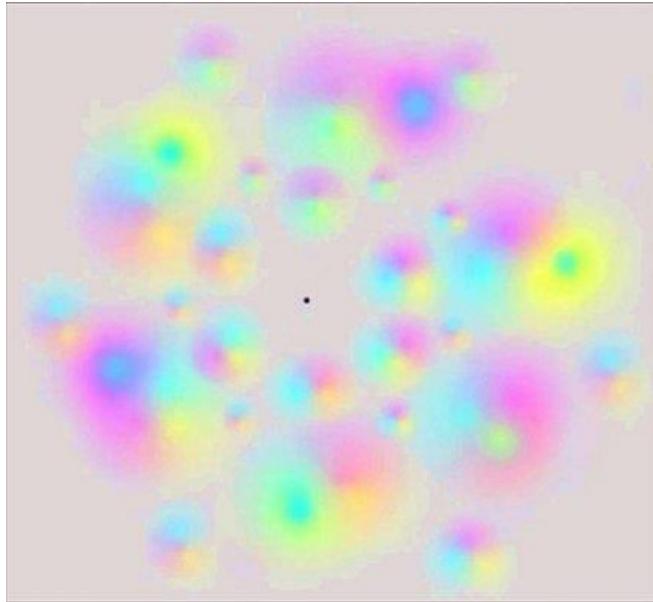
“ The frequency at which an intermittent light stimulus appears to be completely steady

[ 62 ]

**Troxler effect**

<https://telanganatoday.com/troxler-effect>

“ Troxler made the discovery that steadily fixating gaze on a single place can cause surrounding images in the visual field to seem to slowly disappear or fade.



[ 63 ]

**Saccadic suppression**

“ Saccadic masking, also known as saccadic suppression, is the phenomenon where the brain selectively blocks visual processing during eye movements in such a way that neither the motion of the eye nor the gap in visual perception is noticeable to the viewer. Wikipedia

**Contrast sensitivity**



Contrast sensitivity is the ability to detect subtle differences in shading and patterns.

[ 64 ]

(section G)

Q10: Your patient reports that when looking up at a blue sky, they see tiny moving particles sliding across the scene in rows. When they look down at the grass, the images disappear. They are describing:

- A. Floaters
- B. Capillary circulation in the retina
- C. Maxwell's spot
- D. Phosphenes

[ 65 ]

(section G)

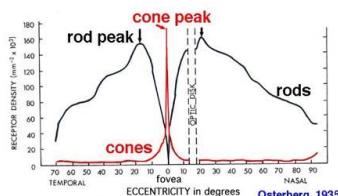
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- A. Floaters
- B. Capillary circulation in the retina**
- C. Maxwell's spot
- D. Phosphenes

[ 66 ]

## Entoptic Phenomenon: visual effects whose source is within the eye itself.

A **phosphene** is the perception of light without light actually entering the eye, for instance caused by pressure applied to the closed eyes.



[https://www.opt.uh.edu/onlinecoursematerials/newcoursefiles/opto6124/2\\_Entoptic\\_Pheno.pdf](https://www.opt.uh.edu/onlinecoursematerials/newcoursefiles/opto6124/2_Entoptic_Pheno.pdf)

When a mixture of red and blue light is viewed, the point of foveal focus will have a **central red spot surrounded by a few red fringes**. This is called the **Maxwell's spot**. (There are more blue cones distributed in the fovea so short wavelengths are absorbed).

[ 67 ]

[https://en.wikipedia.org/wiki/Entoptic\\_phenomenon](https://en.wikipedia.org/wiki/Entoptic_phenomenon)

### Scheerer's phenomenon

[https://upload.wikimedia.org/wikipedia/commons/7/70/Blue\\_field\\_entoptic\\_phenomenon\\_animation.gif](https://upload.wikimedia.org/wikipedia/commons/7/70/Blue_field_entoptic_phenomenon_animation.gif)



**Blue field entoptic phenomenon** has the appearance of tiny bright dots moving rapidly along squiggly lines in the visual field. It is much more noticeable when viewed against a field of pure blue light and is caused by **white blood cells** moving in the **capillaries** in front of the **retina**. The white cells are larger than the red cells and must deform to fit. As they go through a capillary, a space opens up in front of them and red blood cells pile up behind. This makes the dots of light appear slightly elongated with dark tails

[ 68 ]

## Entoptic Phenomenon: visual effects whose source is within the eye itself.

Floaters or *muscae volitantes* are slowly drifting blobs of varying size, shape, and transparency, which are particularly noticeable when viewing a bright, featureless background (such as the sky) or a point source of diffuse light very close to the eye. They are all shadow images of objects suspended just above the retina.



[https://en.wikipedia.org/wiki/Entoptic\\_phenomenon](https://en.wikipedia.org/wiki/Entoptic_phenomenon)



Haidinger's brush is a very subtle bowtie or hourglass shaped pattern that is seen moving like a fan or propeller when viewing a field with a component of blue light that is typically *circularly* polarized.

[ 69 ]

(section H.7.a.)

