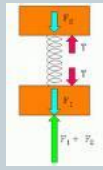
The Binocular Vision Examination

MARC B. TAUB, OD, MS, FAAO, FCOVD
CHIEF, VISION THERAPY AND REHABILITATION
SOUTHERN COLLEGE OF OPTOMETRY
EDITOR IN CHIEF, OPTOMETRY & VISUAL PERFORMANCE

Stress Theory

- Physics:
  - Stress represents the force that tends to deform the body.
  - Results in strain
  - Stress is the cause and strain is the result
- General speech
  - We say we are "under stress"
  - Stress is still the effector



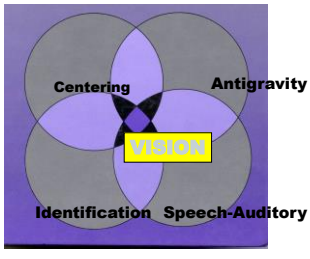
Stress Theory

- Hans Selye
  - Stress is the response
  - Stressors are the factors that produce the response
  - Definition:
    - "the non-specific response of the body to any demand made upon it."
    - Emphasizes three factors
      - Stress is a response or reaction to something
      - The response can be produced by any agent, event or circumstance
      - The response is non-specific

Influences on Adaptation

- Stress does not affect every person the same way
- Stress does not produce the same response in the same individual at all times
- Every individual has different stress tolerances
- Interacting factors
  - Stressor variables
    - Type, persistence, intensity…
  - Concurrent conditions
    - Genetics, external factors (temp, pollution, noise)
  - Psychological factors
    - Personality and attitude
  - Prior conditioning

Skeffington's Model of Vision



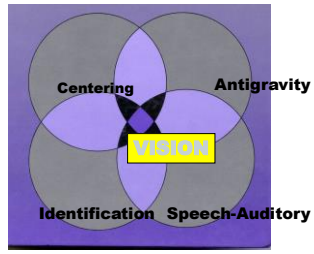
Skeffington's Four Circles

- Antigravity System (Vestibular)
  - Basic frame of reference for orientation and spatial localization
  - Internal Balance and position in space
- Centering (Convergence)
  - Directing body, head, and eyes toward area in space for information processing
  - Attention and orientation in external space

Skeffington's Four Circles

- Identification (Accommodation)
  - Gathering meaning from areas of selected attention in external space
  - Resolution, discrimination, differentiation, and determination of relationships between details
- Speech-Auditory
  - Analysis and communication of what is seen

Skeffington's Model of Vision



Nearpoint Stress Model

- Skeffington
  - Humans are biologically unsuited for near-vision tasks imposed by society
  - The demands for sustained concentration, immobilization and mental effort provoke a stress response.
  - Characterized by a drive for the centering process to localize closer to the individual than identification.

Nearpoint Stress Model

- For efficient reading
  - Vergence and accommodation need to localize at the plane of regard
    - The drive for vergence to localize closer than accommodation leads to blur or diplopia
    - This is the stressor!
  - Now what can we do????
  - Adapt!!!!

Nearpoint Stress Model

- What are our choices?
- 1) Avoidance
  - Easiest solution to the problem as far as they are concerned.
- 2) Inefficient visual function
  - Might eventually lead to avoidance
- 3) Accommodative or vergence adaptation
  - i.e.-Accommodative or convergence insufficiency,

COVD Quality of Life (QOL) Questionnaire

- Developed by a COVD committee in 1995
- Can be used to assess change via
  - Vision therapy,
  - Change in distance spectacle RX
  - Use of near point lenses

COVD College of Optometrists in Vision Development
Prevention • Enhancement • Rehabilitation

COVD Quality of Life (QOL) Questionnaire

- Original version-30 questions
- Shortened version-19 questions
- Advantages of survey
  - Ease of administration
  - Low cost
  - Standardized
- Disadvantage of survey
  - Leaves no room for elaboration by the clinician.
- Parents versus Patients
  - Older children-patients
  - Younger children-parents and patients

COVD Quality of Life (QOL) Questionnaire

- Scoring
  - "always"-4 points
  - "frequently"-3 points
  - "occasionally"-2 points
  - "seldom"-1 point
  - "never"-0 points
  - Total scores were obtained by summing the scores for each individual question
  - >20-indicative of a visual efficiency or perceptual disorder
- How should you use it?

Cover Test

- Cover test
  - Unilateral
    - Used to detect strabismus
    - If no movement, does this mean there is not a tropia?
  - Alternating
    - Used to detect phoria
    - Used to assess amount of phoria and strabismus
    - Does the exact amount really matter?

Cover Test

- Impact of accommodation
  - Under-accommodation
    - Over estimate the degree exophoria
    - Under estimate the degree of esophoria
  - Change fixation target
    - Improves attention and fixation
  - Move the target slightly to the side to confirm fixation
- Norms
  - Distance:
    - 1 XP +/-2
  - Near
    - 4 XP +/-2

Phoria Measurement

- Von Graffe
  - In phoropter
  - Used to determine lateral and vertical phoria
  - Must keep the letters clear at all times
  - This can be used interchangeably with the cover tests, right?
  - Norms
    - Distance
      - 1XP +/-1
    - Near
      - 2 XP +/-2

Phoria Measurement

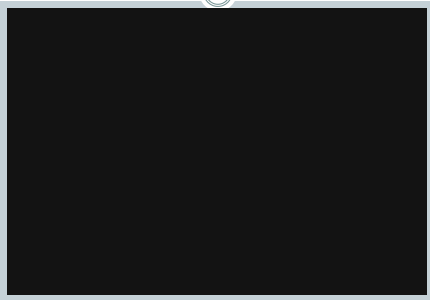
- Howell Card
  - Uses prism for dissociation
  - Similar to modified Thorington
  - Can be used for distance and near
  - Blue and yellow colors help make determination of eso or exo.
  - Can use +/-1 flippers to determine a gradient AC/A ratio

