SI 388
Perception: Visual, Part 2

WEEK 4-2 (WED 27 SEP) – FOCUS, PERIPHERAL, AND COLOR VISION

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Today

- Teach A Chapter Presentation by Group 3
  - Feedback link (also on Canvas/Announcements) https://goo.gl/forms/Nrrm5wBuGWucLeAP2
- Finish lecture from Monday (Visual Perception 1)
- Lecture Visual Perception 2

Learning Objectives

After today's lesson, students should be:

- ❑ Understand basic principles of human visual perception
- ❑ Apply those principles to interface design

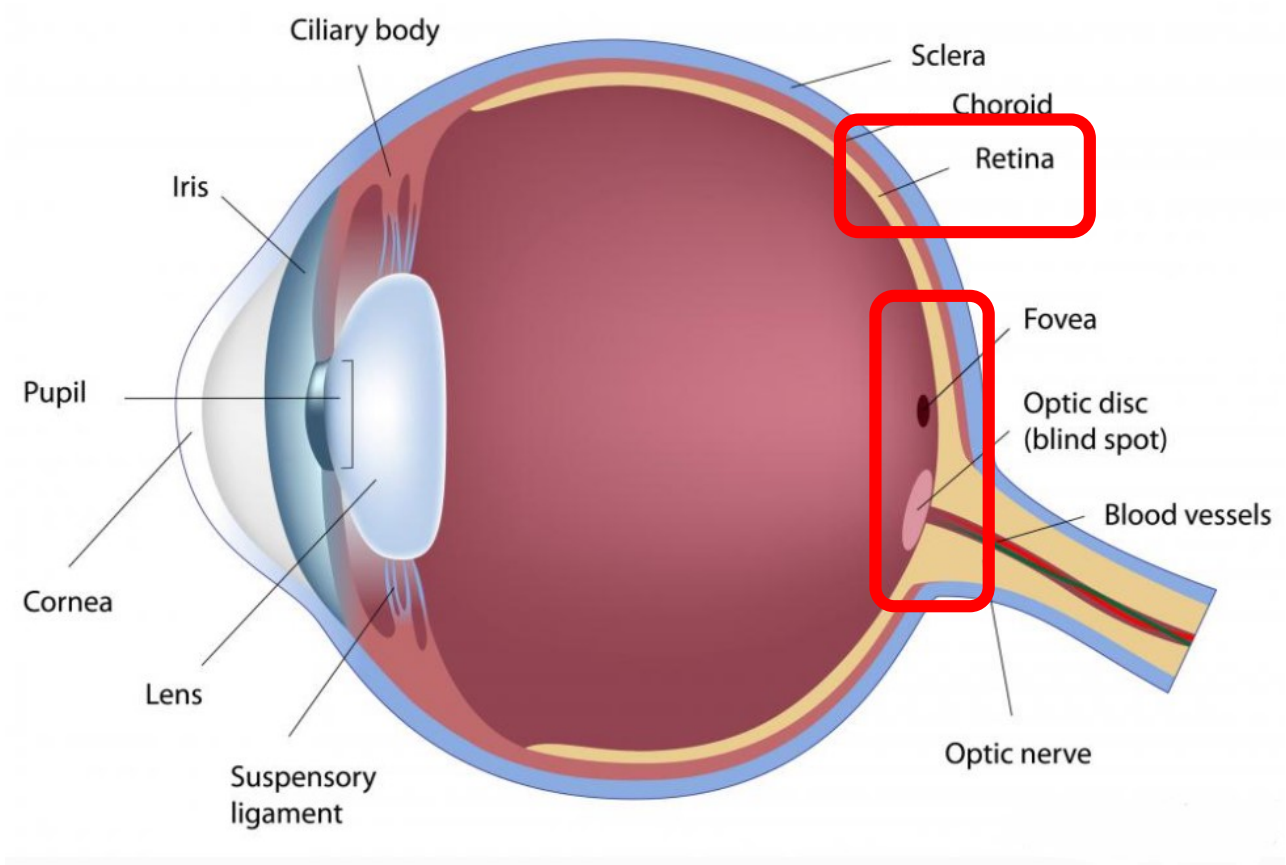
Visual Perception: So Far

- For sighted people, vision is most powerful sense
- Provides means of perception critical for most interfaces
- Need to understand basics for effective work in HCI / UX field
- In this class, we care about perceptual part of Human Information Processing (HIP Model), not biological aspects of how vision works

