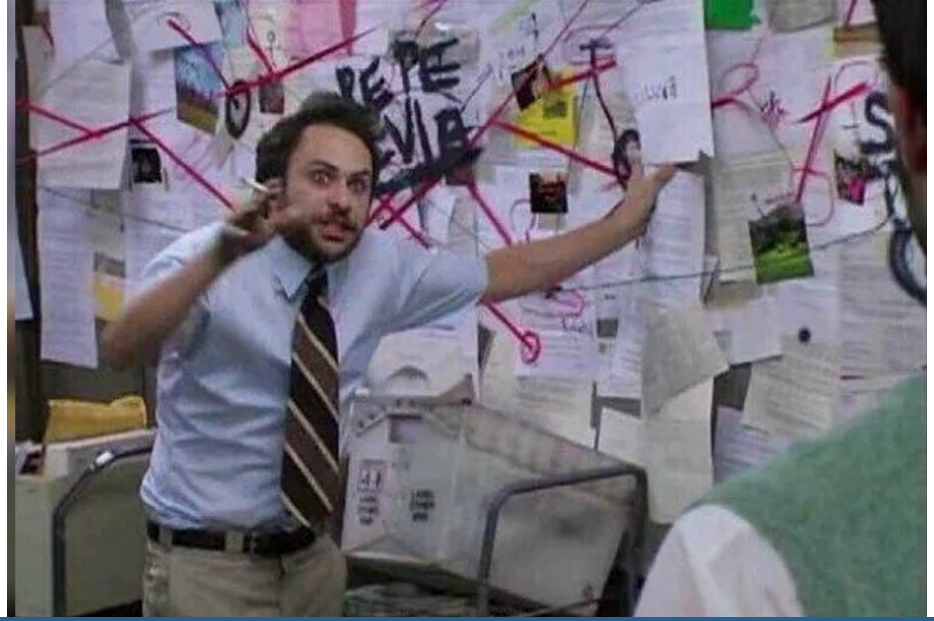


# How Glasses Can Mess Up a Perfectly Good Refraction

Charlie Saccarelli, ABOM

# Financial Disclosure

Charlie Saccarelli is an owner and the president of Chadwick Optical.
He potentially makes money when you buy stuff from Chadwick Optical.

Charlie's Car
2009 Nissan Versa

- I am an optician presenting information on ophthalmic optics.
- Ophthalmic Optics is like the “Little Tikes” version of the field of optics.
- To many of the things I say, a vision scientist or physics professor might interrupt and say “well technically that’s not entirely correct because blahhhhhhhhhhh”

# ONE MORE THING

- Email me at cbs@chadwickoptical.com, and I'm happy to share the entire presentation with you. Or text/What's App/whatever me at 267-374-5601

- If you have any weird questions you're embarrassed to ask in a public setting, don't be shy about hitting me up with them. The only stupid question is one that is never asked.
    - My kids and staff are super sick of hearing about glasses. Please call/text me.
- I'll have space for a couple questions at the end of each section.

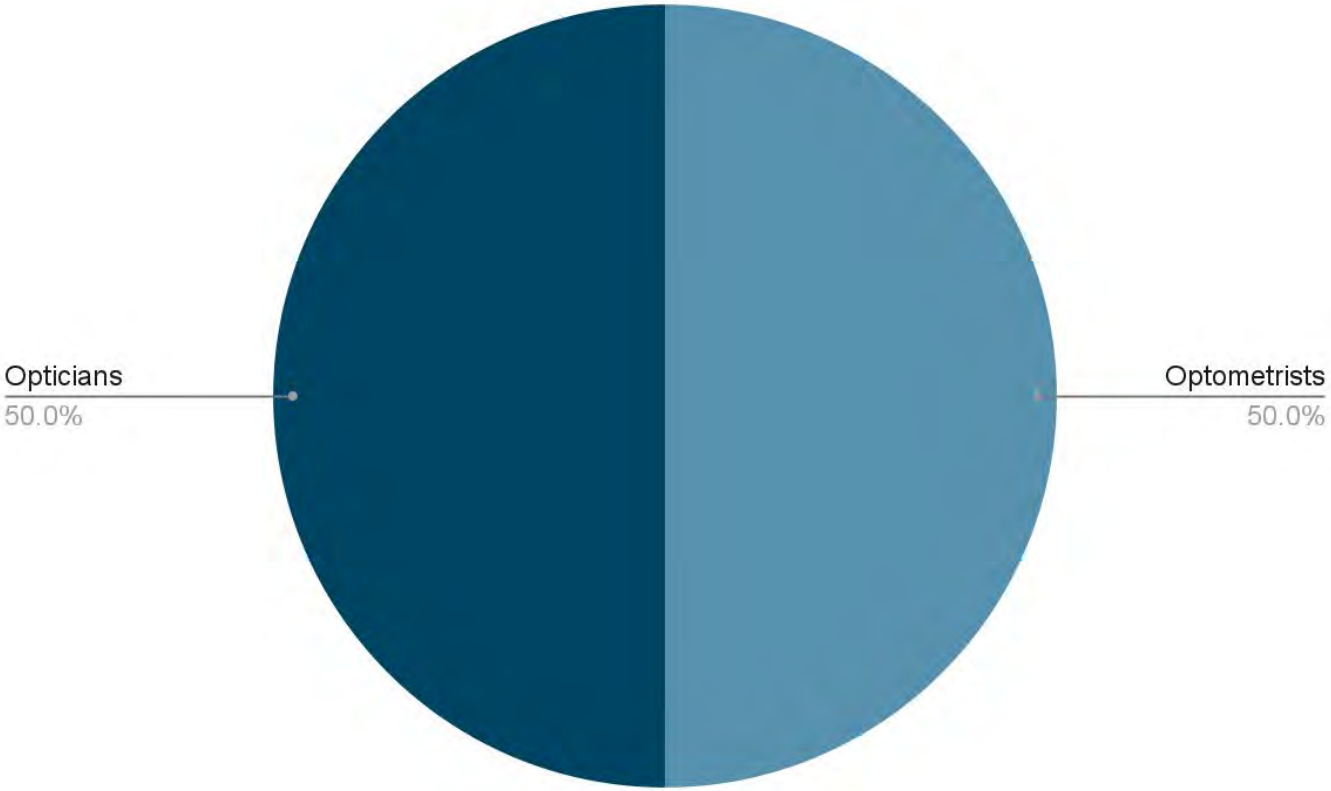
## Poll from live PECAA CE event with ODs and opticians