Near Point of Convergence

- Assesses convergence amplitude
  - Objective and subjective test
- Repetition is crucial
  - Both break and recovery will recede greater in patients with bv issues
- Targets used
  - Accommodative-
    - 5cm break, 7cm recovery
  - Penlight with red lens-
    - 7cm break, 10cm recovery

- Convergence Insufficiency
  - More likely to have reduced break and recovery
  - More likely to have reduced NPC with PL and red lens

Near Point of Convergence



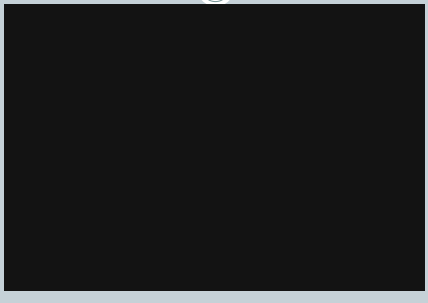
Smooth Vergence

- Assesses the amplitude of the fusional vergence response for both positive and negative fusional vergence.
  - Blur finding
    - Accommodation
    - How much convergence and divergence can be altered before accommodation is affected.
  - Break finding
    - Fusional vergence free of accommodation
  - Recovery
    - Provides information regarding the patient's ability to regain fusion following diplopia
    - How quickly and satisfactorily can a patient put the disrupted world back together again

Smooth Vergence

- Skeffington (1969)
  - When blur is low the case is new.
  - When break is low the case is old.
  - When recoveries are low adaptation is poor.
  - Embedded vs. non-embedded
- Its all about degrees of freedom!

Step Vergence



Stereo Testing

- Evaluate the degree and presence of stereopsis
  - Suppression check (R+L)
  - Local/Contour Stereopsis
    - Wirt circles, Titmus stereofly and animals
    - Uses two similar targets that are laterally displaced.
    - Contains monocular cues
    - Helps determine if peripheral stereopsis is present
    - What should we shoot for?
  - Global Stereopsis
    - Random dot stereopsis
    - Helps to determine the presence of a constant strabismus

Prism Facility

- Assesses the dynamics of the fusional vergence system and the ability to respond over time.
- Measures vergence stamina
  - Akin to accommodative amplitudes and accommodative facility
  - What power to use?
    - 8BO/8BI
    - 12BO/3BI
    - 16BO/4BI
    - 12BO/6BI

Age	Norms
5-7	2.5cpm
8-10	5.0cpm
11-13	6.5cpm
Young Adults	8.0cpm

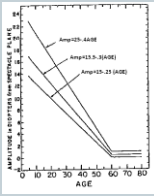
Accommodative Testing

- Amplitude
  - Push-up
  - Pull-away
  - Minus lens-to-blur
- Facility
  - Monocular
  - Binocular
- Response
  - Monocular estimated method (MEM)
  - Fused cross cylinder (FCC)
- Other
  - NRA/PRA

Expected Values

- Hofstetter's Formulas
  - Based off of the work of Donders and Duane in the early 20th century.
  - Target was a single black line.
  - Minimum Accommodation
    - 15-0.25(Age)
  - Average Accommodation
    - 18-1/3(Age)

Age (Years)	Amplitude (D)
10	14.67
15	13.00
20	11.33
25	9.67
30	8.00
35	6.33
40	4.67
45	3.00
50	1.33
54	0.00



Accommodative Amplitude

- Push-up vs. pull away
- Materials:
  - Near point card or fixation target (tongue depressor with accommodative target affixed).

Accommodative Amplitude

- Important Issues
  - Calculating diopters
    - Take the inverse of the measurement in meters
    - Example:
      - First sustained blur at 8" or 20 cm.
      - 1/0.2 = 5.00 D Amplitude of Accommodation.
  - Careful distance measurement
    - Small measurement errors=big errors
    - Example: 2 inches=5cm=20D
    - Example: 2.5 inches=6.3cm=16D

Accommodative Amplitude

- Monitor patient response
  - Easier out of the phoropter
    - Watch for facial expression changes
    - Watch for the child that is not really looking!
    - Make sure the child does not back away from the target
- Relative distance magnification
  - A 20/30 letter at 40cm
  - Becomes equivalent to a 20/60 letter at 20cm
  - Becomes equivalent to a 20/120 letter at 10cm
  - Solution to this problem???
    - Change letter size at 20cm and 10cm-NOT PRACTICAL!
- Comparison to Hofstetter
  - Hamasaki-
    - 106 subjects (212 eyes), ages 42 to 60 years
    - overestimation by 2D

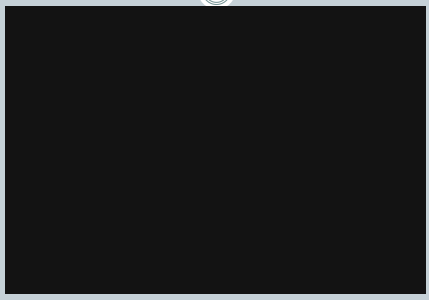
Accommodative Amplitude

- Minus Lens-to-Blur
  - Important Issue
  - Concerns about minification
    - Due to increasing the power of the minus lenses used
    - Solution??
      - Change testing distance to 33cm
      - 2.50D still used in final calculation
      - ie. -6.00+|2.50| = 8.50D of accommodation
  - Expected values
    - About 2D less than the push up method

Accommodative Facility

- What to record
  - Patient Rx used
  - Lens used
  - Near point card and print size used
    - Important for retesting
    - Important for amblyopes
  - Number of cycles per minute
  - Difficulty clearing plus or minus
    - Trouble clearing minus-trouble stimulating accommodation and/or divergence
    - Trouble clearing plus-trouble relaxing accommodation and/or convergence

Accommodative Facility



Accommodative Facility

- Failure to clear minus
  - Accommodative Insufficiency
  - Convergence Excess
    - Minus causes an increase in esophoria with requires NRV to keep the target single
- Failure to clear plus
  - Accommodative Excess
  - Convergence Insufficiency
    - Plus causes an increase in exophoria with requires PRV to keep the target

Accommodative Facility

- What to record:
  - Does performance deteriorate with testing?
    - Starts off with quick changes but slows down over time
  - Does suppression occur and with which lenses?
  - Postural changes
    - Does patient slump in chair
    - Head tilt or turn
  - Patient complaints
  - Does patient attempt to move card?