Parts of the Eye: An Overview

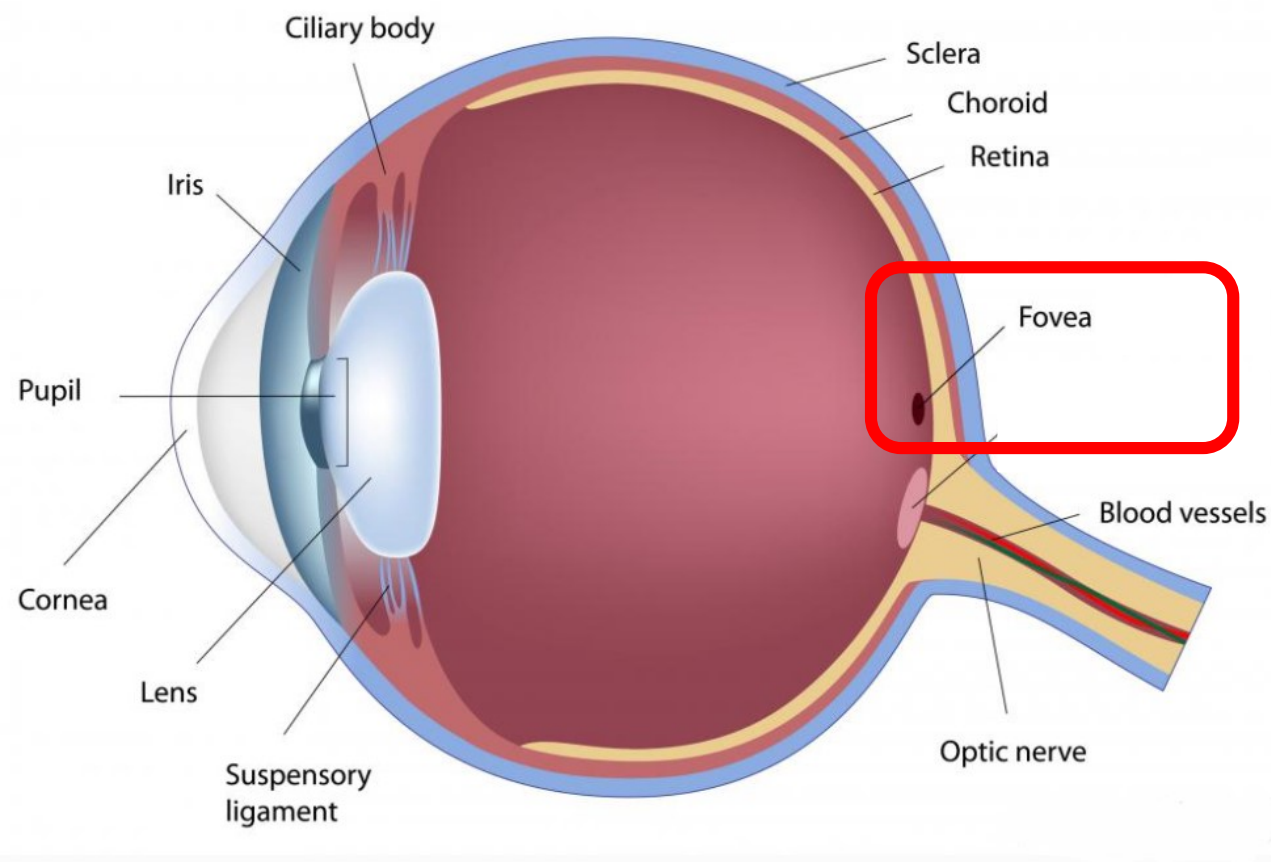
Main features for HCI (today)

- Retina
- Rods and cones
- Fovea



Fovea

- Small area on retina
  - Clearest images are sensed within it



Fovea

- Can clearly view area size of thumbnail at arm length
- Density of photoreceptor cells:
  - 158,000 cone cells per mm^2
    (vs 9,000 cone cells per mm^2 in rest of retina)
- Info from foveal cone cells is transferred into and processed faster by brain than info from rest of retina
- 50% of all visual info comes from fovea

