OVERVIEW OF TODAY'S LECTURE:
- BV/Accommodation Evaluation & Testing
  - Motor Alignment & Interaction Testing
  - Vergence Testing
  - Accommodation Testing
  - Expected Findings
- Diagnostic Data Groups

BV/Accommodation Evaluation

General Information:
- Must have accurate and balanced refraction
- Measurement of phoria at distance and near
- AC/A & CA/C
- PFV & NFV
  - Direct vs. Indirect Testing
- Convergence Amplitude (NPC)
- Sensory Status
- Accommodation

General Information:
- Testing out of the phoropter:
  - Whenever suspect BV/Accommodation problem
  - For fidgety or small children
  - Easier patient instructions
  - Qualitative assessment
  - OBJECTIVE

Vergence Defined:
- A disjunctive rotational movement of the eyes so that points of reference on the eyes move in opposite directions (as in convergence and divergence).

Types of Vergence:
- Reflex:
  - Tonic: caused by tonus in EOMs in awake individual; decreases with age.
  - Proximal: induced by an awareness of the nearness of an object.
  - Accommodative: convergence elicited upon accommodation.
  - Fusional: vergence that makes adjustment to gain single, binocular vision.
- Voluntary:
  - Ability to converge without a near stimulus.
**BV/Accommodation Evaluation**

- **Positive Fusional Vergence (PFV):**
  - Tested with ______ prism or binocular ______ lenses

- **Negative Fusional Vergence (NFV):**
  - Tested with ______ prism or binocular ______ lenses

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**Accommodation Defined:**

- The increase in optical power by the eye to maintain a clear image as objects are moved closer. Occurs through a process of ciliary muscle contraction and zonular relaxation, causing the elastic-like lens to "round up" and increase its optical power.
- Primary stimulus is blur.

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**Motor Alignment & Interaction Testing**

- Cover Test
- Dissociated Phoria
- Fixation Disparity
- AC/A & CA/C

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**Cover Test**

- **Objective** measure of phoria
  - Distance phoria is a reflection of tonic vergence
  - Near phoria is based on AC/A ratio
- Controlling accommodation
  - Multiple targets
  - Moving the target
Dissociated Phoria

- vonGraefe (in phoropter)
  - Subjective measure of phoria
  - Controlling accommodation
  - Problems
    - Young children
    - Least repeatable phoria measurement
- Maddox rod/Modified Thorington
  - In or out of phoropter
  - Repeatable results

Maddox Rod Diagrams:
Uncrossed diplopia (Eso)       Crossed diplopia (Exo)

Fixation Disparity

- Evaluates BV under associated conditions.
- Measures vergence error under binocular conditions.
- Useful in determining prism correction.
- Wesson card, vectographic slide, Wolfe card, Mallet unit, Sheedy disparometer, etc.
- More to come in future lecture.

AC/A Ratio

- Determines the change in accommodative convergence that occurs when a person accommodates or relaxes accommodation by a given amount.
- Clinical significance in both diagnosis and management of BV disorders.
- More to come in future lecture.

CA/C Ratio

- Determines the change in accommodation that occurs when the patient converges or relaxes convergence a given amount.
- Not commonly assessed in clinic.
Vergence Evaluation
- Direct Tests:
  - Smooth vergence
  - Step vergence
  - Vergence facility
- Indirect Tests:
  - NPC
  - NRA/PRA
  - Binocular accommodative facility
  - MEM/FCC

Smooth Vergence
- Assesses fusional vergence amplitude & recovery at distance and near.
- Direct measure of fusional vergence.
- Performed in the phoropter.
- Subjective test.
- Accommodation maintained at one distance.
- Patient must use PFV or NFV to maintain fusion.
  - Concerned/compensating vergence for XP vs. EP
- Smooth vs. step vergence.

Step Vergence
- Evaluating fusional vergence amplitude & recovery outside the phoropter (in free-space).
- Direct measure of fusional vergence.
- Use prism bar.
- Subjective and/or *Objective.