Accommodative Facility

- Interpretation
  - Trouble with only monocular testing
    - Accommodative problem
  - Trouble with both monocular and binocular testing
    - Vergence and/or accommodative problem
- Examples
  - 13 cycles per minute (cpm)OD, OS, 5 cpm OU
  - 5 cycles per minute (cpm)OD, OS, 4 cpm OU

Accommodative Facility

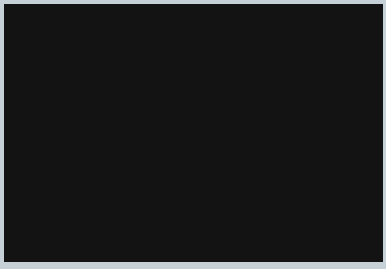
- Norms
  - Developmental Trend upwards-
    - Why???

Age	MAF	BAF
6	5.5 +/-2.5	3.0 +/-2.5
7	6.5 +/-2.0	3.5 +/-2.5
8-12	7.0 +/-2.5	5.0 +/-2.5
12 and older	11.0 +/- 5.0	8.0 +/-5.0

Accommodative Posture

- Monocular Estimated Method
  - Purpose:
    - To objectively determine a patient's accommodative posture or lag of accommodation
    - To determine the appropriate near vision Rx.
  - Select the appropriate M.E.M. card corresponding to a grade or reading level closest to that of the patient.
    - Card selected can be low demand (large print) or high demand (small print).
    - If too high of a demand-increase stress response-will lead to a higher minus response

Accommodative Posture



Accommodative Posture

- To verify the estimation
  - a neutralizing trial lens is interposed QUICKLY IN AND OUT, in front of one eye at a time, as the retinoscope light passes across the eye.
- Lens speed is crucial
  - ***DO NOT*** *hold the lens in front of an eye for greater than 1/5 of a second because the eye will have time to accommodate to the lens and/or binocularity may be disrupted.*
- ***Don't forget to check both meridians for presence of astigmatism.***

Accommodative Posture

- Recording:
  - 1. The power of the neutralizing lens used for each eye, including any astigmatism (with the axis).
  - 2. Fluctuations or instabilities in the reflexes.
  - 3. Rx used.
  - 4. Reading level on MEM card used.
  - 5. Distance used.
- Expected Findings
  - Normal lag of accommodation is between +0.25 to +0.75 D.
- Pass/Fail Criteria:
  - unequal reflexes
  - a lag greater than +0.75
  - any against motion (excessive accommodation)

Accommodative Posture

- Lag of Accommodation
  - Focus is slightly behind the target
  - Accommodative Insufficiency
  - Convergence Excess
- Lead of Accommodation
  - Focus is slightly in front of the target
  - Accommodative Excess
  - Convergence Insufficiency

Accommodative Posture

- Binocular Crossed Cylinder
  - Set-Up
    - Patient is in the phoropter
    - Place the cross cylinder lenses in front of the patient.
    - Have patient close their eyes and add plus +1.50 D to each eye.

Accommodative Posture

- Upon opening their eyes:
  - ask the patient which lines appear darker and clearer.
    - It should be the vertical lines.
  - If not, have patient close eyes and add more plus until upon opening their eyes, they indicate it is the vertical lines.
- Plus lens power is decreased in 0.25 D steps until patient reports that the lines are either equal or the horizontal lines are darker or clearer.

Accommodative Posture

- The first horizontal response is recorded.
- If there are several "equal" responses and no horizontal, the middle equal or last one can be used as the value.
- The expected result is +0.50D +/- 0.50D.

Accommodative Posture

- NRA/PRA
  - Indirect measure of accommodation
  - Binocular procedure
  - Set-Up
    - Patient is in the phoropter,
      - Wears his/her habitual reading Rx or distance refraction.
      - Target (20/30) line of letters is placed at 40cm.
      - Illumination is full

Accommodative Posture

- Procedure:
  - The patient is instructed to report the first sustained blur.
  - Minus (PRA) lenses are introduced binocularly in 0.25 D steps until blur is reported.
  - After the blur is reported, give the patient a few seconds to ensure that it the letters remain blurred.
    - If they do not, continue the process until blur is constant.
  - Take away minus until the letters are once again clear
  - Repeat the process with plus (NRA)
- Expecteds
  - PRA: -2.37 +/-1.00
  - NRA: +2.00 +/-0.50

Accommodative Posture

- Clinical Pearl-Differentiate between Vergence and Accommodation
  - At blur point-cover one eye
  - 1) If blur remains-accommodative component
  - 2) If blur disappears-only vergence related
  - Example 1:
    - NRA +1.25, when one eye covered, letters are clear
    - Binocular Problem
  - Example 2:
    - NRA +1.25, when one eye covered, letters remain blurry
    - Binocular and/or accommodative problem

AC/A Ratio

- To determine the change on accommodative vergence that occurs when the patient relaxes or stimulates accommodation by a given amount
- Is used to determine efficacy of plus at near
  - Calculated
    - AC/A=IPD(cm)+NFD(m)(Hn-Hf)
  - Gradient
    - Phoria measurement is repeated with either +/-1.00
  - Differences
    - Calculated is typically larger than gradient
      - Due to the effect of proximal vergence patients tend to under accommodate to a given stimulus (lag of accommodation)
        - Lowers the result of the gradient method