Foveal Vision

- Everything outside foveal vision field is blurry.
- Johnson: “Peripheral vision like looking through a frosted piece of glass”

Foveal Vision

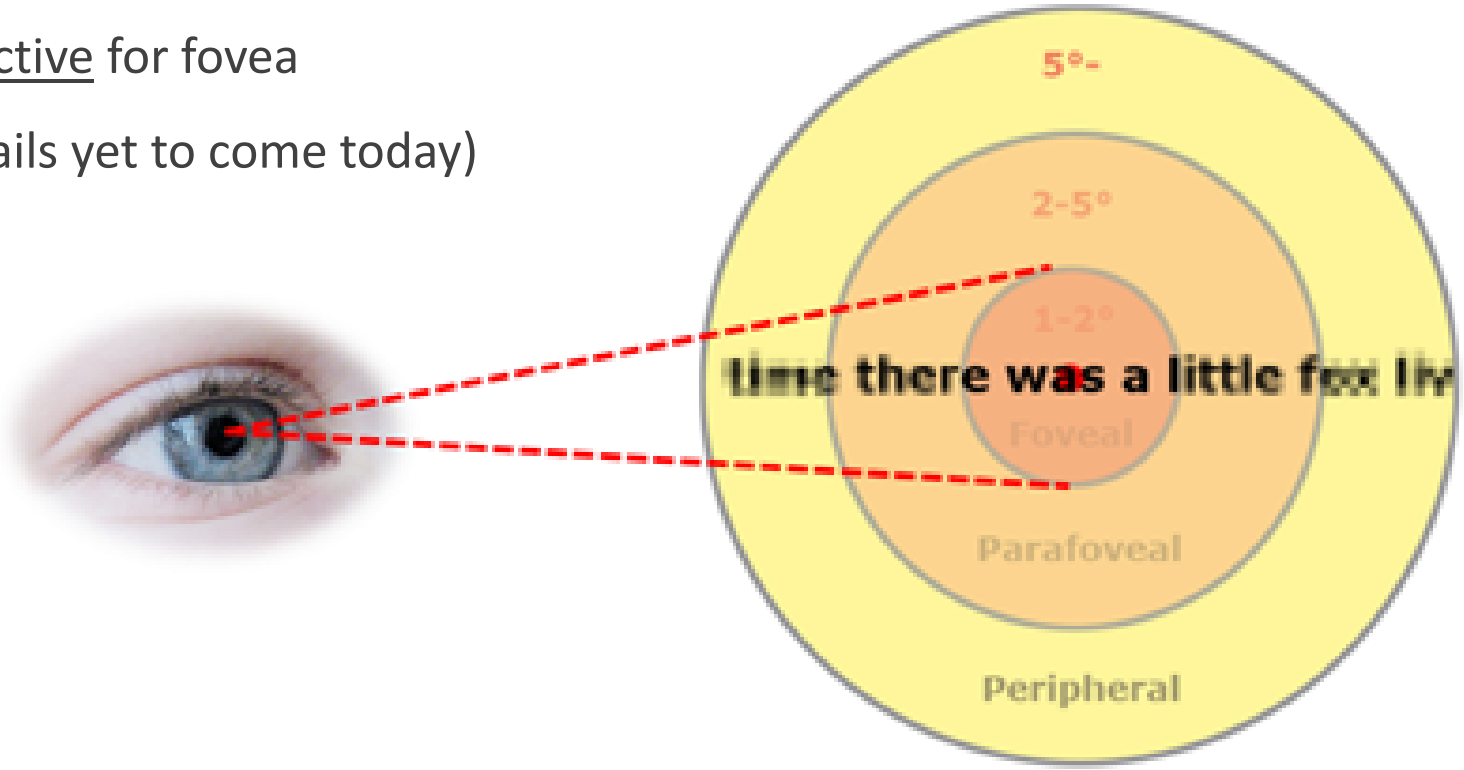
- Why does it seem like we see better than this? …

Our eyes continually scan 3x per sec. across field of vision.
Our brains fill in the perceptual omissions.

Result: our brains fool us into thinking we see everything in focus.