Q: Who is responsible for managing magnification and anisometropia in an RX?

- The Optician
- The Optometrist
- The Patient

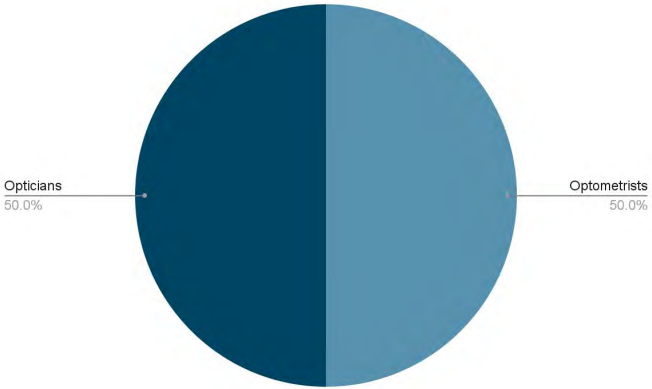
# Poll Results

Who is responsible for managing magnification and anisometropia in an RX?



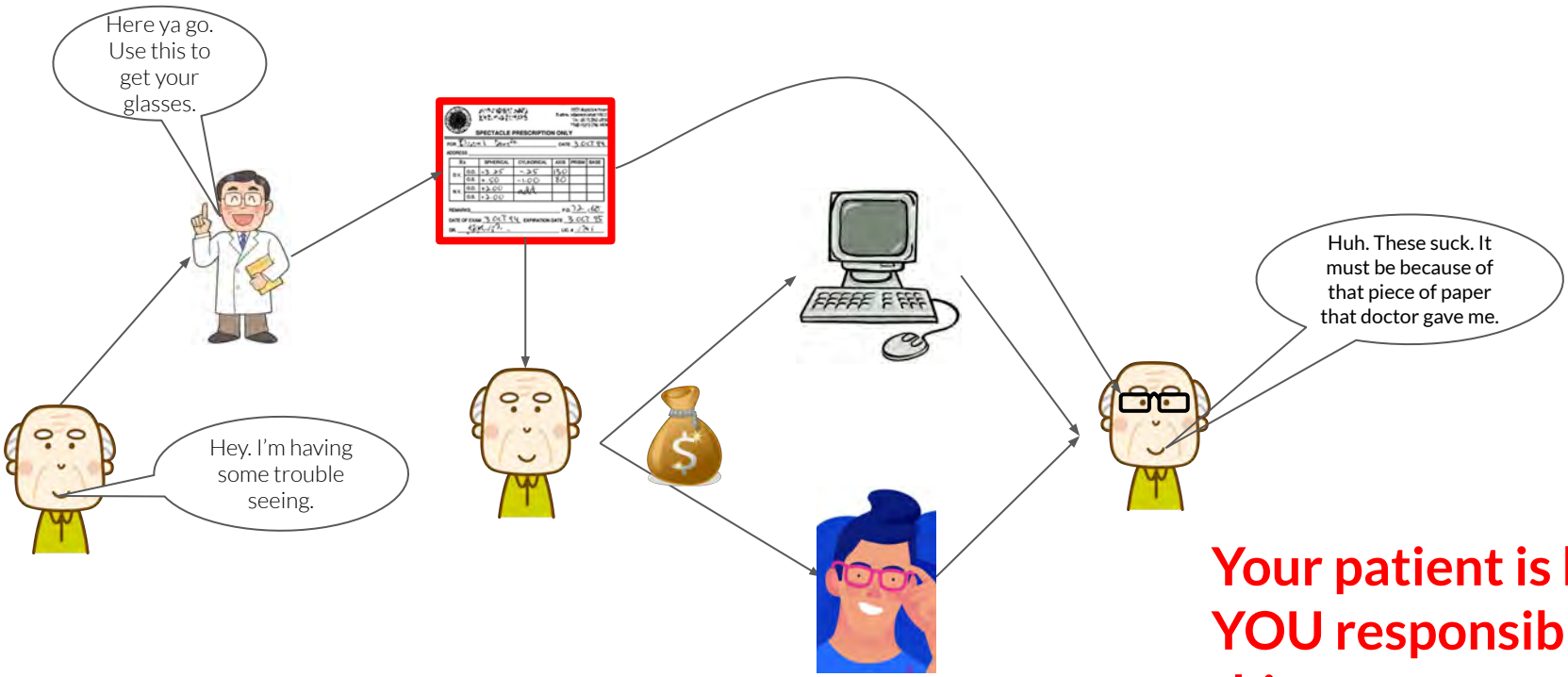
# Follow-up Question

If half the people think it's the optometrist's problem, and half the people think it's the optician's problem…
whose problem does it become?



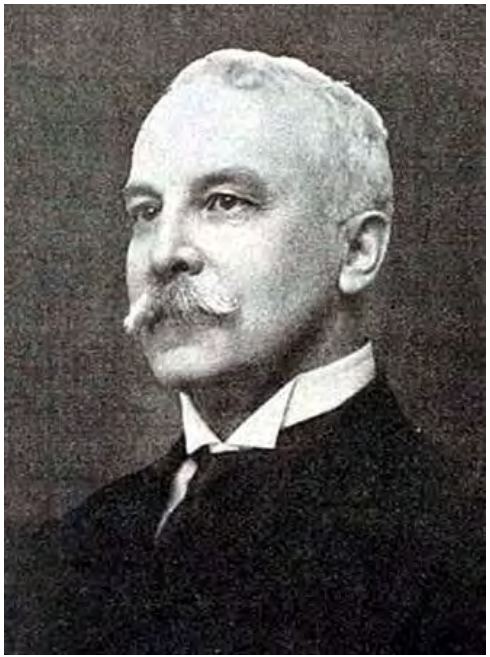

THE PATIENT! (0%)

# The Process (and Why This Course)




**Your patient is holding YOU responsible for this process**

“As to methods, there may be a million and then some, but principles are few. The man who grasps principles can successfully select his own methods. The man who tries methods, ignoring principles, is sure to have trouble.”



Harrington Emerson
1853-1931