Accommodative Convergence/Accommodation

- Example 1:
  - Patient reports an orthophoria with habitual RX at 40 cm.
  - With the +1.00 add, the phoria is 4 exophoria.
  - With the -1.00, the phoria is 4 esophoria.
  - **The *gradient* AC/A is 4/1.**
- Example 2:
  - Patient reports an orthophoria with habitual RX at 40 cm.
  - With the +1.00 add, the phoria is 2 exophoria.
  - With the -1.00, the phoria is 6 esophoria.
  - **The *gradient* AC/A is 4/1.**
- Example 3:
  - Patient reports 2 exo with habitual RX at 40 cm.
  - With the +1.00 add, the phoria is 6 exophoria.
  - With the -1.00, the phoria is 2 esophoria.
  - **The *gradient* AC/A is 4/1.**

Eye Movements

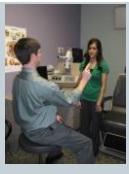
- Fixation
  - Direct observation test
  - Patient is sitting
  - Binocular→→→→Monocular
  - SCCO Grading System
    - Fixate on a near accommodative target for 10s
    - 4-Steady fixation-smooth and accurate
    - 3-One fixation loss
    - 2-Two fixation losses
    - 1-More than two fixation losses.

Pursuit Testing

- SCCO
- Direct observation test
- Patient is sitting
- Move a 20/60-20/80 target slowly horizontally, vertically and diagonally
- Binocular than monocular
  - 4-Smooth and accurate
  - 3-One fixation loss
  - 2-Two fixation losses
  - 1-More than two fixation losses or uncontrolled head movements

Pursuit Testing

- Northeastern State University College of Optometry (NSUCO)/Maples Oculomotor test
- Direct observation test
- Patient is standing
- Procedure:
- Target is moved clockwise and counter-clockwise two rotations.
- Score depends on age and gender

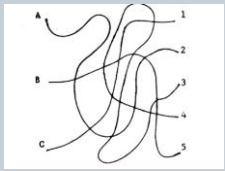


Pursuit Testing

- NSUCO grading
- **Ability**
  - 5-Completes 2 rotations in each direction
  - 4-Completes 2 rotations in one direction only
  - 3-Completes 1 rotation in either direction, but not two
  - 2-Completes 1/2 rotation in either direction
  - 1-Cannot complete1/2 rotation in either direction
- **Accuracy**
  - 5-No refixations
  - 4-Refixations 2 times or less
  - 3-Refixations 3 to 4 times
  - 2-Refixations 5 to 10 times
  - 1-No attempt to follow target or >10 fixations
- **Head/Body Movement**
  - 5-No head/body movement
  - 4-Slight head or body movement (<50% of time)
  - 3-Slight head or body movement (>50% of time)
  - 2-Moderate head or body movement at any time
  - 1-Large head or body movement at any time

Pursuit Testing

- Groffman Visual Tracing
  - The patient traces a line with their eyes only from point to point
  - Responses are timed and compared to standardized data
  - Abnormal
    - Greater than 1 SD from the mean

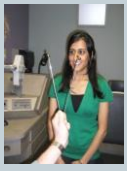


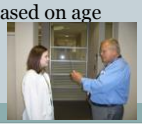
Saccade Testing

- SCCO
  - Direct Observation
  - Patient is seated
  - Binocular→→Monocular
  - Procedure
    - Two target (20/60-20/80), 25 cm apart, 40 cm from patient
    - Targets are presented horizontally, vertically and diagonally
  - Grading
    - 4+ smooth and accurate
    - 3+ some slight undershooting
    - 2+ gross over or undershooting or increased latency
    - 1+ inability to perform the task or any uncontrolled head movement

Saccade Testing

- NSUCO
- Direct observation test
- Patient stands
- Two targets are held 20-25 cm apart.
- The patient makes 5 round trips back and forth.
- Grading is on ability, accuracy and body/head movement.
- Comparisons are made based on age and gender.
- Females-better younger





Saccade testing

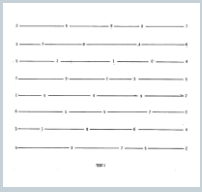
- NSUCO grading
- **Ability**
  - 5-Completes 5 roundtrips
  - 4-Completes 4 roundtrips
  - 3-Completes 3 roundtrips
  - 2-Completes 2 roundtrips
  - 1-Completes less than two roundtrips
- **Accuracy**
  - 5-No over or undershooting
  - 4-Intermittent slight over or undershooting (<50%)
  - 3-Constant slight over or undershooting (>50%)
  - 2-Moderate over or undershooting noted 1 or more times
  - 1-Large over or undershooting noted 1 or more times
- **Head/Body Movement**
  - 5-No head/body movement
  - 4-Slight head or body movement (<50% of time)
  - 3-Slight head or body movement (>50% of time)
  - 2-Moderate head or body movement at any time
  - 1-Large head or body movement at any time

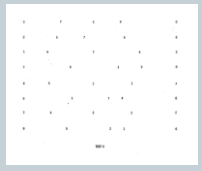
King-Devick Saccadic Test

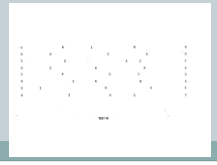
- Reading eye movements
- Developmental growth
- Procedure
  - Patient calls out 40 numbers horizontally
- The lower the time→→→→the more efficient the eye movements
- Grading
  - Based on the number of errors and time

