

## Outline:

### Fixation Disparity I Definitions & Purpose

Retinal slip

Micro Strabismus

Closed-loop error

Prevents decay of vergence

### II. Sign Convention

### III. Measurement with Nonius lines

### III. Factors influencing magnitude of FD

Phoria

Prism

Lenses and Accommodative vergence

### IV. Provable test- Forced duction FD curve

Prisms induced

Associated phoria

slope

relation to prism adaptation

Lens induced

√. V. Relation to AC/A ratio

√I. VI. Vertical Fixation Disparity

## Four Maddox Components of Convergence

Tonic

Proximal

Fusional

Accommodative

Fusional vergence component is a **buffer** that takes up the slack left by the other four components.

The “slack” or residual error of the sum of tonic, proximal and accommodative vergence is measured as the phoria.

Stress is assumed to be related to the amount of fusional vergence effort under binocular viewing conditions.

Prism adaptation reduces the demand on fusional vergence by increasing tonic vergence under binocular viewing conditions.

## **Shortfall of the Maddox classification in the classical case analysis:**

**The Maddox classification** assumes that the phoria, measured under monocular conditions, equals the residual error under binocular viewing conditions.

Maddox does not consider **prism adaptation**, that reduces the demand on fusional vergence under binocular viewing conditions.

Instead of assuming the dissociated phoria equals the demand on fusional vergence under binocular viewing conditions, why not measure the stress on fusional vergence directly under binocular viewing conditions?

How can we assess the demand under binocular viewing conditions?

Fixation disparity is a small error under binocular viewing conditions that is proportional to the demands on fusional vergence.

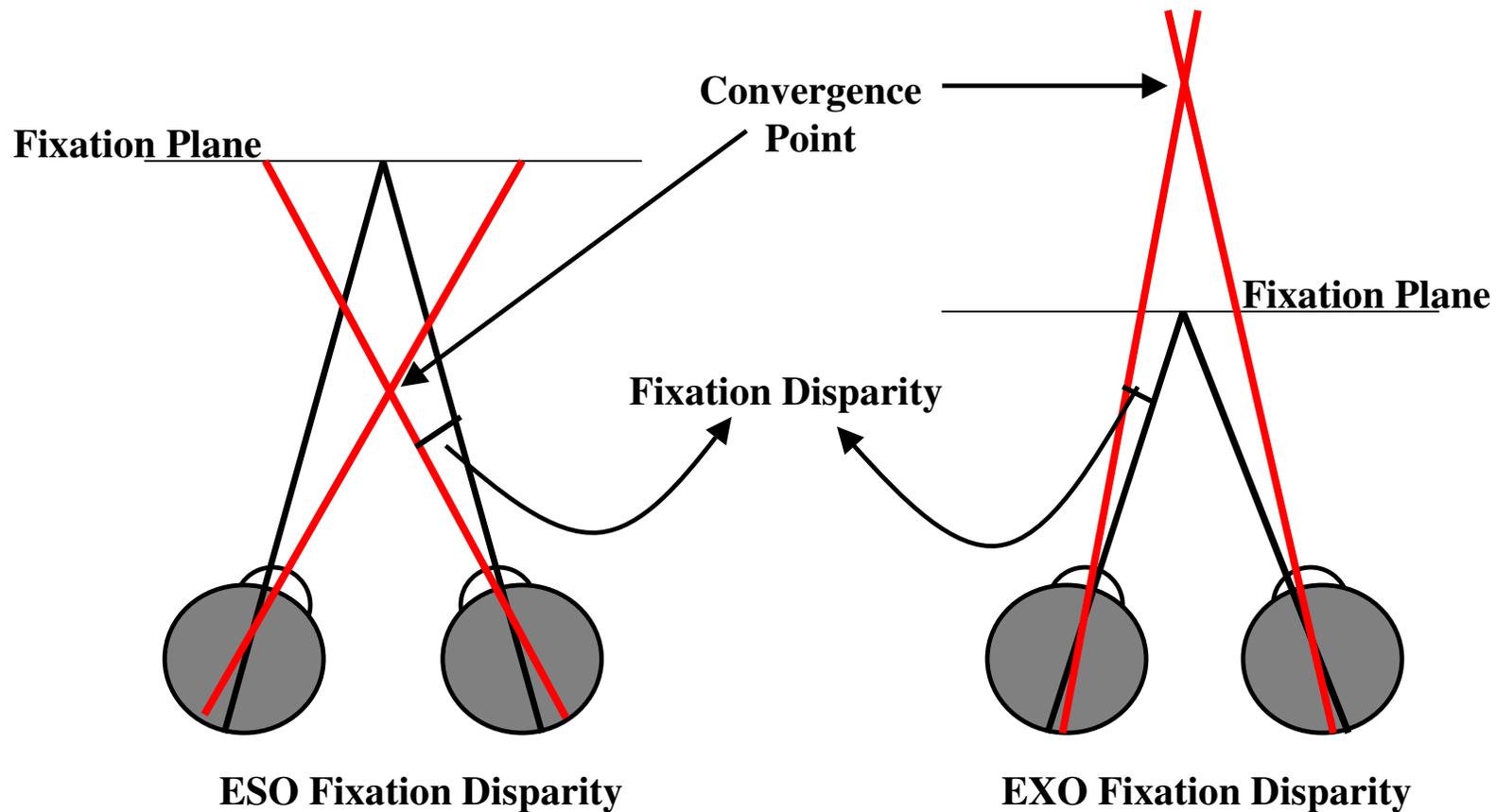
**Fixation Disparity is a steady-state error-** Room temperature thermostat analogy. Under binocular viewing conditions, it keeps the eyes from drifting back to their position of rest.

