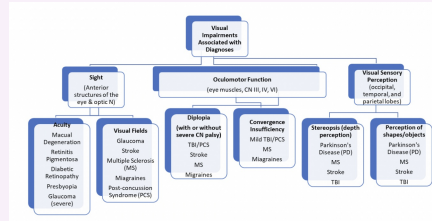


### Visual impairment w/ diagnoses



### Brain Injury Related Visual Dysfunctions/ Other

**Traumatic Brain Injury (TBI)** an injury that affects how the brain works. Motor Vehicle Accident Athletes (football, boxing, skateboarding, etc.), Gunshot wounds, Domestic Violence, Falls

**Acquired Brain Injury (ABI)** brain damage caused by events after birth, rather than as part of a genetic or congenital disorder CVA or Stroke Aneurysm Anoxia – oxygen deprived Brain tumor/brain tumor resection or removal located in occipital lobe, parietal lobe, cerebellum, or Optic Tract Cranial Nerves III, IV, and IV palsies

**Optic Neuritis** Optic neuritis can affect your vision and cause pain. When the nerve fibers become inflamed, the optic nerve can also start to swell. This swelling typically affects one eye, but can affect both at the same time. Optic neuritis can affect both adults and children. Multiple Sclerosis

### Brain Injury Related Visual Dysfunctions/ Other (cont)

**Migraines** A migraine that involves visual disturbance is called an ocular migraine. Ocular migraines can develop with or without the accompanying pain of a classic migraine. During an ocular migraine, or migraine with aura, you may see flashing or shimmering lights, zigzagging lines, or stars Kaleid-oscope vision

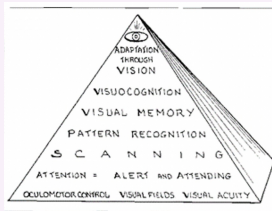
**Vitamin Deficiencies** Disturbed or blurred vision can also occur as a result of a Vitamin B12 deficiency. This happens when the deficiency causes damage to the optic nerve that leads to your eyes. The nervous signal that travels from the eye to the brain is disturbed due to this damage, leading to impaired vision



### Brain Injury Related Visual Dysfunctions/ Other (cont)

Medications used for depression, Parkinson's disease, seizures, ulcers, asthma, arrhythmia, and hemorrhoids can cause this type of glaucoma; Many cancer treatments, including chemotherapy, radiation, steroids and immunotherapies, are known to cause eye-related side effects such as dryness, tearing, cataracts, sensitivity to light, infection or altered vision. It's even possible for eye color to change.

### Hierarchy of Visual Perceptual Processing



### Oculomotor System

|   |                                    |                                    |
|---|------------------------------------|------------------------------------|
| <b>Gaze systems</b> that redirect the eyes to each new target | Voluntary or "targeting" movement: | Smooth pursuits/tracking           |
|   | Involuntary oculomotor movements:  | Vestibular-oculomotor reflex (VOR) |

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### Attention= Alert + Attending

|                                |                                 |  |
|--------------------------------|---------------------------------|--|
| <b>Alertness &amp; Arousal</b> | Ability to maintain awake state | Reticular Activating System (RAS)  |
| <b>Attending</b>               | Frontal eye fields              | Gaze stabilization center (sustained gaze or fixation on target or object) |



### The Brain's Visual Processing Modes

**Focal Mode** (ventral stream) **What is it?**, object recognition, exclusively visual and impacted by changes in acuity, involves attention

**Ambient Mode** (dorsal stream) **Where it is?**, works in concert with vestibular, somato-sensory, and auditory, sense to subserve spatial orientation, posture, and gaze stability,; reflexive in nature

### Vestibular-oculomotor reflex (VOR)

Close relationship between oculomotor function and vestibular function to **maintain gaze stability during whole-body movement and head movement**

Normal VOR has a disconjugate 1:1 ratio of tracking object to head movement – implying the **head and eye movement are opposite but equal**

VOR must be suppressed during combined eye-head movement for the **image to be maintained on the fovea**

VOR cancellation or suppression test is essentially a **higher demand on smooth pursuit function**

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### Scanning

#### integration of vestibular and oculomotor function

integrates movement directed from frontal eye fields (gaze stabilization center), primary visual cortex, and visual association areas to navigate the environment and avoid obstacles

### Some may have difficulty with

Reading – poor reading comprehension

Sports or recreational activities – increased risk of secondary injuries

Balance – inability to quickly locate items (decreased reaction time) and respond to environmental barriers

Depth perception (stereopsis) – miss steps climbing stairs, unable to reach for items efficiently due to over or undershooting target