**Do your methods potentially contradict/confuse the methods of others?**

“The word **should** is the verbal equivalent of the pull-out method…it cannot be trusted.”

Charles Saccarelli
1982-

Is what you think **should** happen…actually happening?

Are you trusting parts of the process that maybe shouldn’t be trusted?

# Outline

- History of Refraction vs. Lens Design
- A Dramatic Display to Reinforce the Name of the Course
- Different Ways To Accidentally Create Unwanted Prism
- Different Ways To Accidentally Create Unwanted Astigmatism
- The Wonderful World of Progressive Lenses and Branded Shampoos
- A hypothesis on why polycarbonate is so popular despite having almost no redeeming qualities

# History of Refractions & Lenses

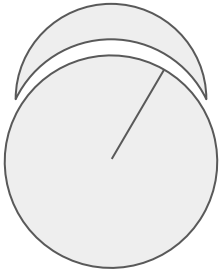
# Rough Timeline of Refraction/Eyeglasses

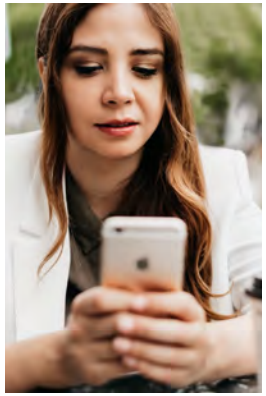
- ~1300 - Wearable glasses invented
- 1862 - Snellen Chart Invented
- 1865 - Diopter accepted as optometry's unit of measurement
- 1915 - Phoropter Invented