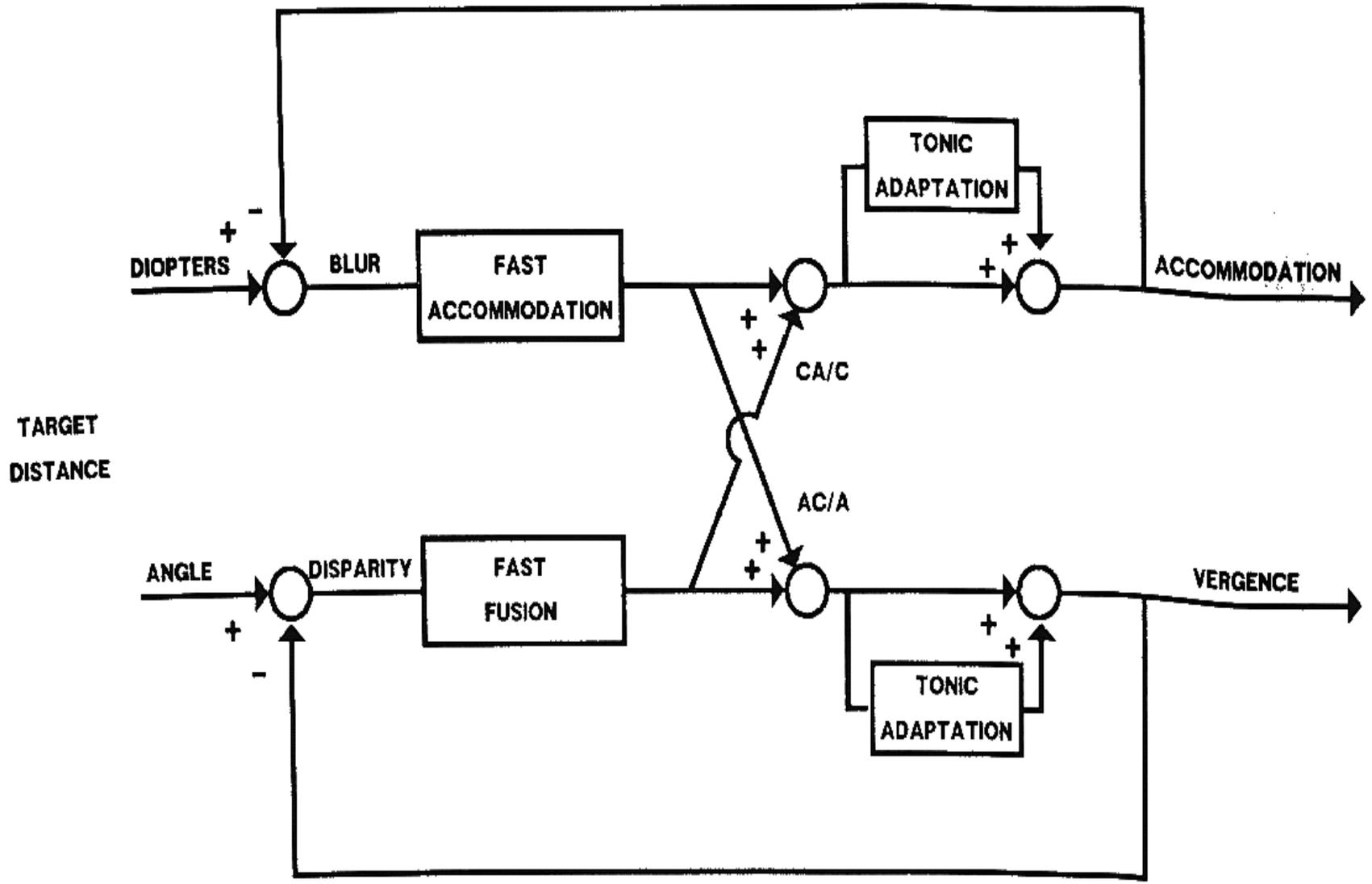
Fixation disparity *increases* when we fuse with the **phasic component of disparity vergence**. It is analogous to trying to heat a room with open windows.

Fixation disparity *decreases* when we fuse with **adaptable tonic vergence**. This is analogous to heating a room with sealed windows.

# Fixation Disparity - Definition

- Fixation disparity is the difference between the convergence angle under binocular viewing and the angle subtended by the target at the centers of rotation





**Fixation disparity:** A small error in convergence or eye alignment in the presence of feedback from disparity.

**Phoria** A vergence error without fusion (i.e. when one eye is occluded- i.e. open-loop or without feedback from disparity). AKA dissociated phoria

**Synonyms-**

Retinal slip

Micro- strabismus

## **Sign Convention:**

Eso (+) excessive convergence error

Exo (-) excessive divergence error

## **Units of measurement:**

Minutes of arc.