### Binocular Coordination require effective...

|                           |   |  |
|---------------------------|---|--|
| smooth pursuits/-tracking | ability to binocularly follow a moving target smoothly and coordinately | Dysfunction: poor binocular fusion (blurry vision), diplopia (double vision), visual fatigue |
|---------------------------|---|--|

|          |  |  |
|----------|--|--|
| saccades | quick, simultaneous movement of both eyes between two or more phases of fixation in the same direction | Dysfunction: Over or undershooting target, visual fatigue, delayed visual speed or processing due to inefficiency with localizing/ targeting key information |
|----------|--|--|

|             |  |  |
|-------------|--|--|
| convergence | ability to fixate on an object <b>coming towards</b> you | Dysfunction: Exotropia, <b>convergence insufficiency</b> , Diplopia with nearsighted tasks |
|-------------|--|--|

|            |  |  |
|------------|--|--|
| divergence | ability to fixate on an object <b>going away</b> you | Dysfunction: Esotropia, Divergence insufficiency, Diplopia with farsighted tasks |
|------------|--|--|



### Binocular Coordination require effective... (cont)

|  |   |  |
|--|---|--|
| stereopsis/spatial localization                            | Judgement of space and distance (stereopsis (depth perception))   | Can be affected by: changes in acuity, <b>contrast sensitivity</b> , poor integration of focal and ambient visual processing systems, divergence and/or convergence insufficiencies ( <b>binocular vision dysfunctions</b> ) |
| focal and ambient visual processing-physiological diplopia | <b>Brain's ability to receive, interpret, and act upon visual stimuli</b> ; focal mode: what is it?; Ambient mode: Where is it? |  |

### Actions of the eye (dont need to really memorize)

|                  |                   |                     |               |
|------------------|-------------------|---------------------|---------------|
| Lateral rectus   | ABD               | CN 6 (Abducens N)   | contralateral |
| Medial rectus    | ADD               | CN 3 (Oculomotor N) | contralateral |
| Superior rectus  | Elevation         | CN3                 | contralateral |
| Inferior rectus  | Depression        | CN3                 | contralateral |
| Inferior Oblique | Elevation and ER  | CN 3                | contralateral |
| Superior Oblique | Depression and IR | CN 4                | ipsilateral   |

### Eye Movement Synergy

Binocular coordination is a result of synergistic movement of the contralateral eye

Example: Look to the left without moving your head

Antagonistic and synergistic movements occur in monocular coordination

### Eye Alignment

|                      |  |   |  |   |
|----------------------|--|---|--|---|
| Phoria               | Natural position of the eye; <b>fusion</b> and depth perception <b>is intact</b>   | Esophoria: tendency to aim in front; Exophoria: behind the point of focus                           | Symptoms: eye misalignment, poor oculomotor control, impaired visual processing; | <b>Changes in phoria</b> symptoms are subtle: difficulty concentrating, frontalor temporal headaches, sleepiness after reading, stinging of eyes after reading  |
| Strabismus or Tropia | Visible turn of one eyes: Esotropia-one eye turns in; Exotropia-one eye turns out; Hypertropia; One eye turns up relative to other eye | Diplopia: long-term effects result in central vision suppression (peripheral vision remains intact) | **fusion (binocular vision) and depth perception (stereopsis are not present     | inability to judge distances, under/over reaching objects, double vision (diplopia), head tilt or turning, difficulty reading, appear spaced out, avoid near activities, become confused or disoriented |

### Visual Perception

**Form** the visual skill that allows us to distinguish one object from another similar object. Being able to tell the difference between the letter "b" and "d" or "3" and "8". Though the forms are similar in shape, they are very different in meaning. The ability to see and distinguish these differences is form constancy.

**Constancy (b vs d)**



### Visual Perception (cont)

**Visual discrimination** each of the above six skills require some degree of visual discrimination. Visual Discrimination is the ability to identify detail, seeing items likes and differences in shape, color, position and orientation.

**Visual closure** the visual skill that allows us to detect, differentiate, select, draw conclusions and understand information when we are only given certain pieces of information, rather than the entire account, story or explanation.

**Figure Ground** the visual skill that allows us to distinguish, segregate, isolate or find an object or stimuli in varying environments. This can include faces, figures, objects, landscapes, and letters or numbers. Properly processing our visual figure ground helps to organize the information we see in our environment.

**Spatial Relations** the visual skill that allows us to process the visual environment around us and the location of objects in respect to ourselves.

**Visual Memory** the visual skill that allows us to record, store and retrieve information. It allows us to learn and later recall what is learned.

**Visual Sequential Memory** similar to visual memory in that it allows us to store and retrieve information when necessary or useful. However sequential memory helps us remember and recognize people, places we have been, and series of events, equations, and procedures

### Visual Cognition

Understanding the interaction of **\*\*visual construct and cognition...** Object structure (i.e. weight, size, position, color, etc)

Executive function (memory and attention)

Attention and awareness

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