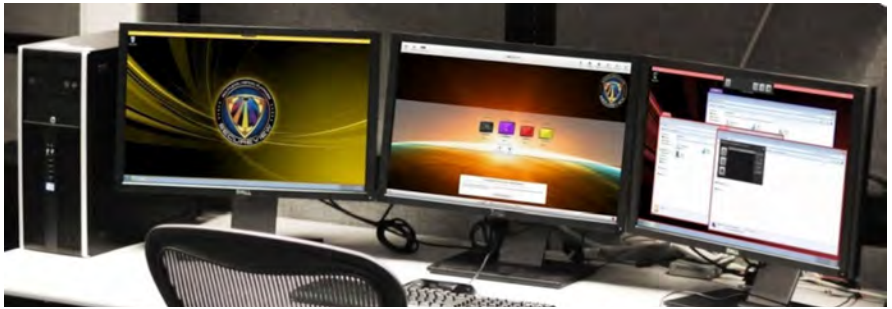
- 1925 - Tillyer Lens - corrected curve lenses for reduced aberrations
  - -6.00 back curvature provides ideal field of view
- 1931 - Ful-Vue frames with pantoscopic tilt introduced
- 1960 - Martin's Rule of Tilt
  - Perceived power is affected by the tilt of the glasses
- 1989 - Aspheric Lenses Introduced for non-cataracts
- 2000 - Freeform Progressive Lenses Launched
- 2009 - Freeform Single Vision is Launched

# Demands on Visual System 1925 vs 2025









# A couple of the root problems

Are these two equal?

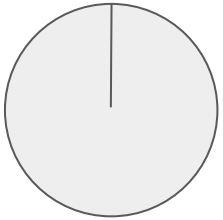
Look through glasses normally

Flip glasses so the temples are facing away from you

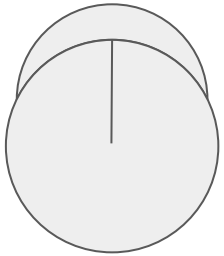
Close one eye and make a little circle to look through

Magic Stuff

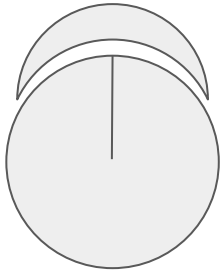
Eyeball



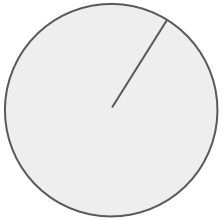
w/ Contacts

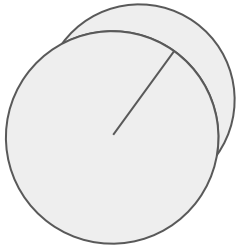


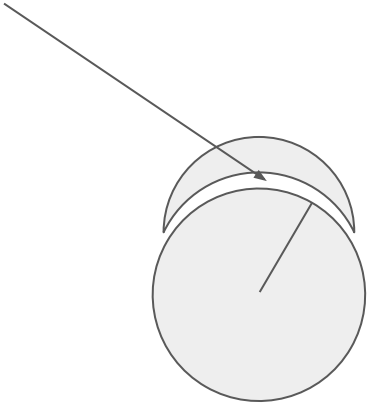
w/ Glasses



Our lack of understanding of this space creates a whole lot of problems







# Creation of Unwanted Prism

# Does anyone remember Prentice Rule?

Power x Distance(cm) = Prism

-2.50 x 0.2cm (2mm)= ½ diopter of prism

-1.25 x 0.2cm (2mm)= ¼ diopter of prism

-5.00 x 0.2cm (2mm)= 1 diopter of prism

# How were ANSI standards created?

A. Based on what could reasonably be manufactured repeatedly and reliably and influenced by the biggest companies trying to minimize their manufacturing failures

B. A diverse study of thousands of humans, assessing their tolerance and reaction to ophthalmic stimuli, carefully considering how humans are best served by ophthalmic lenses