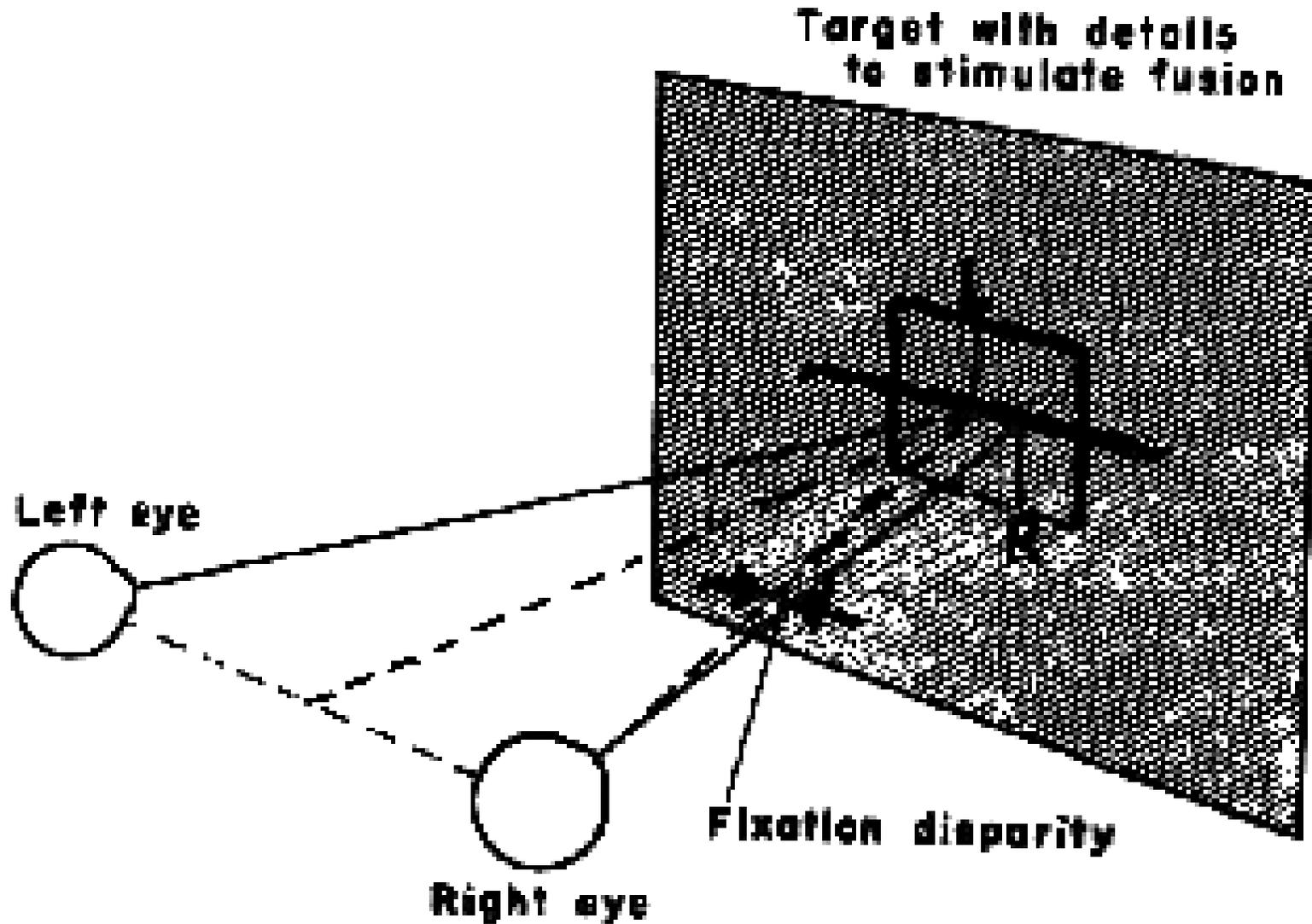
**Measurement tools using Nonius lines:** Nonius lines are a measure of Dichoptic Vernier Acuity

**Mallett Unit**- Measures the amount of prism needed to reduce fixation disparity to zero (**associated phoria**)

**Disparometer**- Measures the fixation disparity directly.

Demonstrations:

**Nonius lines** are adjusted to lie on each fovea and their offset indicates the small vergence error, i.e. Fixation Disparity



## **Factors that influence the magnitude of FD.**

- 1) **Phoria**      Eso FD increases with Eso phoria  
                     Exo FD doesn't increase with Exo phoria
  
- 1) **Prisms**      (Base-out  $\Delta$  reduces Eso and increases Exo)  
                     (Base-in  $\Delta$  reduces Exo and increases Eso)
  
- 2) **Lenses**      (Plus lenses reduce Eso and increases Exo)  
                     (Minus lenses reduce Exo and increase Eso)

