VISUAL AND VESTIBULAR STRATEGIES TO OPTIMIZE SCHOOL PARTICIPATION AND LEARNING
Disclosure:

Financial: Janine Wiskind receives an honorarium from Education Resources.

Non-financial: She has no relevant non-financial relationships to disclose.
Objectives

- Understand the role of the visual and vestibular systems in successful academic performance
- Identify visual and vestibular systems dysfunction in your students
- Provide compensatory strategies to facilitate improved performance of the visual and vestibular system
- Facilitate treatment strategies to enhance function of the visual and vestibular system
WHAT IS VISION?

- YOUR reality
- How we perceive our world directly correlates to how we react.

© 2013 Janine Wiskind
VISION’S ROLE

- Attentive functions
- Movement Detection
- Subliminal awareness
- Spatiotemporal orientation
- Anticipation, adaptation, and support for learning, memory and recall

© 2013 Janine Wiskind
<table>
<thead>
<tr>
<th>SIGHT</th>
<th>VISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability of the eye to respond to light</td>
<td>Ability to understand what is being seen</td>
</tr>
<tr>
<td>Innate ability dependent on structural integrity of visual system</td>
<td>A learned process that develops through years and experience with the environment</td>
</tr>
<tr>
<td>Hard wired</td>
<td>Soft wired</td>
</tr>
</tbody>
</table>

© 2013 Janine Wiskind
# CENTRAL VS AMBIENT

<table>
<thead>
<tr>
<th>CENTRAL</th>
<th>AMBIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conscious level</td>
<td>Unconscious level</td>
</tr>
<tr>
<td>gives us detail</td>
<td>detects movement</td>
</tr>
<tr>
<td>tells us what to pay attention to</td>
<td>gives us our ability to understand where we are in space</td>
</tr>
<tr>
<td>Declarative learning</td>
<td>Anticipation</td>
</tr>
</tbody>
</table>

© 2013 Janine Wiskind
AMBIENT SYSTEM

- Constant subliminal updating
- Stability
- Grounding
- Reading
- Vertical Activity

© 2013 Janine Wiskind
How do children use their vision at school?
VISION IS MORE THAN 20/20

- Visual Acuity: school assess far vs. near
- Walking through the hallways
- Navigating the classroom
- Close work at desk
- Accommodation: copying
- Following the teacher
- Socialization: eye contact and play

© 2013 Janine Wiskind
A large percentage of your students experience visual dysfunction that goes undetected. Why?

RESULT:
- Academic struggles
- Difficulty attending
- Possible behavior issues
- Avoidance of work and play
ADDITIONAL DEFICITS

- Postural control
- Spatial monitoring
- Impaired motor planning
- Ideation
- Transitions
- Organizational skills
Pathways

- Visual fields need to take in the letters and words
- Fixate on word and blur periphery
- Anticipate periphery

Occipital Lobe: interpret image
Temporal Lobe: Recognition
Parietal Lobe: spatial understanding; programming movement of the eyes
Frontal Lobe: directing eyes: pursuits/saccades
- Parietal Lobe: spatial awareness
- Frontal Lobe: in conjunction with parietal lobe effectively coordinate eye-hand coordination to understanding placement and alignment of letters
- Cranial Nerves: ocular motor control
- Ciliary muscles: endurance
ANATOMY OF THE VISUAL SYSTEM
VISUAL PATHWAY

- Nasal fibers contra lateral
- Outer fibers ipsilateral
- Information from right or left visual fields enters opposite portion of retina but travels to same side of brain

© 2013 Janine Wiskind
The optic nerve brings visual information down to the optic chiasm.

Two neural pathways descend from the optic chiasm:

- Geniculostriate pathway (90% of all visual information): form and color.
- Tectopulvinar pathway: motion detection at brainstem levels.