Vergence Facility
- Assesses the dynamics of the fusional vergence system and the ability to respond over a period of time.
- Direct measure of fusional vergence dynamics.
- Usually subjective.
- Amplitude vs. facility.
- Strength of prism (3 BI / 12 BO).

Near Point of Convergence (NPC)
- Assesses the convergence amplitude.
- Indirect measure of PFV.
  - Uses:
  - Target.
  - Repetition.
  - Subjective and/or Objective.
NRA / PRA
- Part of the near point evaluation of accommodation and binocular vision.
- Indirect vergence measure.
  - Accommodation and vergence are integrated
- Subjective.
- Adds, over-minus, end-point for PRA...
- NRA: indirect measure of PFV or NFV?
- PRA: indirect measure of PFV or NFV?

Binocular Accommodative Facility (BAF)
- Assesses the interaction between accommodation and vergence.
- Indirect measure of vergence.
- Need suppression checks.
- Subjective.
- Minus lenses → PFV or NFV?
  - Similar to NRA or PRA?
- Plus lenses → PFV or NFV?
  - Similar to NRA or PRA?

MEM / FCC
- Measures accommodative accuracy.
- Indirectly assesses fusional vergence.
  - Examples of Exo vs. Eso
- MEM is Objective.
- Lead vs. lag of accommodation.
- FCC is Subjective.
  - Difficult with children.
  - Not as repeatable as MEM.

Accommodation Evaluation
- Accommodative Amplitude
  - Push-up / Pull-away
  - Minus lenses
- Accommodative Facility
  - Binocular
  - Monocular
- Accommodative Accuracy
  - MEM / FCC

Accommodative Amplitude (AA)
- Measures the amplitude of accommodation under monocular conditions.
- Subjective.
- Norms:
  - Average AA: 18.5 – (1/3)age [18 – (1/3)age]
  - *Minimum AA: 15 – (1/4)age
- Push-up vs. Pull-away:
  - Target & relative magnification.
- Minus lens amplitude:
  - Target minification.

**Accommodative Facility**
- Evaluates the stamina and dynamics of the accommodative response.
- Subjective.
- Monocular (MAF) vs. Binocular (BAF).
  - Which should be performed first?
- Suppression checks on BAF.

**MEM / FCC**
- Discussed in earlier slide.

**BV/Accom Test Norms**
- Tables of Expecteds: (at the end of this handout)
  - Very important to know
  - Table 1.2 S&W BV norms
  - Table 1.4 S&W Accommodative norms

**Case Analysis**
- Analysis Approaches:
  - Graphical Analysis
  - OEP Analytical Analysis System
  - Morgan’s System of Normative Analysis
  - Fixation Disparity Analysis
  - Integrative Analysis Approach

**Graphical Analysis**
- You learned this last semester.
- Allows visualization of findings.
- Good teaching, learning tool.
- Leaves out key BV/Accom tests (facility, FD, MEM) and thus can fail to identify some problems.

**OEP Analytical Analysis System**
- OEP = Optometric Extension Program
- 21 point exam
- Check-chain-typing
  - Compare (to expected values) – Group data – Identify condition
- Not used much in current practice
- OEP uses different “language” than classic optometric language.
Morgan’s Normative Analysis
- Uses idea of evaluating groups of data
- Compare findings to Morgan's norms
- Look for trends in data
- Has not been updated to include newer testing (facility, FD, MEM)

Fixation Disparity Analysis
- We’ll discuss more next week.
- Data is gathered under binocular conditions.
- Most often utilized if other data is not conclusive of a problem and/or for determining treatment (prism, added lenses).