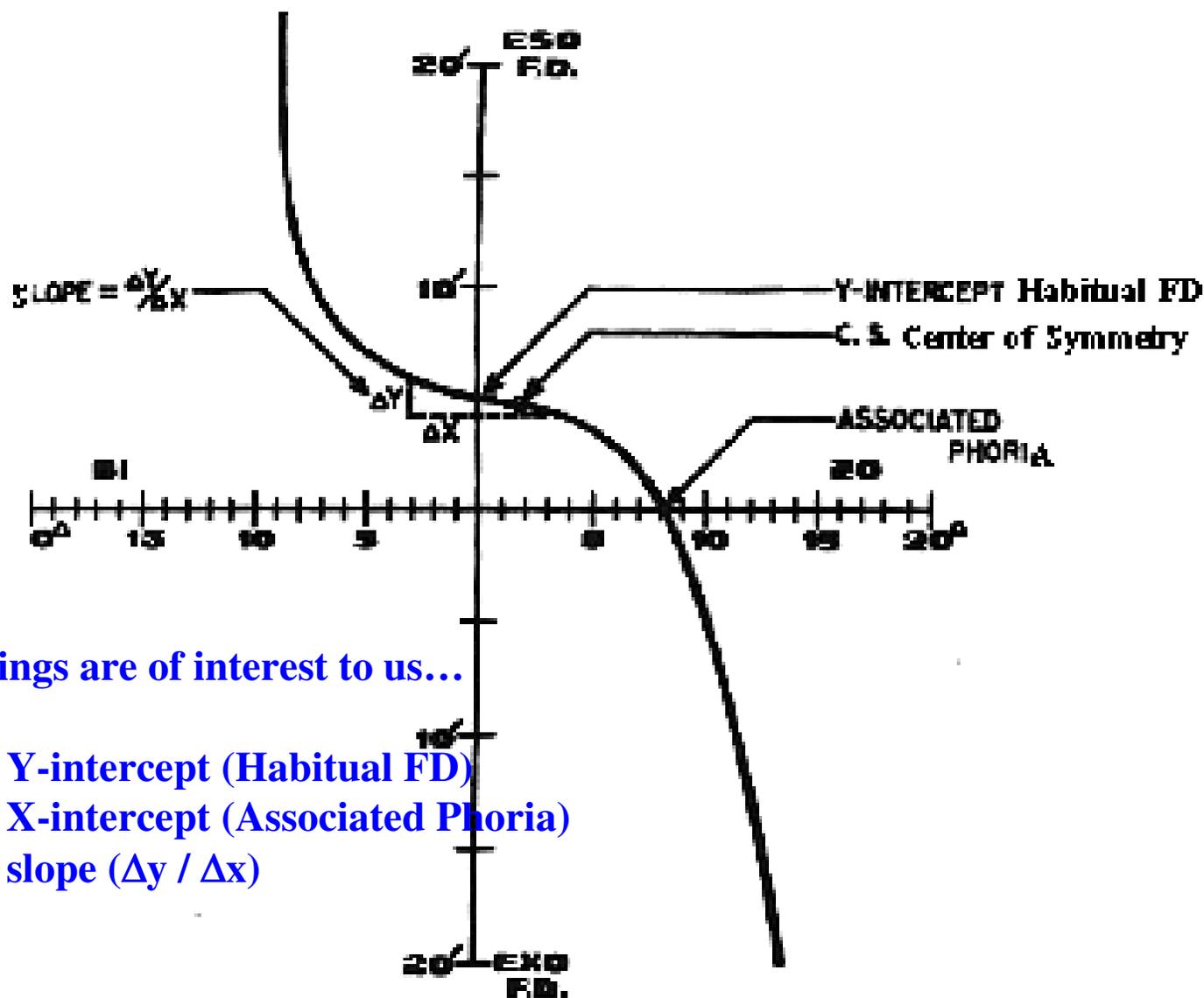
## **Forced Duction (prism induced) Fixation Disparity Curve:**

A provocative tests of prism adaptation.

Measure changes in fixation disparity with added prisms.

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# Phoria Status and Fixation Disparity