© 2013 Janine Wiskind
The Visual Pathways

- Superior colliculus
- Optic chiasm
- Retina
- Striate cortex
- Lateral geniculate nucleus
- Optic nerve

Kalat (2001) p165
Dorsal Stream
- Inferior parietal lobe
- Unconscious visual processes
- Detection of motion and movement
- Guidance of movement
Ventral Stream
- temporal lobe
- conscious processes
- discrimination of shapes, textures, objects, faces
- object centered representation and stored in long term memory
VISUAL STREAMS

http://www.waece.org/cd_morelia2006/ponencias/stoodley.htm
THE VISUAL PATHWAY FLOWS THROUGH EVERY LOBE WITHIN THE BRAIN (32-40 visual centers)
IMPAIRMENTS RESULTS IN:

- Insecurity
- Postural and Balance Impairment
- Changes in Muscle Tone
- Compromise to explore, manipulate, and learn from interacting with the environment

- [http://www.childrensvision.com/reading.htm](http://www.childrensvision.com/reading.htm)

© 2013 Janine Wiskind
IDENTIFY DEFICITS
Does the parent/teacher have any concerns?
- **Behavior** and **attention** in class
- Is the child irritable or anxious?
- Avoidance
- Emotional
- Difficulty walking in a group/hallway
- Gives up/avoids seat work
- Posture seated
- Head positions: Branden
FIXATIONS

- Does the child alert (grasp with eyes) to new objects when presented?
- Does the child maintain visual contact with the new object?
- Fixate: 3-4 seconds (Functional: 10 sec)
- Assess in all planes
  - Dark room/flashlight

© 2013 Janine Wiskind
Ask the child!

- Jenifer’s basketball student
- OT in course’s son
- Jadon
Use an object that is entertaining to the child
Use something that they have to focalize on
Move the object clockwise horizontally, vertically, and rotational
Increase the Cognitive Demand

Treatment: address fine to gross
Preferable to assess in standing
If unable, try achieve vertical head alignment
Perform binocularly
Hold the objects 16 inches from the child’s face about 4 inches from midline (total 8 inches apart)
Don’t provide instructions about head movement
The following assessments/techniques should be done under the guidance/training of a developmental optometrist.
Move the object (penlight) towards child at eye level between the two eyes
- Ask child to verbalize when sees two
- Continue to move the object 1-2 inches in and then move it back out
- Ask the child to verbalize when sees one again
- Record the point at which child sees double (the break) and recovers.
Normal point of diplopia (Break) = usually 2-4” from eyes
Normal point of fusion (Recovery) = 4-6”
If child states they do not see double: possible suppression present
Watch eyes carefully
- Does one eye drift out?
- Does one eye slip in?
- Does the child lose focus?
BINOCULARITY SCREENING

- Cover Test
- Alternate Cover Test
- Suppression Testing
  - Worth 4-dot test
  - Red/green filters
- Hirschberg Test
Cortical Visual Columns
COVER TEST

- Assesses for strabismus
- Child fixates on penlight at midline
- Cover their eye with one hand
- Watch for movement of the uncovered eye as you move your hand away from the covered eye and re-cover it
- Did the uncovered eye deviate in any direction?
- Repeat 3x
ALTERNATING COVER TEST

- Assesses for a phoria
  - Tendency of the eye to turn in/out but can be controlled by individual

- Child fixates on penlight at midline
- Cover the right eye and left eye back and forth
- Observe if the uncovered eye moves (i.e., eye being uncovered)
COEXISTING DISORDERS

- Cerebral Palsy
- Down Syndrome
- Spina Bifida
- Head Injury
- ADHD
- LD
- Prematurity
- Mental Retardation
- Autistic Disorder
- Seizure Disorder
- Emotional Disabilities
- Hearing Impairments

© 2013 Janine Wiskind
21st CENTURY?