King-Devick Saccadic Test

- Three levels



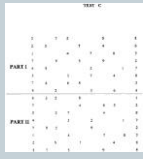




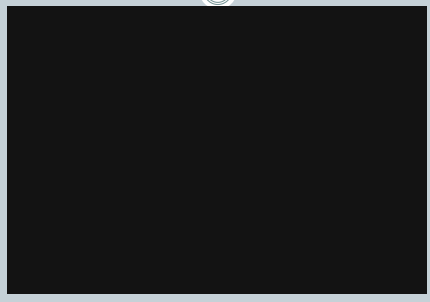
King-Devick Saccadic Test

Developmental Eye Movement Test (DEM)

- Reading eye movements
- Considered a visual-verbal test
- Vertical array
  - Tests automaticity-the ability to automatically recall numbers
- Horizontal array
  - Tests horizontal eye tracking
- Grading is based on:
  - Number of errors
  - Types of errors
  - Time for each section
  - Horizontal time/Vertical time



Developmental Eye Movement Test (DEM)



Developmental Eye Movement Test (DEM)

- Types of errors 4 8 2 0 4
- Omission
- Transposition 4 2 8 0 4
- Substitution 4 7 2 0 4
- Addition 4 8 7 2 0 4
- Only additions and omissions are figured into the adjusted horizontal time

Developmental Eye Movement Test (DEM)

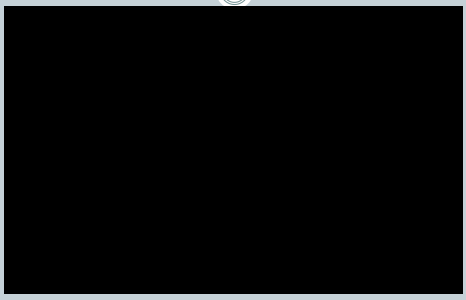
- Four Possible Outcomes
- No deficit in Ocular motility or automaticity
- Ocular Motility Dysfunction
  - Normal vertical, High horizontal and ratio
- Automaticity Problem
  - High horizontal and vertical, Normal ratio
- Automaticity and OMD
  - Abnormal vertical, horizontal and ratio
  - Horizontal is worse than the vertical making the ratio high

Visagraph/Readalyzer

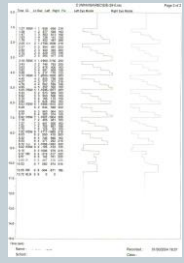
- **Objective test**
- Measures reading eye movements
- Goggles contain infrared sensors that detect eye movement
- Results are recorded and evaluated by a computer
- Age normed passage-2 paragraphs long
- Reading comprehension assessed.
- Must get 7/10 questions correct unless not valid.

Visagraph/Readalyzer

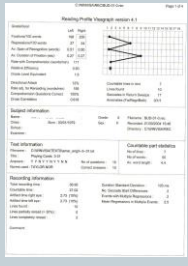
- Information determined and calculated
- Fixations
- Regressions
  - Backward jumps
- Reading rate
- Duration of fixation
  - How long does each one take?
- Span of recognition
  - How much are they seeing with each fixation?
  - ie. .50 means they see half of a word per fixation
- Directional attack
  - Fixations/Regressions
- Efficiency
- Grade equivalent

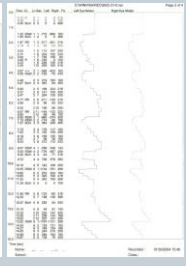


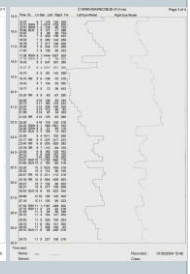
Visagraph-The Good



Visagraph-The Bad







Nearpoint Stress Model

- How does this work?
  - Stress causes vergence to localize closer than accommodation
  - As per the AC/A ratio, when vergence is stimulated, so will accommodation
  - When accommodation is stimulated, vergence will stimulate more, ramping up even further.

Nearpoint Stress Model

- How do we naturally stop the stress process?
  - What is a buffer?
    - Some examples
      - Chemistry
      - Banking
      - Vision
        - Hyperopia and exophoria are the visual system's buffers.

Adaptation to Visual Stress

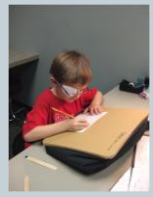
- Signs
  - Exophoria (>6X') or Esophoria (<1X')
    - Exo-fighting the stress
    - Eso-loss of the Exo buffer
  - Low or high MEM or fused cross-cylinder
    - Low-absorption of the hyperopic buffer
  - (NRA/PRA both <1.75)

Adaptation to Visual Stress

- Myopia, emmetropia or higher amounts of hyperopia
  - Myopia/emmetropia-loss of the hyperopic buffer
    - Reduces the accommodation required to maintain clarity at near, reducing the associated over-convergence.
  - Hyperopia-trying to build in a greater buffer.
- Low blur, break or recoveries on vergences
  - Low blur-newer problem
  - Low break-more embedded
  - Low recoveries-poor stability

General Management Approach

- Most appropriate Optical Correction
- Plus at near or prism
  - relief of visual stress
- Vision Therapy
  - Visual Hygiene
    - Maintain good posture
    - Take breaks
    - Good lighting
    - Slant the reading material



Treatment Strategies: plus at near

- Does plus at near clear the symptoms?
- Exam findings that suggest the need for plus at near
  - Low AA
  - Eso at near
  - Low PRA
  - High lag on MEM/FCC
  - Higher NRA than PRA
    - Balance to determine the tentative add power.
    - ie: PRA=-0.50, NRA=+2.00
      - Add them up (2.50)
      - Divide by 2
      - This is the balance you are aiming for.
      - In this case, the add power should be +0.75D.

Treatment Strategies: plus at near

- What conditions generally respond to plus at near?
  - Accommodative Insufficiency
  - Ill-Sustained Accommodation
  - Symptomatic Esophoria at near
- To determine plus acceptance
  - Performance testing with the tentative add
    - MEM, AA, stereo testing, VO star, NPC
  - Trial period-in office or at home (loaner lenses)

A case for plus!