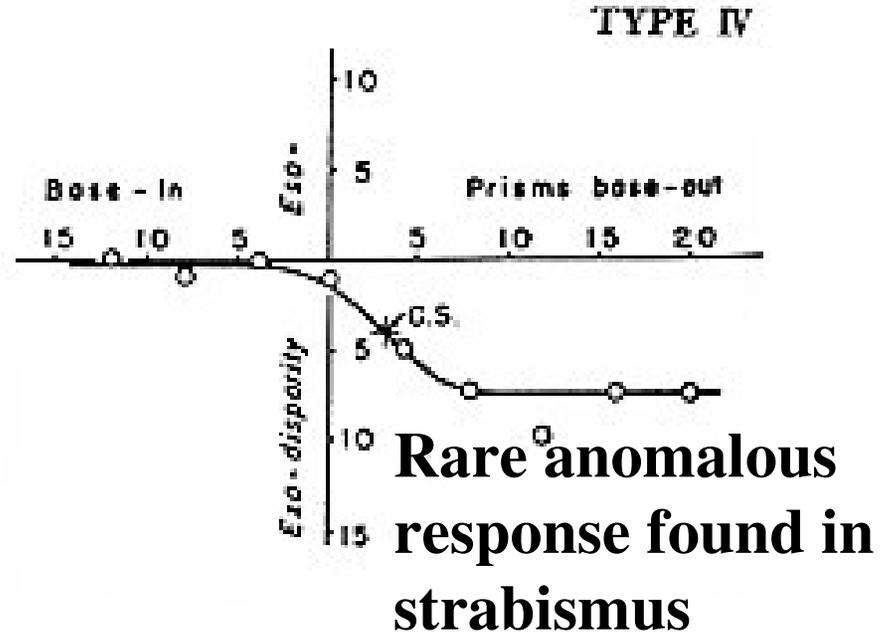
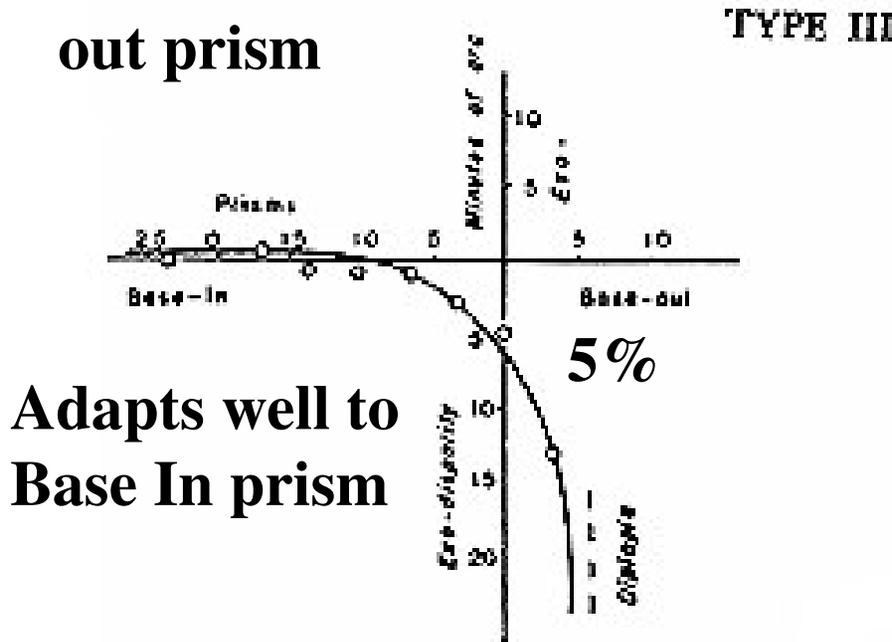
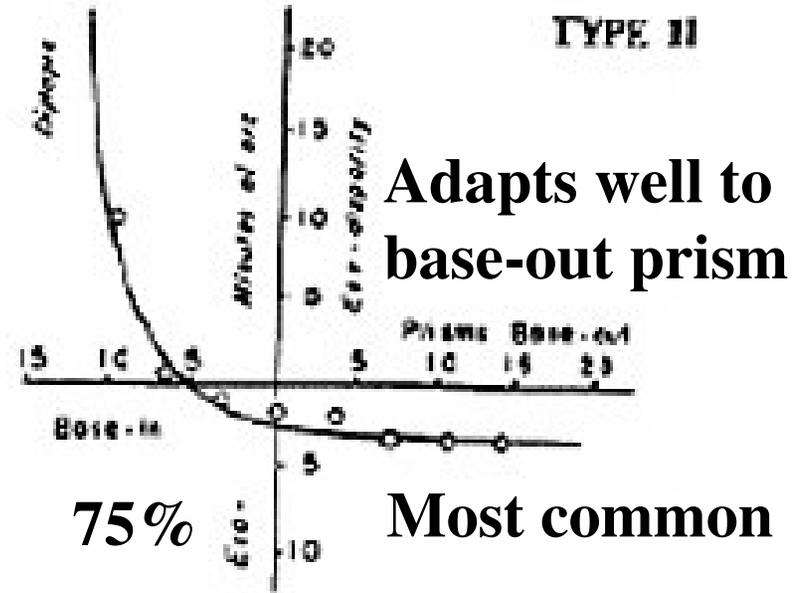
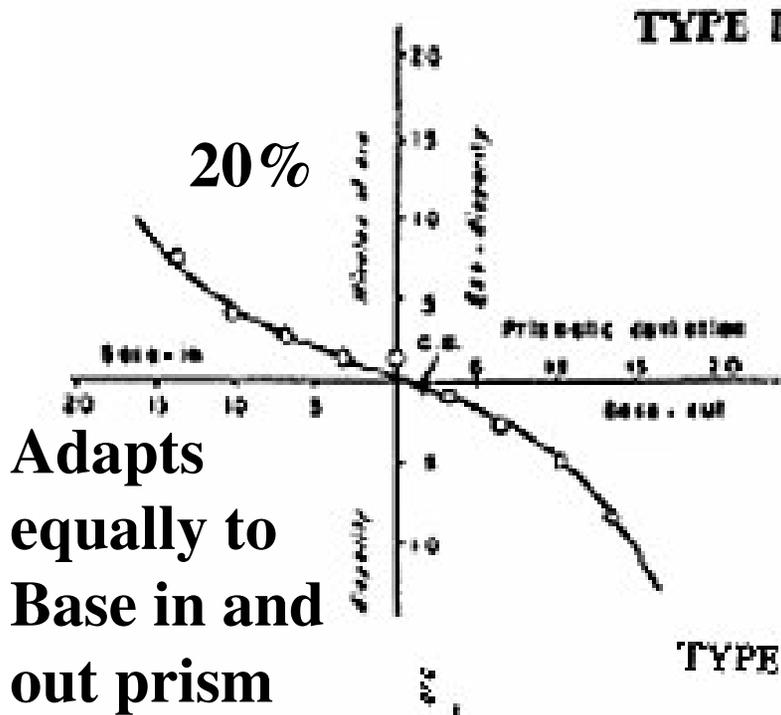
Three things are of interest to us...