- Are we giving children the opportunity to develop these skills?
- Static versus dynamic play
- 2D learning versus active engagement in their world
- Near vision and glasses
Activity Break

☐ Laterality Code

© 2013 Janine Wiskind
THE VESTIBULAR SYSTEM
“vestibular input tells us whether or not we are moving, how quickly we are moving and in what direction we are moving. It provides us with that sense of safety that can only come from knowing that one’s feet are planted firmly on the ground.” (Trott, Laurel, and Windeck, 1993, pg. 6)
DEVELOPMENT

- Fully developed around 5 months in utero
- Fully myelinated prior to birth
- Continues to develop until at least 15 years of age
- Vestibular stim = ↑ arousal level = ↑ visual exploration = ↑ motor development and reflex integration
FUNCTIONS

- Detects Rotation:
  - allows a person to shake their head and maintain visual contact
- Detect Linear Movement:
  - maintain upright posture
  - Gravity: sensitive to sustained head tilt in any position
### THE INNER EAR

<table>
<thead>
<tr>
<th>OTOLITH: UTRICLE AND SACCULE</th>
<th>SEMI-CIRCULAR CANALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>calcium carbonate crystals embedded in endolymph</td>
<td>Hair cells move in endolymph and excite vestibular nuclei</td>
</tr>
<tr>
<td>Utricle: linear and acceleration detectors</td>
<td>Pairs in matching ears</td>
</tr>
<tr>
<td>Saccule: Force of gravity; nodding</td>
<td>1 pair horizontal</td>
</tr>
<tr>
<td></td>
<td>2 prs vertical: R ant/L post</td>
</tr>
<tr>
<td></td>
<td>VOR Reflex</td>
</tr>
</tbody>
</table>
OTOLITHS

(c) Macular function

Head upright

Statoconia

Gravity

Gelatinous material

Head tilted back

Gravity

Receptor output increases

Otolith slides "downhill," distorting hair cell processes

© 2013 Janine Wiskind
SEMI-CIRCULAR CANALS

(a) Endolymph in semicircular canal
- Cupula
- Hair cells
- Sensory nerve fibers

(b) Movement of endolymph bends cupula

FUNCTIONAL IMPLICATIONS

STRONG FOUNDATION
- Hold head still as eyes move
- Hold eyes steady as head moves
- Turn head to orient in space
- Influence muscle tone and body alignment

POOR FOUNDATION
- Lost in Space
- Crave movement
- OR
- Fear movement
VESTIBULAR SYSTEM AND SCHOOL

- Arousal!
- VOR: Stable Platform
- Bus ride
- Bending down to retrieve dropped items
- Participation in PE
- Behavior?
- Anxiety?
VESTIBULAR SYSTEM AND SCHOOL

- Tolerating busy environments
- Play: self-esteem
- Spatial monitoring
- Posture and Tone
- Endurance

© 2013 Janine Wiskind
Is it relevant to “school-based” therapy?
Non-vestibular influences affecting assessment:
- Attention
- Arousal State
- Unintended ocular fixation
- Insufficient head stabilization

Recommended: Effective testing of vestibular system involves
- PRN
- Postural Testing
POSTROTARY NYSTAGMUS TEST

- Eyes open
- Head positioned in 30 degrees flexion providing best alignment for semi-circular canals
- Child rotates clockwise 10 times
- +/- 1 min break to allow body to adjust
- Child rotates counter-clockwise 10 times
- Normal range: 6 > 14
  - Hypo: -2 seconds
  - Hyper: +1.5 seconds

© 2013 Janine Wiskind
NOTE: Research suggests children with disability show inconsistencies of duration likely due to arousal level, visual fixation, and head position.

Mean score = 10; ask for feedback.

Underaroused: < 6 seconds
- do activities with eyes closed first

Overaroused: > 14 seconds
- do activities that are both visual/vestibular
POSTROTARY NYSTAGMUS TEST

- A child does not always know what they can/cannot tolerate
- Physiological Changes:
  - Respiration rate
  - Flushed face or pale face
  - Fatigue/lethargy
  - Yawning
- Proprioceptive/Heavy Activity
- Ice: palms of hands, neck, temples.
POSTURAL TESTS

- Standing Balance eyes Open/Closed
  - SIPT
  - Balance on dominant foot
  - Hands on hips
  - Top of other foot behind knee of opposite leg
  - Score up to max of 30
  - Perform eyes open and then eyes closed
REALITY OF SCHOOL-BASED THERAPY