Integrative Analysis Approach
- Attempts to integrate the most positive aspects of the other approaches.
- Groups related optometric data.
- The OD must be knowledgeable of:
  - Expected findings
  - The relationship of one finding to another
  - Duane’s classification system

Integrative Analysis Approach
- Optometric Data Groups:
  - Positive Fusional Vergence Group
  - Negative Fusional Vergence Group
  - Accommodative System Group
  - Ocular Motor System Group
  - Vertical Fusional Vergence Group
  - Motor Alignment & Interaction Group

Positive Fusional Vergence Group
- PFV – Smooth vergence
- PFV – Step vergence
- PFV – Vergence facility
- NPC
- NRA
- BAF (+)
- MEM

Negative Fusional Vergence Group
- NFV – Smooth vergence
- NFV – Step vergence
- NFV – Vergence facility
- PRA
- BAF (-)
- MEM
Accommodative System Group
- Monocular AA
- Binocular AA
- MAF
- BAF
- MEM
- NRA/PRA

Motor Alignment & Interaction Tests Group
- Distance CT
- Near CT
- Dissociate phoria at distance
- Dissociated phoria at near
- Fixation disparity
- AC/A ratio
- CA/C ratio
Table 1.2: Scheiman and Wick, 3rd edition
Table 1.4: Scheiman and Wick, 4th edition (textbook has error for NPC values)

<table>
<thead>
<tr>
<th>Test</th>
<th>Expected Finding</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td>1 exophoria</td>
<td>±2 Δ</td>
</tr>
<tr>
<td>Near</td>
<td>3 exophoria</td>
<td>±3 Δ</td>
</tr>
<tr>
<td>Distance lateral phoria</td>
<td>1 exophoria</td>
<td>±2 Δ</td>
</tr>
<tr>
<td>Near lateral phoria</td>
<td>3 exophoria</td>
<td>±3 Δ</td>
</tr>
<tr>
<td>AC/A ratio</td>
<td>4.1</td>
<td>±2 Δ</td>
</tr>
</tbody>
</table>

**Smooth vergence testing**

<table>
<thead>
<tr>
<th>Test</th>
<th>Expected Finding</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base-out (distance)</td>
<td>Blur: 9</td>
<td>±4</td>
</tr>
<tr>
<td></td>
<td>Break: 19</td>
<td>±8</td>
</tr>
<tr>
<td></td>
<td>Recovery: 10</td>
<td>±4</td>
</tr>
<tr>
<td>Base-in (distance)</td>
<td>Break: 7</td>
<td>±3</td>
</tr>
<tr>
<td></td>
<td>Recovery: 4</td>
<td>±2</td>
</tr>
<tr>
<td>Base-out (near)</td>
<td>Blur: 17</td>
<td>±5</td>
</tr>
<tr>
<td></td>
<td>Break: 21</td>
<td>±6</td>
</tr>
<tr>
<td></td>
<td>Recovery: 11</td>
<td>±7</td>
</tr>
<tr>
<td>Base-in (near)</td>
<td>Blur: 13</td>
<td>±4</td>
</tr>
<tr>
<td></td>
<td>Break: 21</td>
<td>±4</td>
</tr>
<tr>
<td></td>
<td>Recovery: 13</td>
<td>±5</td>
</tr>
</tbody>
</table>

**Step vergence testing**

*Children 7–12 yr old*

<table>
<thead>
<tr>
<th>Test</th>
<th>Expected Finding</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base-out (near)</td>
<td>Break: 23</td>
<td>±8</td>
</tr>
<tr>
<td></td>
<td>Recovery: 16</td>
<td>±6</td>
</tr>
<tr>
<td>Base-in (near)</td>
<td>Break: 12</td>
<td>±5</td>
</tr>
<tr>
<td></td>
<td>Recovery: 7</td>
<td>±4</td>
</tr>
</tbody>
</table>