1. The Y-intercept (Habitual FD)
2. The X-intercept (Associated Phoria)
3. The slope ( $\Delta y / \Delta x$ )

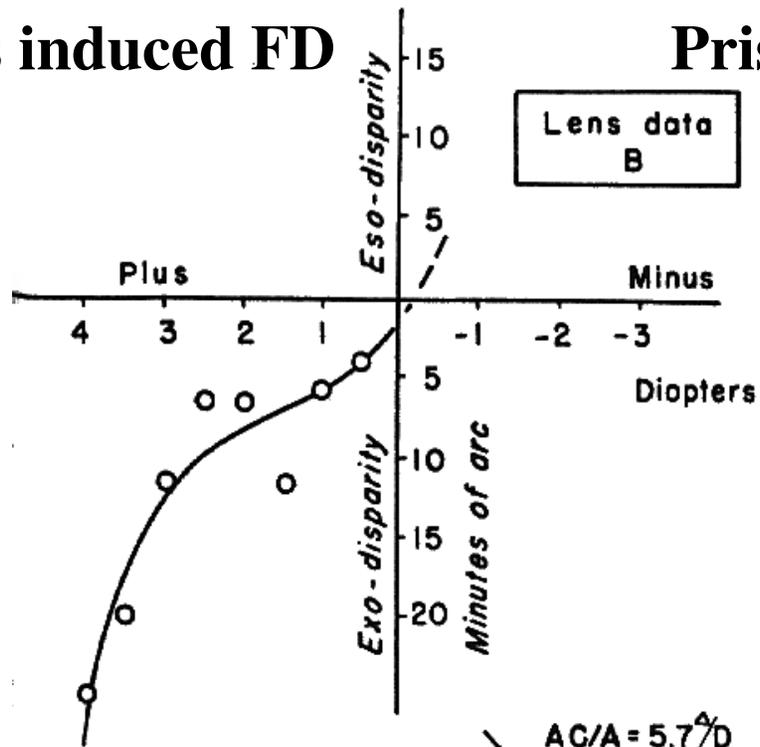
**Associated phoria-** the amount of prism that reduces fixation disparity to zero- good index of how much prism to prescribe.

**Dissociated phoria-** the amount of prism that reduces the phoria to zero under open-loop conditions. Standard clinical phoria measure.

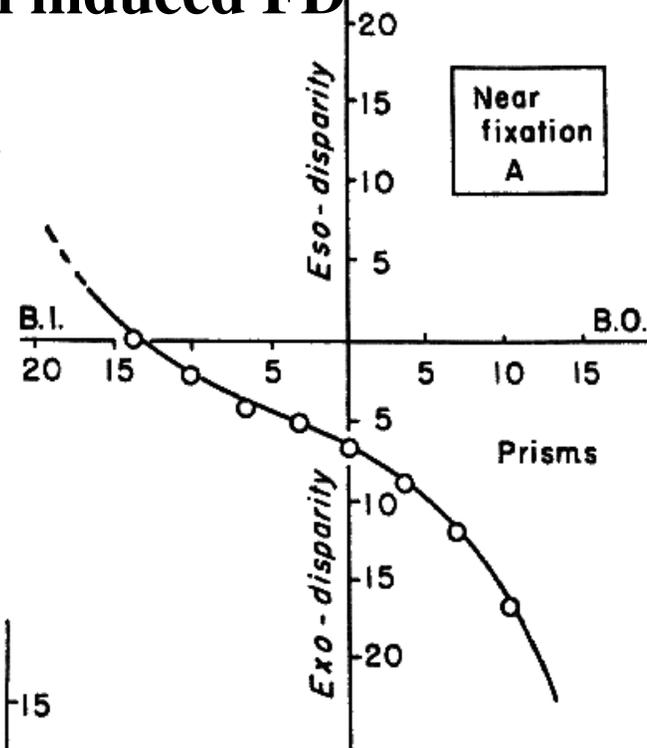
# Four categories of forced duction Fixation Disparity Curves