# ANSI Binocular Tolerances for Vertical & Horizontal Prism

Vertical: 1mm OR ⅓ of a diopter, whichever is more forgiving

Ex. You prescribe ¼ base down, lab produces 0.08 base up, it passes

Horizontal: 2mm OR ⅔ of a diopter, whichever is more forgiving

Ex. You prescribe ½ base in, lab produces 0.16 base out, it passes

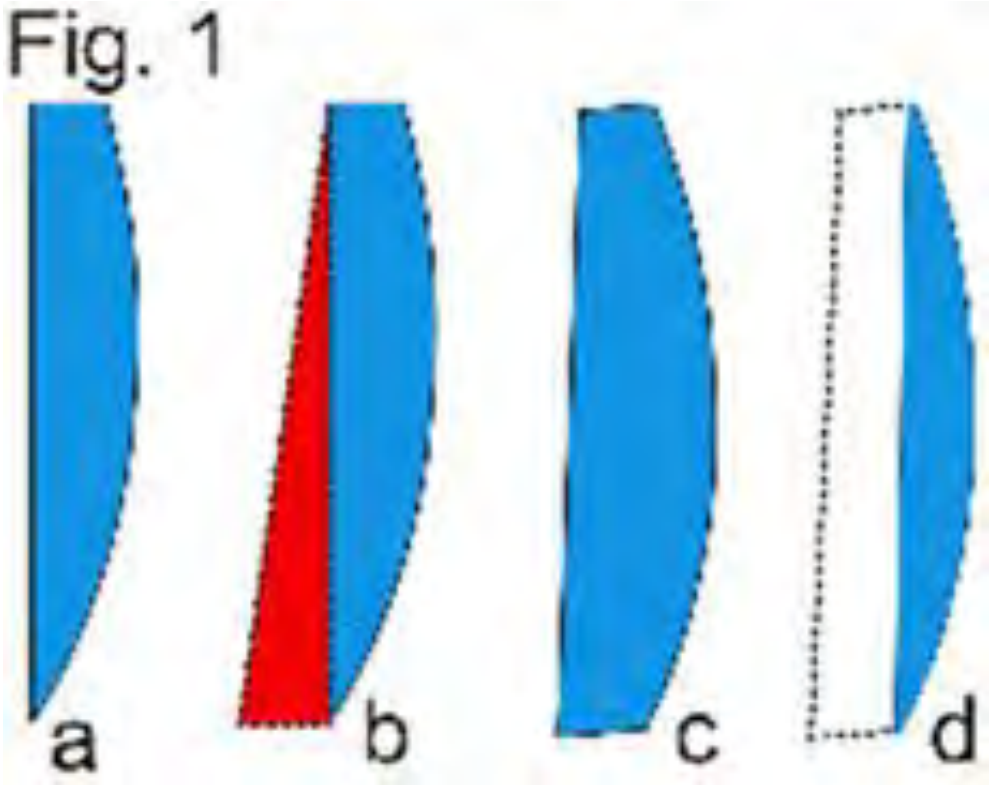
Yoked Prism: Not considered by ANSI

Ex. Lab can completely ignore you as long as it meets the above standards

# Progressive Lenses - Base Down Bonus Prism?

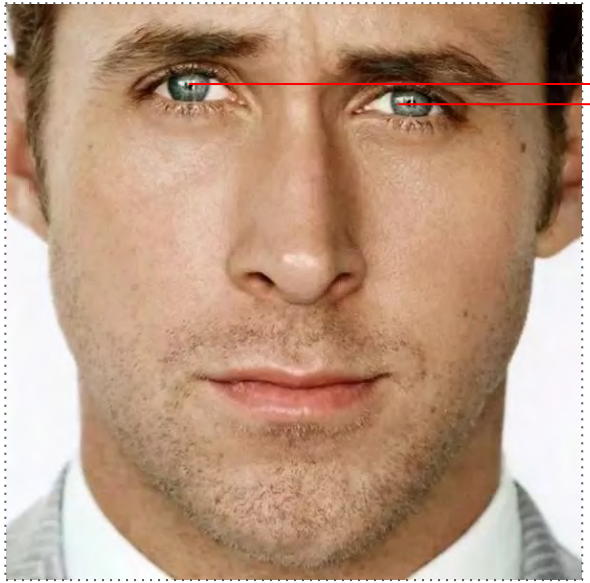
Figure A: PAL w/o prism thinning

Figure B-D: The creation of secret bonus prism…for aesthetics



# BEAUTIFUL MAN NEEDS HELP

- Splits time between contacts and glasses
- Doesn’t love his glasses
- RX: -2.00 OU




# Ways to Potentially Help (Or Make Things Worse)

**Potential Optometry Things**

- Prescribe Vertical Prism to Match the Contact Lens Experience?

**Potential Opticianry Things**

- Measure Unequal OC heights?
  - Online…certainly not.
  - Opticians…maybe?

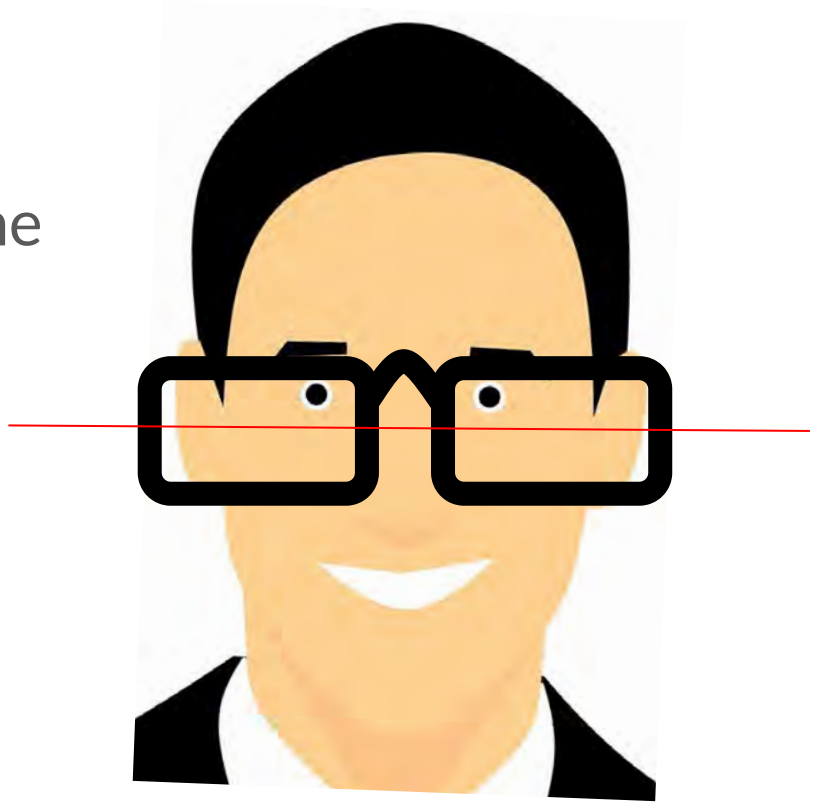
…what happens if you do neither?
…what happens if you do both?
…are we doing neither?
…are we doing both?
**…do you know?**