- Time
- Educate!
- Home Programs
- Glass half full

© 2013 Janine Wiskind
Transitions: Use proprioceptive system to compensate for poor peripheral awareness (take your hands off the wall....)
- Carry binder
- Weighted box
- Weighted backpack
- Sensory tools: compression vest, weighted vest, belt
Optimal seating:
- Desk height
- Facing teacher/board as frequently as possible
- Decreasing need to turn head
- Decrease visual periphery
- Copy at near
- Creative seating: ball chair, t-stool, chair backward
Lighting:

Because of the slow processing of visual information in the diseased or injured eye, many persons with limited vision are able to perceive the flicker in fluorescent lights which is imperceptible to persons with healthy eyes. While this does not present a health problem to most people (except those with epilepsy,) it does become a source of annoyance for some.
Google search: Fluorescent light and….  
- Headaches  
- Migraines  
- Nausea  
- Vision problems  
- Fatigue  
- Anxiety  
- Autism  
- Panic attacks  

**Suggestion:**  
F32SPX30 tube
ACCOMMODATIONS

- enlarged print
- Read written directions aloud
- Break assignments into clear, concise steps. Often multiple steps can be difficult to visualize and complete.
- Provide information about a task before starting to focus attention on the activity.
- Ruler as reading guide
- Binder/slant board

© 2013 Janine Wiskind
ACCOMMODATIONS

- Place black construction paper under worksheets to increase contrast
- Colored paper (rose, peach is suggested to reduce glare)
- Provide boundaries on the page
- Filters
  - Blue colored overlay: works ambient system
  - Oranges: Alerting
TREATMENT SUGGESTIONS

- Pay attention to level of arousal:
  - Zuhayr
  - Ben
  - Zian
Home activities:
- simple fixation, pursuit, and saccade work
- Active play: Mary Kawar astronaut training preparatory exercises

www.eyecanlearn.com
http://www.childrensvisions.com/fun.htm
VISUAL REGARD/FIXATION

- Flashlight catch
- Lower functioning or younger children
  - Black and white contrast blanket
  - Flashlight on body or wall in dark room
  - Move child while keeping flashlight still

© 2013 Janine Wiskind
PURSUITS AND SACCADES

- Penlights and toppers:
  - Amazon: penlights
  - Bernell.com: toppers
- Tracking Tube
- Marsden Ball
- Finding words within words
- Cancellation activities

© 2013 Janine Wiskind
Marble catch: roll marble across table and child catches it with/in cup

Straw football

Ex: Ms. Burnett’s class

John

© 2013 Janine Wiskind
EYE ALIGNMENT/CONVERGENCE

- Change head and body position during these activities
- Pop bubble wrap
- Hand over hand rope pull

© 2013 Janine Wiskind
EYE ALIGNMENT/CONVERGENCE

- Toothpick in straw
- Pen in loose fist
- Catching rings on arms or feet
- Brock String
- Balloon pat following direction to walk forward/backward, side step, etc

© 2013 Janine Wiskind
VESTIBULAR ACTIVITIES

- Change the position of the head!
  - Set up your environment – manipulate head position through play.
  - Scooter board: look down at dots on the floor, locate items to the side while propelling self forward
  - Rolling
  - Somersaults
  - Pilates “seal”
  - Inversion activities: bowling, rolling the ball, board game
VESTIBULAR ACTIVITIES

- Change the base of support
  - Feet together
  - Standing/walking on heels OR toes
  - Transitioning between standing and lower stool
  - Stepping up and down
  - Prone
  - Curled up in supine: stack blocks on knees; color with body crayons
Think about your visual-vestibular systems

- Do you get on spinning toys at the park?
- Do you read in the car?
- Can you swing for hours on the swing?
- Do you choose to spin around just to see how dizzy you can make yourself?
Is your experience with the above, the daily experience of your students?
Please don’t forget about the poorly developed or poorly coordinated visual-vestibular systems of your students

Think about it as part of their treatment plan

Educate their parents and teachers!