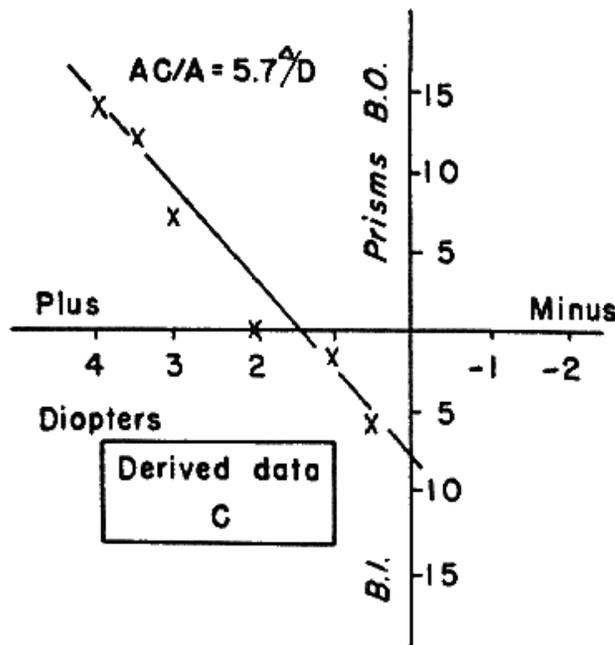
## Lens induced FD



## Prism induced FD

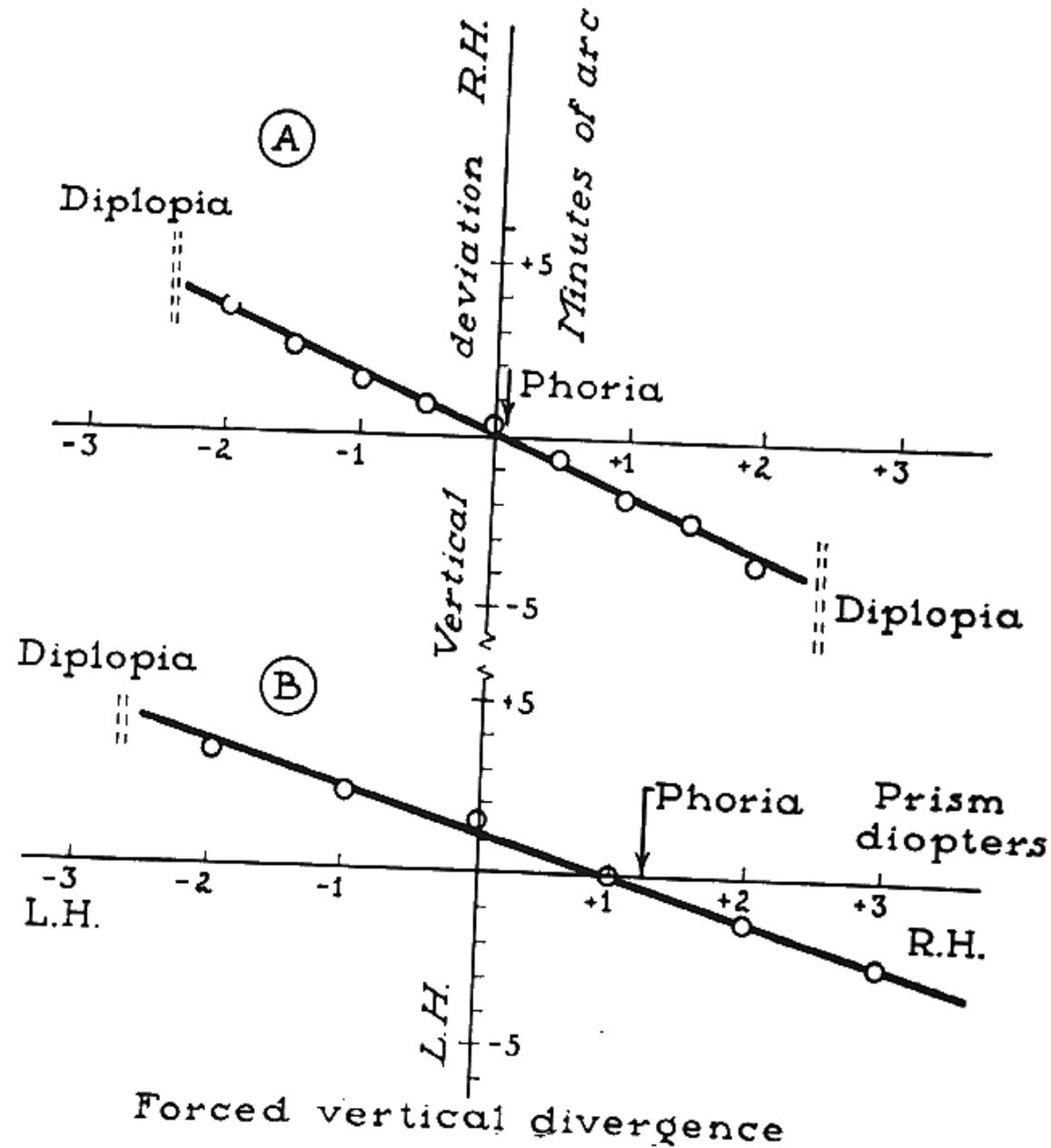


Estimate the AC/A under binocular conditions.



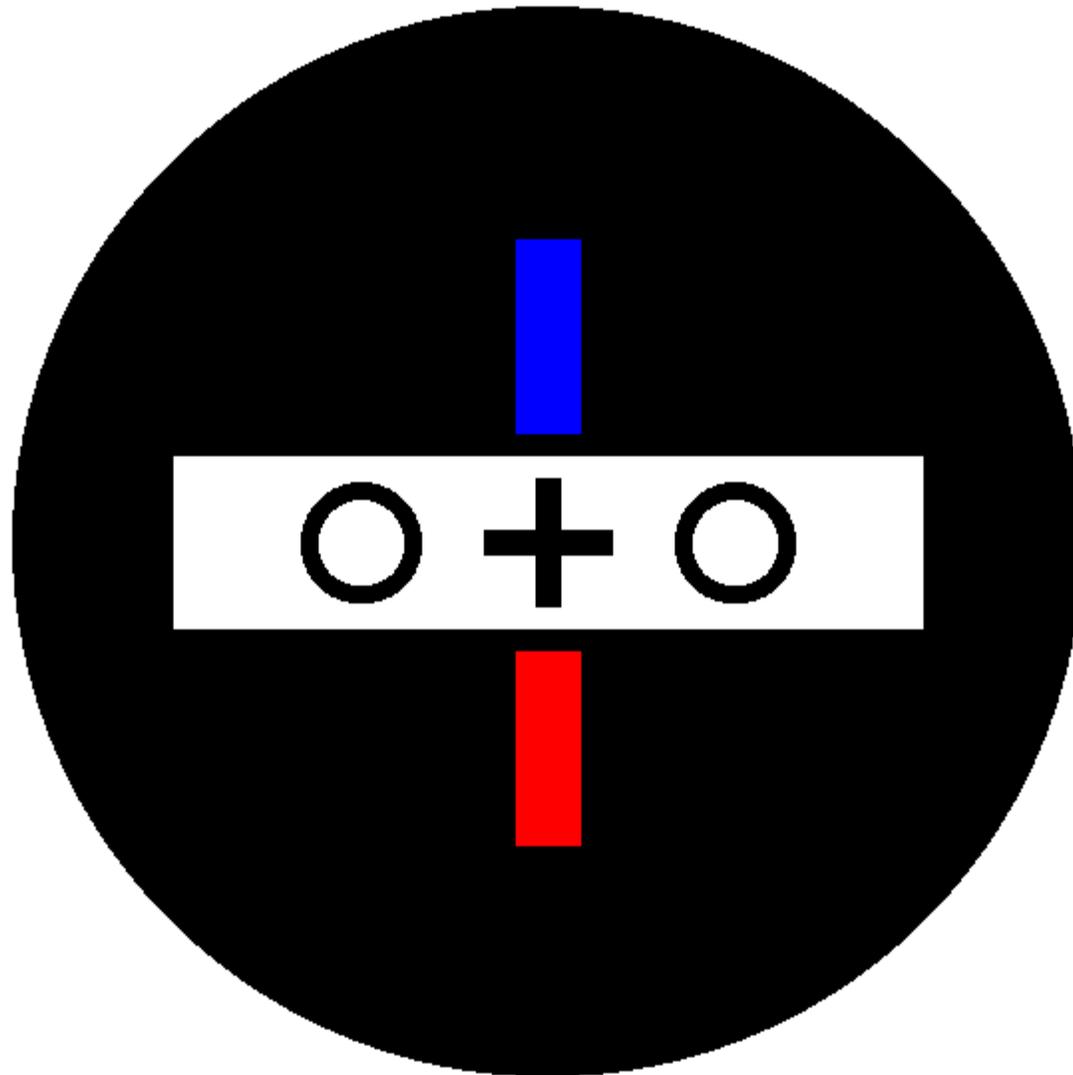
Plot lenses against prisms that produce the same fixation disparity