3 Types of Vision

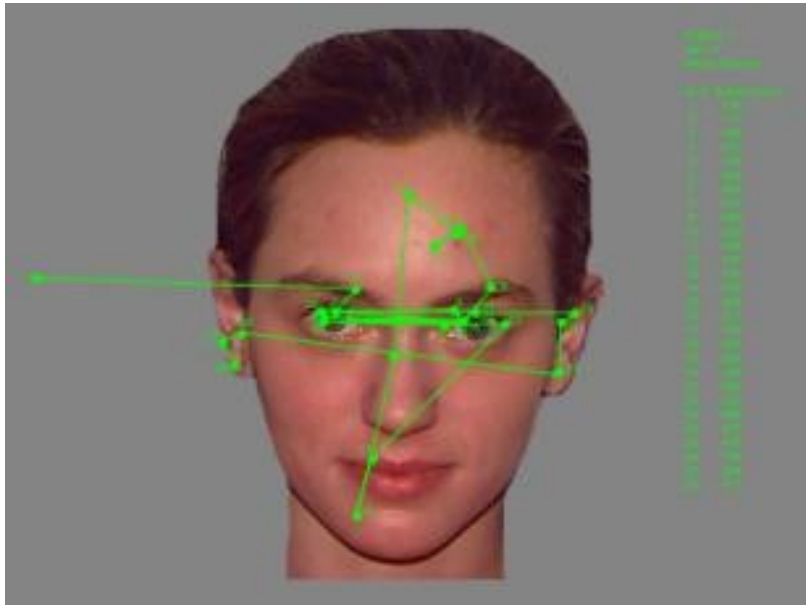
- **Foveal** = clear
- **Parafoveal** = is fuzzy but predictive for fovea
- **Peripheral** = see it poorly (details yet to come today)



Parafoveal Vision

- We focus on what's within foveal vision
- Brain does process what's in parafoveal range
  - ~2-5 degrees from the fovea—creates a range of visible area

- Use **saccades** and **fixations** to "jump" to items of interest outside foveal field
  - 0.1 second
  - Pre-determined, ballistic



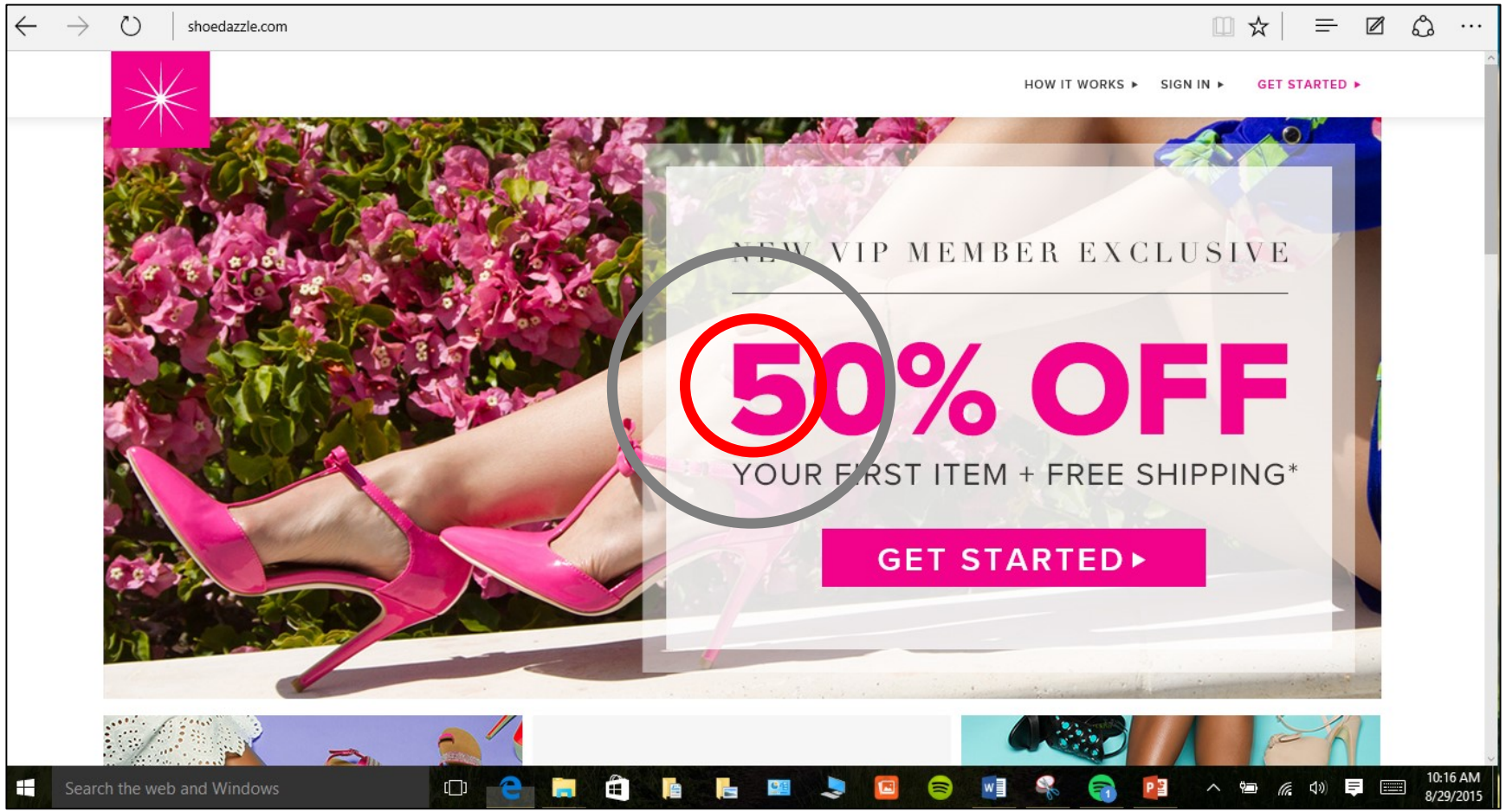
https://people.cs.umass.edu/~mahadeva/papers/book-chapter.htm