- 11 year old female
  - Complains of blur at distance after extended near work.
  - Headaches at the end of the day
- VA
  - Distance: 20/20, Near 20/15
- Stereo
  - 30 sec
- Cover test
  - Ortho at dist and near
- Phoria in phoroptor @ near
  - 2 eso
- Previous exam, 1 month previous showed:
  - Manifest: -0.50 OU
  - Cycloplegic:-0.75 OU

A case for plus!

- Today's exam
  - MEM: Plano
- Through plano
  - NRA/PRA
    - +2.25/-2.50
  - Vergence ranges:
    - BI @ dist x/10/3
    - BO 2 dist x/12/8
    - BI @ near 14/16/6
    - BO @near X/20/6
  - Vergence facility (8 BO/4BI)
    - 12 cpm, BI slower
  - Accommodative flippers:
    - unable to clear +2.00 so +/-1.00 was used for monocular testing
    - OD 15, OS 16, OU (+/-2.00) 11 cpm

A case for plus!

- Diagnosis
  - Accommodative dysfunction
    - MEM
    - minus refraction on previous exam
    - inability to clear plus on monocular accommodative flippers
    - eso posture
    - slightly reduced stereo
- Treatment:
  - Plus at near: started with +0.50
  - Stereo: 20 sec
  - Patient reported:
    - Reading is easier
    - Letters slightly larger
  - Prescribed +0.50 full time wear, follow up in 1 month

Three cheers for plus at near!

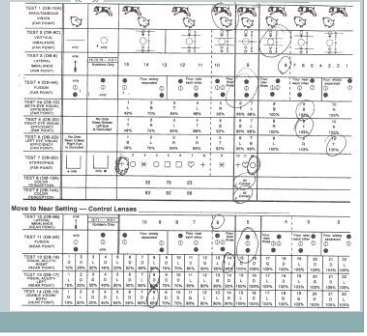
- 7 year old male
  - Mom complains of a constant head turn for the past few weeks
  - Good student but recent change in reading comprehension
- COVD checklist: 6
  - Avoids near work/reading
  - Reading comprehension down
- VA
  - Distance 20/20, near 20/15
- Stereo
  - 70 sec
- Cover test
  - Ortho at distance and near
- Phoria in phoropter
  - Ortho at distance and near

Three cheers for plus at near!

- EOMs
  - Full, no restrictions
- Visual fields
  - Full to finger count OU
- Retinoscopy
  - +0.25 OD, +0.50 OS
- Manifest
  - +0.50 OD, +0.75 OS
- NRA/PRA
  - +3.25/-4.00

Three cheers for plus at near!

- NPC
  - To the nose X 3
- Accommodative amplitude
  - 10 OD, 9 OS
- Vergence ranges:
  - BI @ dist x/10/2
  - BO @ dist x/18/6
  - BI @ near x/18/6
  - BO @near x/24/4



Three cheers for plus at near!

- Diagnosis
  - Fragile binocularity
    - Poor recoveries on vergence ranges
  - Accommodative insufficiency/dysfunction
    - Eso posture on CT and phorias
    - Reduced stereo
    - Low amplitudes
- Treatment:
  - Plus at near: started with +0.50
  - Stereo: 20 sec
  - Prescribed +0.50 full time wear, follow up in 1 month

Three cheers for plus at near!

- Parent reports head turn is gone
  - Reading back to normal
- VA
  - 20/20 distance without rx
  - 20/20 near with rx
- Stereo
  - 20 sec
- Cover test
  - Ortho @distance, 4 exo @near

Three cheers for plus at near!

- NPC
  - To the nose X 3
- Accommodative amplitude
  - 15 OD, 15 OS
- Vergence ranges:
  - BI @ dist x/6/2
  - BO @ dist x/12/7
  - BI @ near 12/18/6
  - BO @near 18/22/12

Too much minus is a detriment!

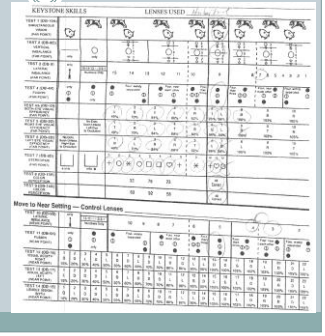
- 11 year old male
  - Complains of distance and near blur since losing glasses 1 month prior
    - Worse when reading
    - Same complaint one year prior
    - Sits close to the board even with glasses
    - Likes math and reading
    - Gets As and Bs, D in reading
  - COVD checklist-24
    - Trouble keeping attention on reading
    - Words run together when reading
    - Headaches when reading
    - Reading comprehension down
    - Avoids near work/reading

Too much minus is a detriment!

- VA
  - 20/100 OD, OS 20/80 OU @dist
  - 20/15 @near
- Stereo
  - 25 sec
- Cover test
  - Ortho @ distance and near
- Phoria in phoropter-through manifest
  - Ortho @ distance, 8 eso @near

Too much minus is a detriment!

- Refractive history
- 2009
  - Rx -1.75-1.00 x 180 OU
- 2010
  - VA 20/20 dist and near
  - Cover test 5 eso
  - Rx -2.25-1.25 x 180 OU
- 2012
  - VA 20/15 OU @ dist
  - Cover test 6 eso
  - Stereo 40 sec
  - Rx -2.25-1.25 x 180 OU



Too much minus is a detriment!

- Back to the present examination
  - Rx -2.25-1.25 x 180 OU 20/15 OD, OS
  - NRA/PRA
    - +2.00/-0.25
  - Rx -1.00-1.25 x 180 OU
    - 20/50 dist OU, 20/20 near OU
  - Rx -1.50-1.25 x 180 OU
    - 20/25- dist OU, 20/20 near OU
- Final Rx -1.75-1.25 x 180 OU 20/20 dist OU, 20/20 near OU
  - What about an add? Yes!!! But, what to Rx?
    - +1.00 prescribed; Why?