## **Should** you know?

# OC Heights (Even if Eyes AREN'T misaligned vertically)

- RX: -2.00 OD, -1.00 OS
  - Frame Sits Low
  - Eyes are 7mm above center
  - OC's vertically centered in frame

- Unprescribed Prism
  - 1.4D base up OD
  - 0.7 base up OS
  - 0.7D vertical imbalance



# MONOCULAR VS BINOCULAR PD's

- RX: -2.00 OU, 0.5 BASE RIGHT
  - PD 66 (34.5/31.5)
- Made Monocular
  - -2.00 OU, 0.5 BASE RIGHT
- Made Binocular
  - -2.00 OU, 0.2 BASE RIGHT

# NEVER MIND PD…
# WHAT ABOUT GAZE SHIFT?

(with glasses 20mm from nodal point)

1 degree gaze shift = 1/3 mm
3 degree gaze shift = 1 mm
6 degree gaze shift = 2 mm
9 degree gaze shift = 3 mm
12 degree gaze shift = 4 mm
15 degree gaze shift = 5 mm

# Creation of Unwanted Prism - Considerations

- ANSI Standards - Vertical/Horizontal/Yoked Prism
- Optical Center Measurements
  - RX Imbalance
  - Frame Fit
  - Physical Asymmetry
- PD Measurements - Monocular vs. Binocular
- Potential Impact of Gaze Shifts

# Questions?

# Creation of Unwanted Astigmatism & Power Change

# Remember This?

The curve, angle and thickness of a lens are important…

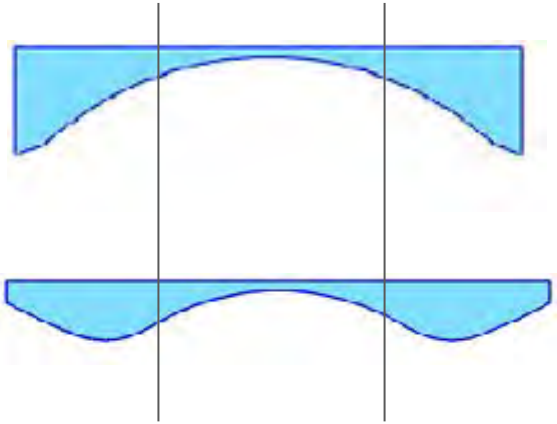
So where can it go wrong?

# Magnification Balancing - Aniseikonia

OD: +5.00
OS: +2.00

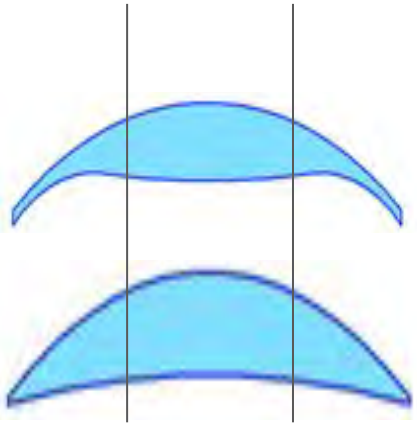
Modifying the base curve, center thickness and vertex distance can help equalize the magnification…***but at what cost?***

# What Were They Wearing Before?

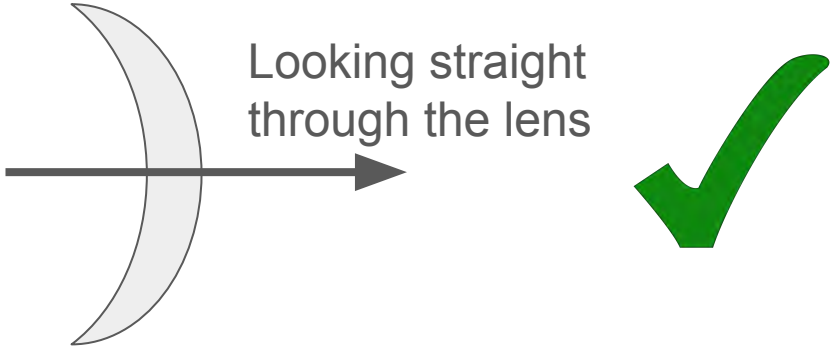


Minus lenses tend to have a similar central area from lens to lens. New tech tends to affect the outsides of the lens.