Try it

Peripheral Vision

- Notices motion, major visual distinctions
- Guides fovea to where to look next
- Helps people see better in the dark (rods in retina, not cones)

Designing for Foveal Vision

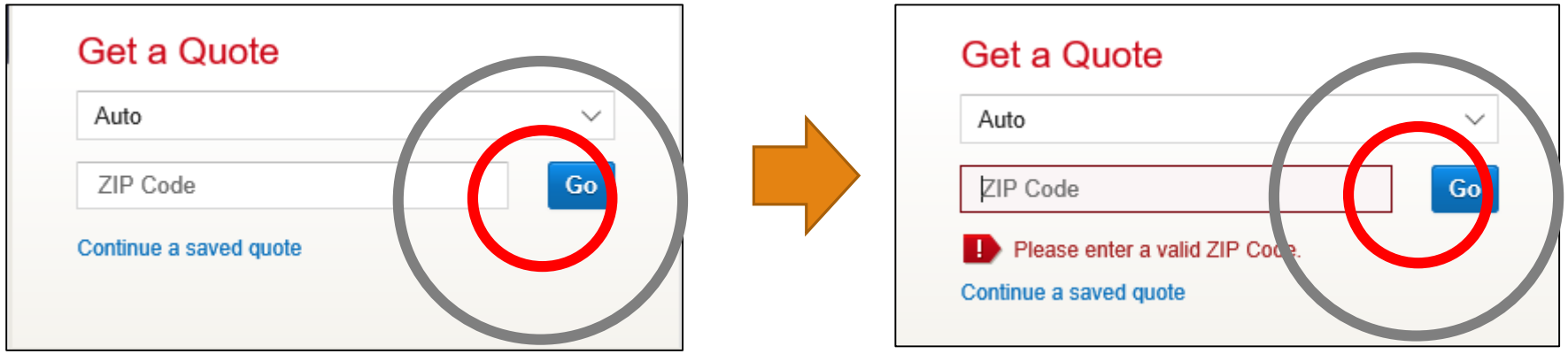


- What's in the foveal field at middle of the centerwell?
- ~2 cm
- What's in the parafoveal field?
- Why?