Q11: Your patient reports the shapes on the HRR Pseudoisochromatic plates correctly on plates 1-4 (demonstration). On the screening plates numbered 5-10, your patient does not see the shapes on plates 7-10. What should you do next?

- A. Diagnose Protanopia
- B. Diagnose Tritanopia
- C. Diagnose Deutanopia
- D. Complete Plates 11-24 to classify the color vision deficiency type and severity

[ 70 ]

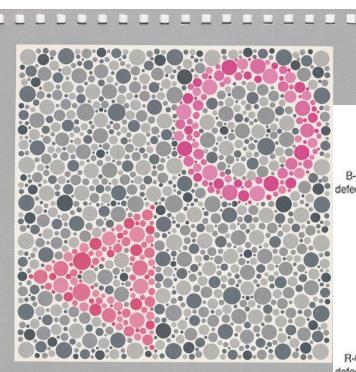
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- D. Complete Plates 11-24 to classify the color vision deficiency type and severity**

[ 71 ]

## Hardy-Rand-Rittler (HRR)



- B-Y defect  
5 O.X  
6 O.▼  
If 5 or 6 are not checked, go to 21-24
- R-G defect  
7 X.▶  
8 O.▶  
9 O  
10 X  
If any of 7-10 are not checked, go to 11-20

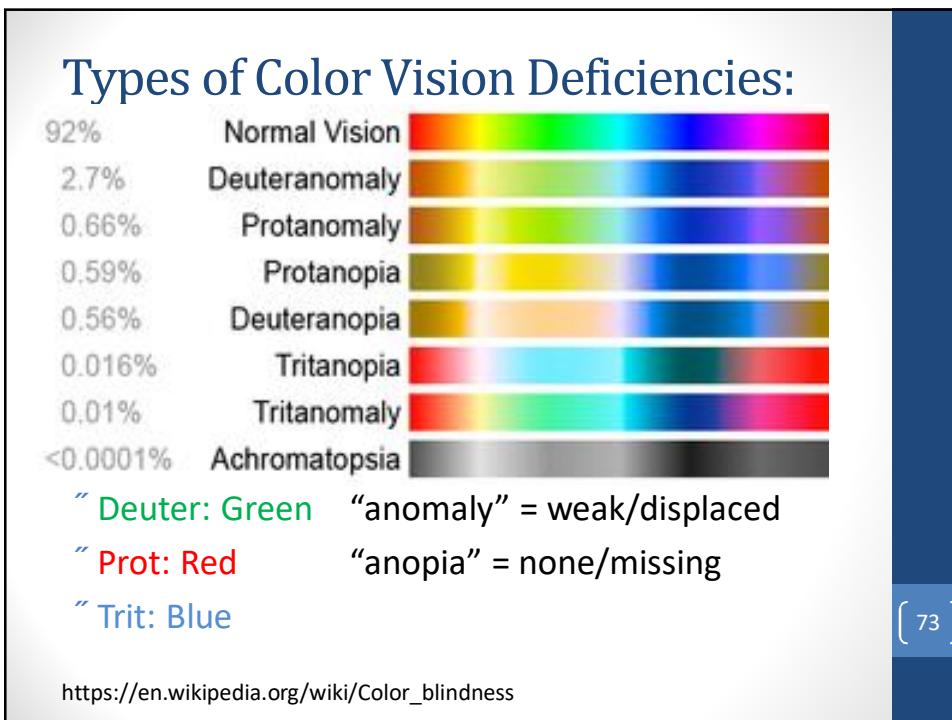
Protan	Deutan	Total number of checks
11 □	△	1. Protan > Deutan
12 □	✗	2. Protan < Deutan
13 △	□	3. Protan = Deutan -unclassified
14 ○	✗	
15 ✗	○	
16 ▲	○	
17 ○	▷	
18 ▷	✗	
19 ✗	○	
20 ○	▽	
21 ▽	✗	
22 ✗	○	
23 ○	▽	
24 ▲	✗	
Total .....	.....	

Tritan	Tetartan	Total number of checks
21 ▽	✗	1. Tritan > Tetartan
22 ✗	○	2. Tritan < Tetartan
23 ○	▽	3. Tritan = Tetartan -unclassified
24 ▲	✗	
Total .....	.....	

[https://ekjo.org/ViewImage.php?Type=F&aid=532955&id=F2&afn=65\\_KJO\\_29\\_6\\_359&fn=kjo-29-359-g002\\_0065KJO](https://ekjo.org/ViewImage.php?Type=F&aid=532955&id=F2&afn=65_KJO_29_6_359&fn=kjo-29-359-g002_0065KJO) (Korean Journal of Ophthalmology)

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(section H.7.c.)

Q12: Your 5-year old male patient is having his first eye examination prior to starting kindergarten. Which test would best identify a color vision deficiency?

A. HRR Pseudoisochromatic plates (shapes: triangle, circle, X)  
 B. Colored block matching: red, orange, yellow, green, blue, and purple  
 C. Ishihara Pseudoisochromatic plates (double digit numbers)  
 D. Anomaloscope

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(section H.7.c.)

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What figures would a 5 year old know?

What would give you an accurate assessment?



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