# Vertical Fixation Disparity induced with vertical prism



Could there be Cyclo vergence fixation disparity?

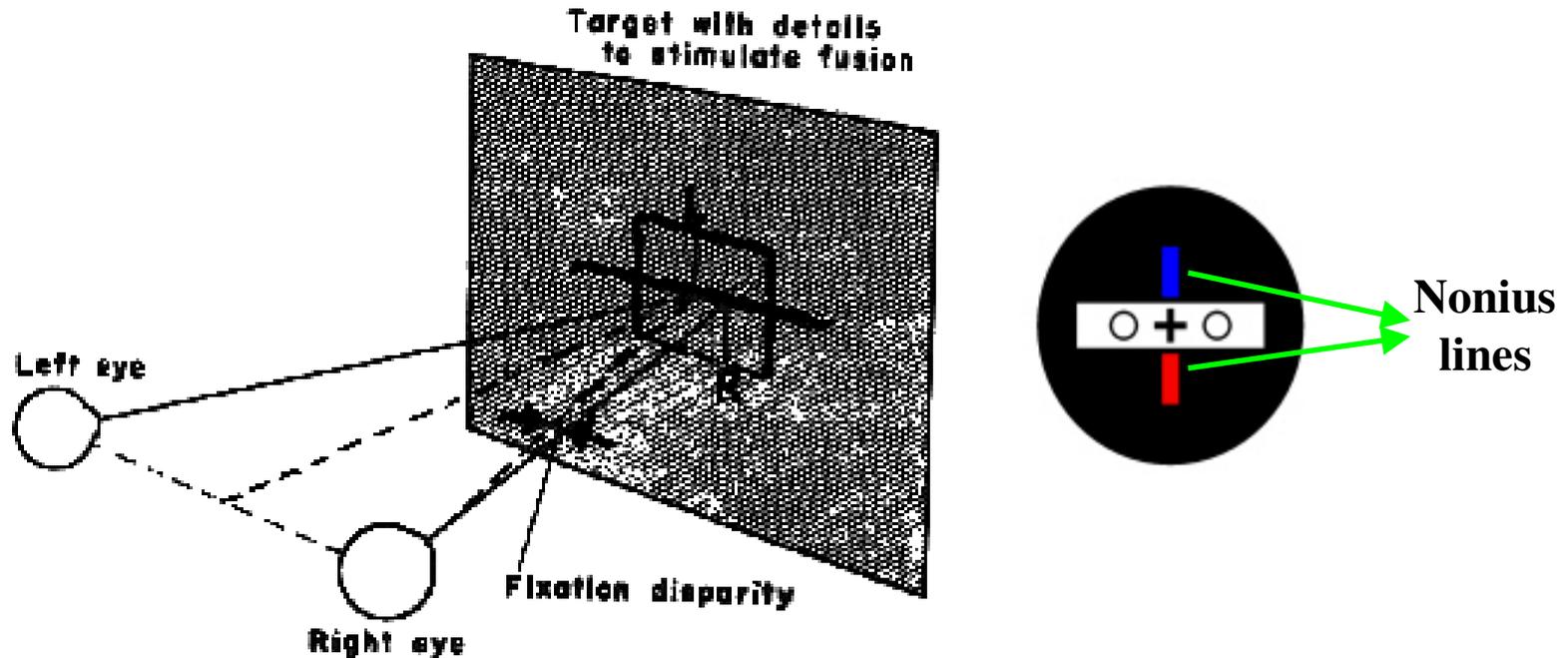
Yes, but its not measured clinically.







# Measuring Fixation Disparity



- Measured using Nonius lines
- View of right and left eyes' separated using red-green goggles or polaroid goggles
- Patient makes qualitative judgment about whether the upper line is to the right or to the left of the lower line
- The perceived location of the upper line is opposite to the deviation of the eye



# Measuring Fixation Disparity



**Demonstrate fixation  
disparometer**

**Demonstrate fixation  
disparity software**

**Mallett Unit**

# Prism induced fixation disparity curve