Designing for Foveal Vision

Another example. Error messaging should be near fields and action mechanisms

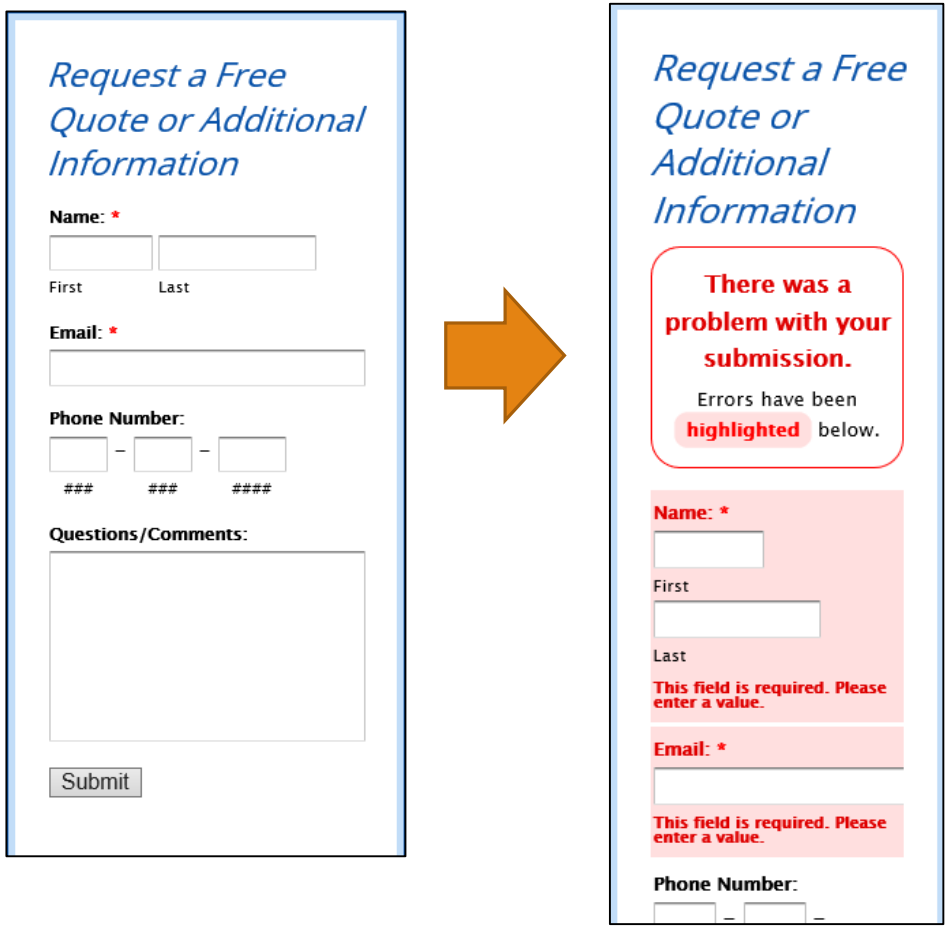
That's where the foveal vision is …



But it can be overdone (next slide)

More Examples

- It's best practice to indicate errors, but **too much salience** when user has just been blocked from progress can lead to irritation …
- State of negative affect (more on this in the lessons on emotional design)