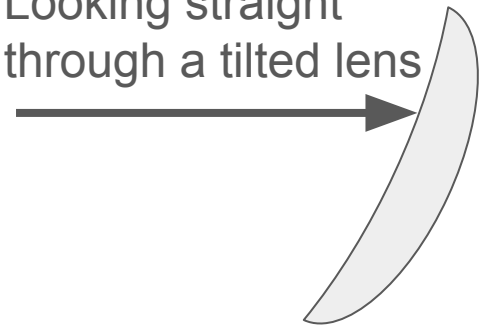
New tech in plus lenses tends to affect the center of the lens, which is exactly where the patient is looking through



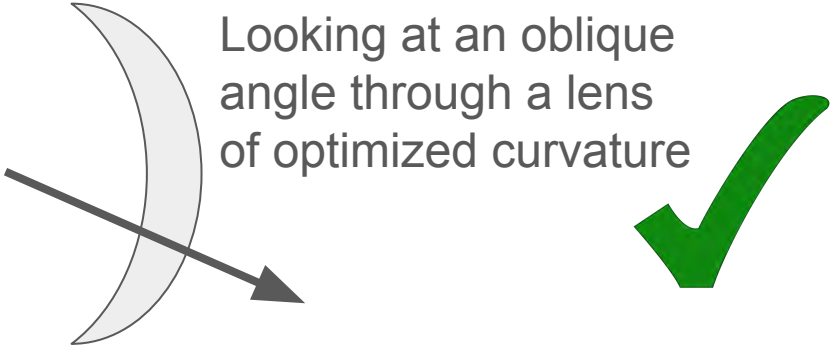
# Creation of Unwanted Astigmatism



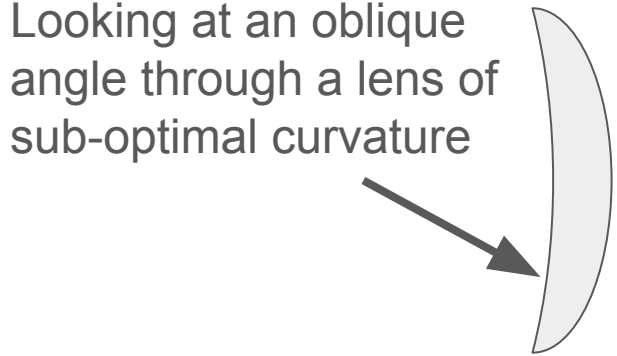
Looking straight through the lens



Looking straight through a tilted lens



Looking at an oblique angle through a lens of optimized curvature



Looking at an oblique angle through a lens of sub-optimal curvature

# Creation of Unwanted Astigmatism

## Lens Properties

- Base Curve
- Asphericity
- Prism Amount
  - Bevel Selection

## Frame Properties

- Face Form
- Pantoscopic Tilt
- Back Vertex

# Lens Designs to Offset Unwanted Astigmatism

## GOOD: Corrected Curve Lenses

- But they ugly

## BETTER: Aspheric Lenses

- Front-side optimized

## BEST: Freeform Lenses

- Uses face form, panto, and vertex distance to create a 10,000 point topographical surface file with each point optimized for various gaze angles

# Your patient is holding you responsible for their vision

- Does your staff know what they're selling?
  - Should they?
- Do you know the implications of the choices your patients are making?
- Do you know what your patients are wearing?
  - Should you?

# Questions?

# Charlie Whines About Progressives

# Progressive Lens Designs

- Front-Side PAL
  - Narrower Field of View
  - More Magnification at Add

- Back-Side PAL (free-form)
  - Wider Field of View
  - Less Magnification at Add

- Dual Side w/ Increasing Curvature
  - Widest Field of View
  - Most Magnification at Add
- Underlying theory - widening corridor reduces sensitivity to “swim”

- Dual Side w/ Decreasing Curvature
  - Wide Field of View
  - Least Magnification at Add
- Underlying theory - reducing magnification across lens reduces sensitivity to “swim”

# Progressive Lens Designs - Which one is best?


Every lab/insurance's "pr

# Variables that Exist Now That Didn't Before

**Old Days**
Front Side PAL

- Same Exact Lens
- Same Design
- Every Single Time
- Design Molded into the lens

**New Designs**
Free Form PAL

- Uses POW Measurements
- Variable Corridor Length based on fitting height
  - Also based on shape of trace
- Every Lens Output Potentially VERY different…even with the same name.
- "Trust us, it's math. You don't wanna deal with it."

Do you know how the variables interact with the final product?
**Should** you?

# Progressive Lens Designs

- What were they wearing before?
  - Can you find out?
    - There used to be a guide…but now labs make their own customized engravings
  - How were they fit?
- What do they like about it?
- What don’t they like about it?

# Charlie Whines About Lens Materials

## aka Confessions of a Poly Skeptic

# Economies of Scale (A bit of business math)

Option 1…let's call it assglay:
Invest $5,000 up front, Pay $10/unit to manufacture, Sell for $15

Option 2…let's call it olycarbonatebay:
Invest $50,000 up front, Pay $1/unit, Sell for $15

Which is better?