*Adults*

<table>
<thead>
<tr>
<th>Test</th>
<th>Expected Finding</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base-out (distance)</td>
<td>Break: 11</td>
<td>±7</td>
</tr>
<tr>
<td></td>
<td>Recovery: 7</td>
<td>±2</td>
</tr>
<tr>
<td>Base-in (distance)</td>
<td>Break: 7</td>
<td>±3</td>
</tr>
<tr>
<td></td>
<td>Recovery: 4</td>
<td>±2</td>
</tr>
<tr>
<td>Base-out (near)</td>
<td>Break: 19</td>
<td>±9</td>
</tr>
<tr>
<td></td>
<td>Recovery: 14</td>
<td>±7</td>
</tr>
<tr>
<td>Base-in (near)</td>
<td>Break: 13</td>
<td>±6</td>
</tr>
<tr>
<td></td>
<td>Recovery: 10</td>
<td>±5</td>
</tr>
</tbody>
</table>

**Vergence facility testing**

*(12 base-out/3 base-in)*

<table>
<thead>
<tr>
<th>Test</th>
<th>Expected Finding</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15.0 cpm</td>
<td>±3</td>
</tr>
</tbody>
</table>

**Near point of convergence**

<table>
<thead>
<tr>
<th>Test</th>
<th>Expected Finding</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodative target</td>
<td>Break: 5 cm</td>
<td>±2.5</td>
</tr>
<tr>
<td></td>
<td>Recovery: 7 cm</td>
<td>±3.0</td>
</tr>
<tr>
<td>Penlight and red/green glasses</td>
<td>Break: 7 cm</td>
<td>±4.0</td>
</tr>
<tr>
<td></td>
<td>Recovery: 10 cm</td>
<td>±5.0</td>
</tr>
</tbody>
</table>
Table 1.4: Scheiman and Wick; 3rd edition
Table 1.6: Scheiman and Wick, 4th edition

### Table 1.4
Table of Expected Values: Accommodative Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Expected Finding</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amplitude of accommodation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push-up test</td>
<td>18 - 1/3 age</td>
<td>±2 D</td>
</tr>
<tr>
<td>Minus lens test</td>
<td>2 D &lt; push-up</td>
<td></td>
</tr>
<tr>
<td><strong>Monocular accommodative facility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(±2.00 flippers, calling out numbers or letters on Accommodative Rock Cards)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 yr old</td>
<td>5.5 cpm</td>
<td>±2.5 cpm</td>
</tr>
<tr>
<td>7 yr old</td>
<td>6.5 cpm</td>
<td>±2.0 cpm</td>
</tr>
<tr>
<td>8–12 yr old</td>
<td>7.0 cpm</td>
<td>±2.5 cpm</td>
</tr>
<tr>
<td>Adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(±2.00 flipper lenses, saying now when clear)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13–30 yr old</td>
<td>11.0 cpm</td>
<td>±5.0 cpm</td>
</tr>
<tr>
<td>30–40 yr old</td>
<td>Not available</td>
<td></td>
</tr>
<tr>
<td><strong>Binocular accommodative facility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(±2.00 flippers, calling out numbers or letters on Accommodative Rock Cards)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 yr old</td>
<td>3.0 cpm</td>
<td>±2.5 cpm</td>
</tr>
<tr>
<td>7 yr old</td>
<td>3.5 cpm</td>
<td>±2.5 cpm</td>
</tr>
<tr>
<td>8–12 yr old</td>
<td>5.0 cpm</td>
<td>±2.5 cpm</td>
</tr>
<tr>
<td>Adults (Use lens power based on amplitude scaled testing—refer to Table 1.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocular estimation method retinoscopy</td>
<td>+0.50 D</td>
<td>±0.25 D</td>
</tr>
<tr>
<td>Fused cross-cylinder</td>
<td>+0.50 D</td>
<td>±0.50 D</td>
</tr>
<tr>
<td>Negative relative accommodation</td>
<td>+2.00 D</td>
<td>±0.50 D</td>
</tr>
<tr>
<td>Positive relative accommodation</td>
<td>−2.37 D</td>
<td>±1.00 D</td>
</tr>
</tbody>
</table>