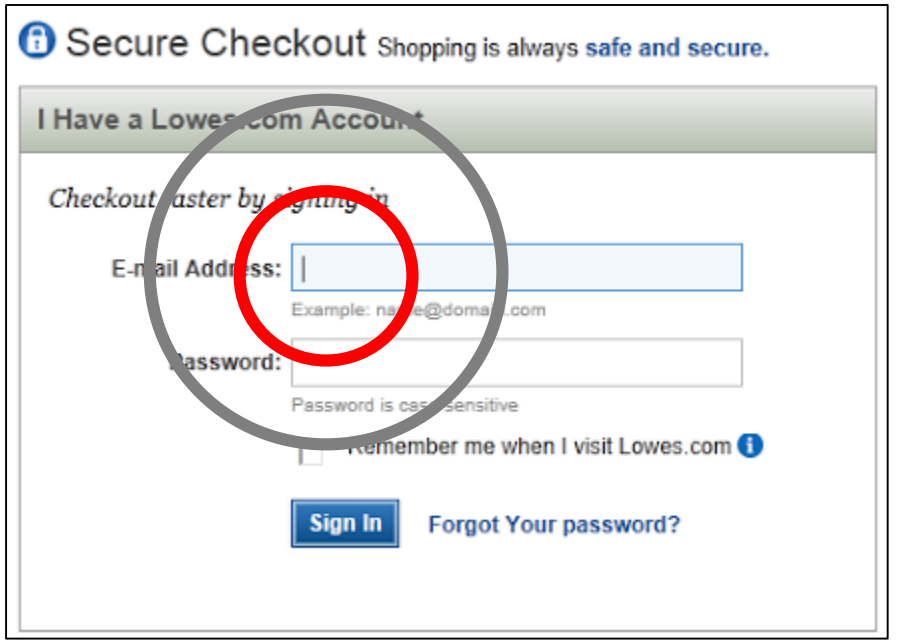


More Examples

Forms

What's in foveal vision?

What's in parafoveal vision?

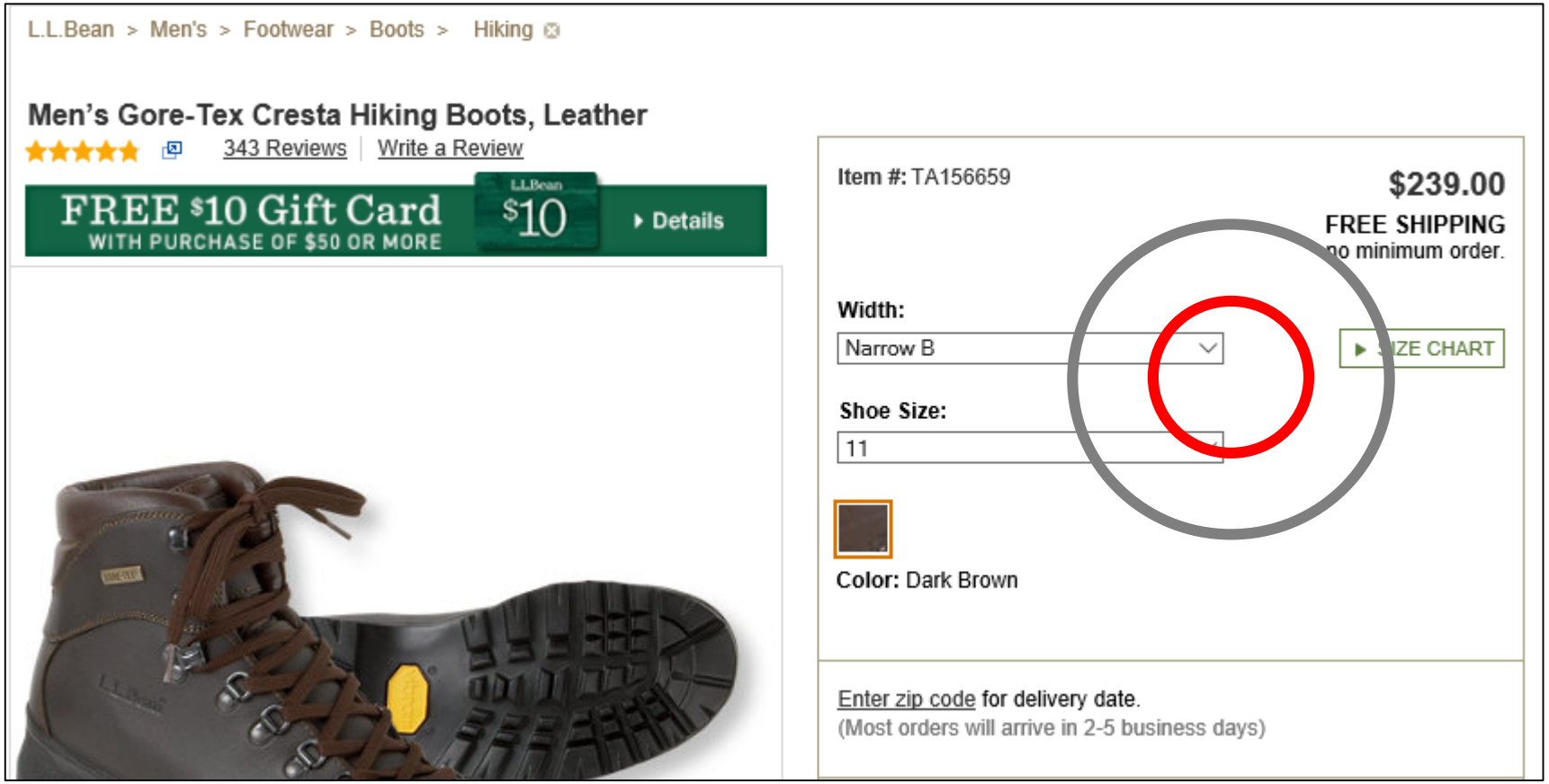


More Examples

Detail page

When user is interacting with the Width dropdown…

- What's in foveal vision?
- What's in parafoveal vision?