# Depends…How many are you selling?

Option 1 (assglay):
Invest $5,000 up front, Pay $10/unit to manufacture, Sell for $15

Option 2 (olycarbonatepay):
Invest $50,000 up front, Pay $1/unit, Sell for $15

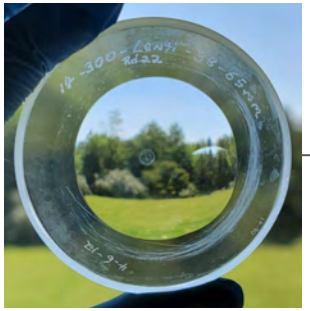
| Qty Sold | Sale Price | Option 1 Profit | Option 2 Profit |
|---|---|---|---|
| 3,000 | $45,000 | **$10,000** | **($8,000)** |
| 10,000 | $150,000 | **$50,000** | **$90,000** |
| 25,000 | $375,000 | **$70,000** | **$300,000** |
| 100,000 | $1,500,000 | **$400,000** | **$1,350,000** |

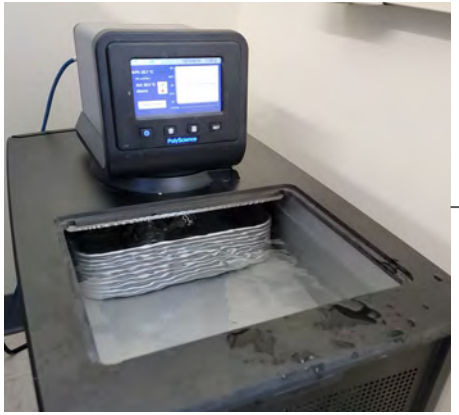
# How Lenses are Made - Glass

1. Round Pucks are cut out of a thick sheet of glass
2. Blanks are placed on a ceramic mold of a certain curvature
3. Molds are run through an extremely hot oven to melt the glass so it forms into the ceramic curvature
4. Front surface of lens is ground to match a master curvature
5. Front surface of lens is polished

… that's a semi-finished lens

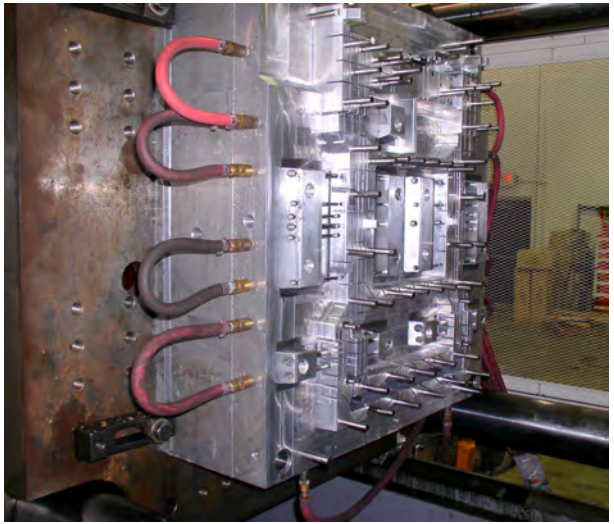
# How Lenses are Made - Casting





# How Lenses are Made - Injection Molding

1. Plastic pellets are heated and shoved into molds at high pressure
2. Lenses comes out



# Manufacturing Pros/Cons to Different Materials

| | Process | Optical Quality | Cost |
|---|---|---|---|
| Glass | Complex, Labor-intensive | The best | High per piece |
| CR-39, Trivex, High Index | Complex, energy & chemical intensive | Good | Medium per piece |
| Polycarbonate | Simple | The Worst | Low per piece |

# Conversation that Probably Happened

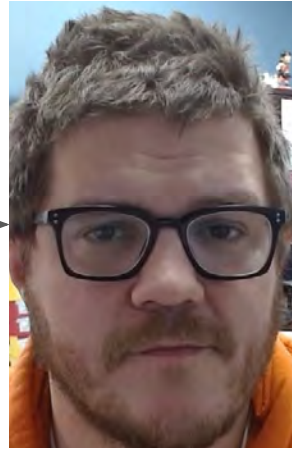
Shareholder Value Guy: “Hey, that stuff they’re making CD’s out of…they can make that clear and it’s super cheap. Can you try to figure out a way to market that?”

Marketing Guy: “Sure! We’ll create a narrative that people lose eyes because their glass and CR-39 lenses shatter. We’ll teach doctors that they have a “duty to warn” their patients and that they’ll probably get sued if they don’t fit their patients in polycarbonate.”

Shareholder Value Guy: “Hey, good idea. Do you think anyone will care that the optics are pretty bad?”

Marketing Guy: “No way! They’ll be too afraid of a lawsuit to care. This is the 80’s! Everybody’s suing everybody!”

Magic Stuff



- Unwanted Prism
- Unwanted Astigmatism
- Variations of Progressive Lenses
- Lens Materials

# Questions?