Good try but not good enough!

- 9 year old male
- Referred by a local optometrist for a VT evaluation
  - Patient reports better vision without glasses
  - Blur at distance after near work with and without Rx
  - Reading at grade level
    - Does not like to read for enjoyment
  - Math is the least favorite subject
  - Sloppy handwriting
- COVD checklist 27
  - Difficulty copying from board
  - Writes up/downhill
  - Omits small words when reading
  - Skips/repeats lines when reading

Good try but not good enough!

- VA (without RX)
  - 20/25+ OD, 20/25- OS, 20/20- OU @ dist
  - 20/20 @ near
- VA (with RX -0.75 OD, -0.50 OS)
  - 20/20- OD, 20/30- OS, OU @ dist
  - OS and OU improved to 20/20 with single letter
  - 20/25 @ near
- Stereo
  - 140 sec
- Cover test
  - Ortho @ dist, 5 exo @near
- Phoria in phoropter
  - Ortho @ dist, 6 exo @near

Good try but not good enough!

- Retinoscopy at near (through habitual and without)
  - +1.75 OD, OS
- NPC (through habitual)
  - 10cm/17cm x 3
  - Repeated through +0.50
    - 10cm/18cm x 3
- Accommodative amplitudes (through habitual)
  - 6 OD, 7 OS
- Vergences (through habitual)
  - BI @ near x/18/5
  - BO @ near x/6/0

Good try but not good enough!

- King Devick
  - Plate 1-45 sec (expected 21 sec)
  - Plate 2-45 sec (expected 23 sec)
  - Plate 3-45 sec (expected 29.5 sec)
- Diagnosis
  - Accommodative dysfunction
    - amplitudes, past Rx and VAs
  - Binocular dysfunction
    - NPC, vergence ranges, stereo
  - Ocular motor dysfunction
    - KD, Vas improved with single letter testing
- Treatment
  - Vision Therapy
  - Plus at near
    - Not this time

Too much plus is a bad thing!

- 9 year old female
- Complains of blur at distance with glasses
  - Patient reports better vision without glasses
  - Grades are good except reading below grade level
- COVD checklist 49
  - Avoids near work/reading
  - Trouble keeping attention on reading
  - Words run together with reading
  - Holds reading too close
  - Reading comprehension down

Too much plus is a bad thing!

- VA with correction (no clue what though)
  - 20/20 @ dist and near
- Stereo
  - 20 sec
- Cover test
  - Ortho @ dist, 4 Exo @near
- NPC
  - To the nose x 3

Too much plus is a bad thing!

- Retinoscopy
  - +2.00-0.75 x 090 OU 20/20 D & N
- MEM
  - +1.50
- Trial frame Rx
  - +1.50 20/20 D & N
- MEM through TF
  - +0.75 OU
- Final Rx
  - +1.50
- Follow up in one month for Rx check
  - Run DEM or King Devick

Too much plus is a bad thing!

- Six weeks later…
- Still complains of blur with glasses
- VA with and without glasses
  - 20/20 D @ N
    - Corrected VA improved after looking at chart for several seconds
- New trial frame performed
  - +1.00 OU
- Patient reported better clarity at distance

Too much plus is a bad thing!

- Proof is in the pudding!
  - DEM without Rx
    - Vertical
      - 40 sec
    - Horizontal
      - 106 sec
  - DEM with Rx
    - Vertical
      - 48 sec
    - Horizontal
      - 49 sec

Take the plus, leave the astigmatism!

- 10 year old male
- Complains of blur @ Dist and Near OU for 1 month
  - The blur varies daily and worse when looking at the board
  - Good student, As and Bs.
- COVD checklist 16
  - Skips/repeats line when reading
  - Words run together
  - Avoids reading/near work

Take the plus, leave the astigmatism!

- VA (uncorrected)
  - 20/30 OD, 20/30+2 OS, 20/20- OU @ Dist
  - 20/25 OD, 20/25+2 OS, 20/20- OU @ Near
- Cover test
  - Ortho @ Dist and Near
- Stereo
  - 140 sec
- Accommodative Amplitude
  - 6D OU

Take the plus, leave the astigmatism!

- Retinoscopy (Distance)
  - +0.50-0.75 x 010, +1.00-1.00 x 002
- Retinoscopy (Near)
  - +0.50 OU
- Manifest (Distance)
  - +0.50-0.50 x 010 20/20-, +0.50-075 x 180 20/20-
    - NRA/PRA +1.00/-0.75
- Final Rx
  - +0.50 OU for full time wear
    - 20/20 OD, OS, OU @ Dist and Near

Don't do a thing!

- 6 year old female
- Failed a school screening one week prior
  - Parent has no clue why!
- Mom does report child sits too close to TV
- On grade level; already reading!
- COVD checklist 4
- VA
  - 20/30 OD, 20/40 OS, 20/30 OU @ Dist
  - 20/20 OD, 20/25 OS, 20/20 OU @Near

Don't do a thing!

- Cover test
  - Ortho @ Dist and Near
- Stereo
  - 30 sec
- NPC
  - 3cm/5cm x 3
- Retinoscopy (Distance)
  - +0.50-0.75 x 090 20/20
  - +1.00-1.00 x 090 20/20
    - NRA/PRA +2.00/-1.75
- Treatment:
  - No Rx at this time!
  - Why?

The case of the blinking girl

- 8 year old female
- Excessive blinking the past two months
- Doing well in school
- No trouble with reading or copying from the board
- Started medication for ADHD four months prior
- COVD checklist 4
- VA
- 20/20 @Dist
- 20/15 @ Near

The case of the blinking girl

- Stereo
  - 25 sec
- Cover test
  - Ortho @Dist
  - 6 exo @ Near
- EOM
  - Head movement in right and left gazes
  - Heavy blinking when crossing midline
- NPC
  - Break at 40 cm x 3
- Accommodative amplitudes
  - 6D OU

The case of the blinking girl

- Retinoscopy (Distance)
  - -0.50 OD, -0.25 OS
- MEM
  - +1.00 OU
- Trial frame
  - +0.75
- Vergence ranges (with rx)
  - BI @ Dist x/14/2
  - BO @Dist x/18/4
  - BI @ Near x/24/8
  - BO @Near x/30/8

The case of the blinking girl

- Phoria in phoropter
  - Ortho @ Dist
  - 4 exo @Near
- NPC with Rx
  - 8cm break/18 cm recovery
- King-Devick with Rx
  - Part I-20.4 sec
  - Part II-23.7 sec
  - Part III-37 sec
- Treatment
  - Full time +0.75, return in 5-6 weeks for check

The case of the blinking girl

- Two month follow up
- VA
  - 20/20 OD, OS, OU @ Dist
  - 20/15 OD, OS, OU @ Near
- Stereo: 20 sec
- CT: Ortho/ 5 exo
- NPC:TTN X 3
- COVD checklist:13
- Vergence ranges
  - BI @ Near x/16/12
  - BO @Near x/18/6

If it is broken, it stays broken!

- 16 year old male complains of blur at distance and near in both eyes.
  - After near work and has trouble reading board after
- History from previous year!
  - 15 year old male complains of mild blur at near.
  - He sees double but he can make himself see single by moving his eyes if you ask him
  - The duration is 1 year
  - The timing is mostly at near

If it is broken, it stays broken!

Test	2015	2014
VA Distance	20/25, 20/25, 20/25+	20/25, 20/25, 20/25
VA Near	20/50, 20/50, 20/30	20/20, 20/20, 20/20
CT	Ortho, 4 XP	Ortho, 6XP
Accommodate Amps	6/6 D	7/7 D
NPC	7/10, 7/10, 8/10	7/10, 7/11, 9/12
COVD	40	23
Stereo	40 sec	Not done
Binocular Balance	+0.25-0.50 X 090 +0.25	-0.50-0.25 X 090 +0.25-0.50 X 090
NRA/PRA	+1.25/-0.75	+2.00/-1.50
FCC	+0.25	+0.25
Vergences at near	BI 16-25-18, BO x-15-6	BI 18-26-20, BO x-18-8

Amblyopia is a binocular condition!

- 15 year old teen
- Complaints of decreased vision OS for many years
- 1st glasses at 9 year old-we have not seen him since!
- Grades-A, B, C's
- COVD checklist-4
- Visual Acuity
  - Distance: 20/15, 20/100, 20/15
  - Near: 20/40, 20/200, 20/15

Acuity is good, but what about binocularity?

- Stereopsis
  - 50 sec of arc on Wirt circles
  - No global forms
- Retinoscopy/Binocular Balance
  - +0.50
  - +5.00-1.00 X 180 20/25 at distance and near
- But… Stereopsis does not change!
- Worth 4 Dot-four dots in bright and dim illumination

Amblyopia is a binocular condition!

- Plan of attack
- Fit with contact lenses
  - Reduces the image size and improves comfort
- Start vision therapy
  - Improve monocular accommodation and eye movements
  - Break suppression
  - Improve binocular accommodation and eye movements
  - Improve vergence skills
- No patching needed!

When is the right time to prescribe?

	4 years old	5 years old	6 years old	8 years old
Visual Acuity (D)	25/40/40	40/40/30	25/25/20	25/25/20
Visual Acuity (N)	100/60/60	30/30/30	25/20/20	30/30/30
Stereo	50 sec, + forms	100 sec, + forms	40 sec, + forms	40 sec, + forms
CT	6 XP, 10 XP	ortho, 4 XP	ortho, 4 XP	ortho, 1 XP
NPC	8/10 X 3	Hirshberg +	TTN X 3	TTN X 3
Retinoscopy	+4.00-1.00 X 180 +2.50	+3.50-2.00 X 150 +2.50-0.75 X 020	+4.00-1.50 X 160 +2.75-0.75 X 010 (Cyclo +.25 more OS)	+4.00-1.00 X 180 +3.00-1.00 X 180 BB +3.00-1.00 X 180 +3.00-1.00 X 180 20/15 @ D 20/25 @ N
Treatment	No RX	No RX	No RX-6m	RX, full time

To Rx or not to Rx, that is the question!

- 4 year old-failed school vision screening
- VA: 20/30 OD, OS, OU at distance and near
- Stereo: 30 sec
- NPC: 2/4 X 3
- Amps: 12 OD, OS
- Retinoscopy: +2.25-1.00 X 015, +2.25-1.00 X 160
- Cyclo Ret: +3.00-1.50 X 010, +2.75-1.50 X 160
- Retinoscopy: +1.50-1.00 X 015, +1.25-1.00 X 160
- VA with any rx combo
  - 20/30, OD, OS, OU
- What would you do?

To Rx or not to Rx, that is the question!

- 7 months later!
- Mom is not sure if glasses are helping
- Child is wearing them!
- VA with and without RX:
- 20/25 OD, OS, OU @ D and N
- Stereo with and without RX : 50 sec
- CT: Ortho @ D and N

- What would you do?

To Rx or not to Rx, that is the question!

- 5 year old-failed school vision screening
- VA: 20/50 OD, OS, OU at distance and near
- Stereo: not understood
- NPC: not understood
- Amps: not understood
- Retinoscopy: +1.50-1.50 X 180, +1.50-1.00 X 180
- Final Rx: +1.00-1.50 X 180, +1.00-1.00 X 180
- VA with any rx combo
  - 20/20, OD, OS, OU @ D and N
- What would you do?

Thank you!

mtaub@sco.edu