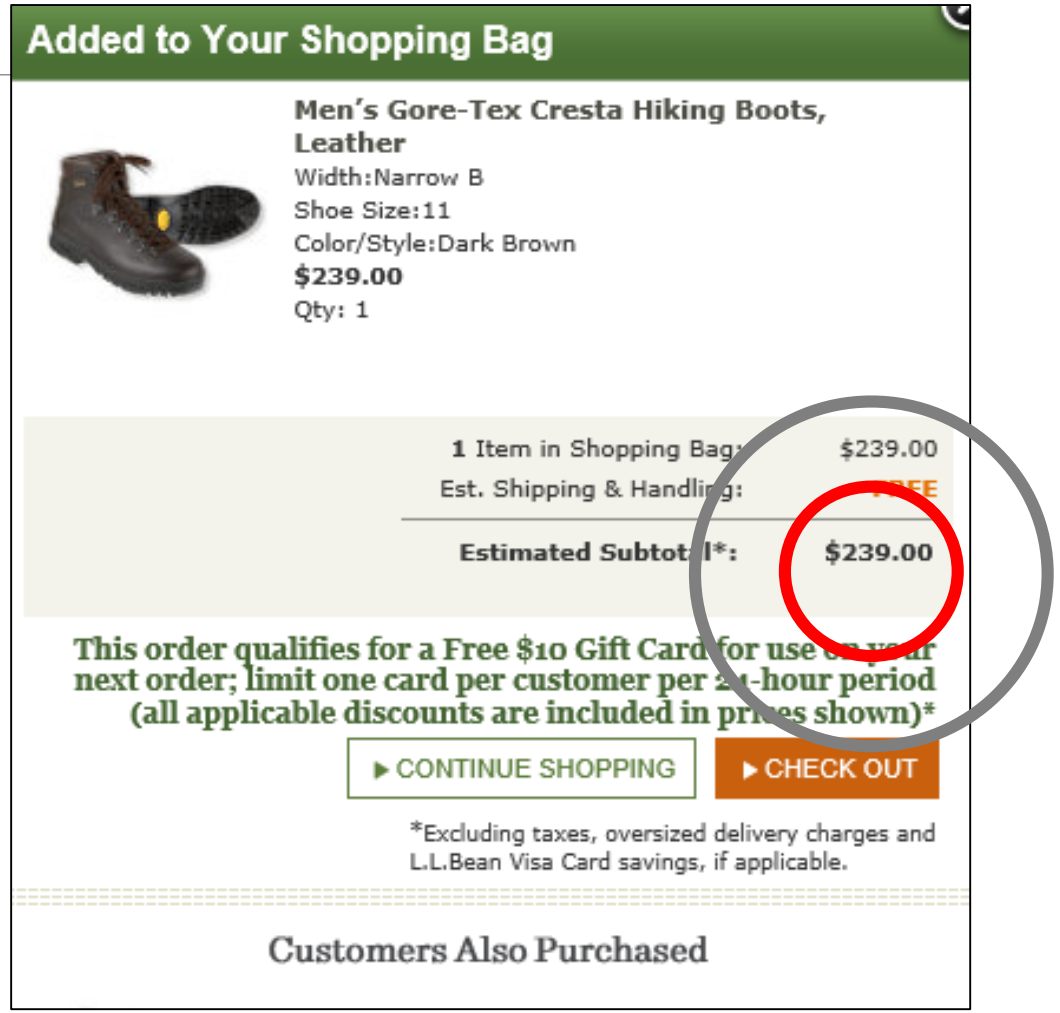


More Examples

Shopping Bag page

What's in foveal vision?

What's in parafoveal vision?

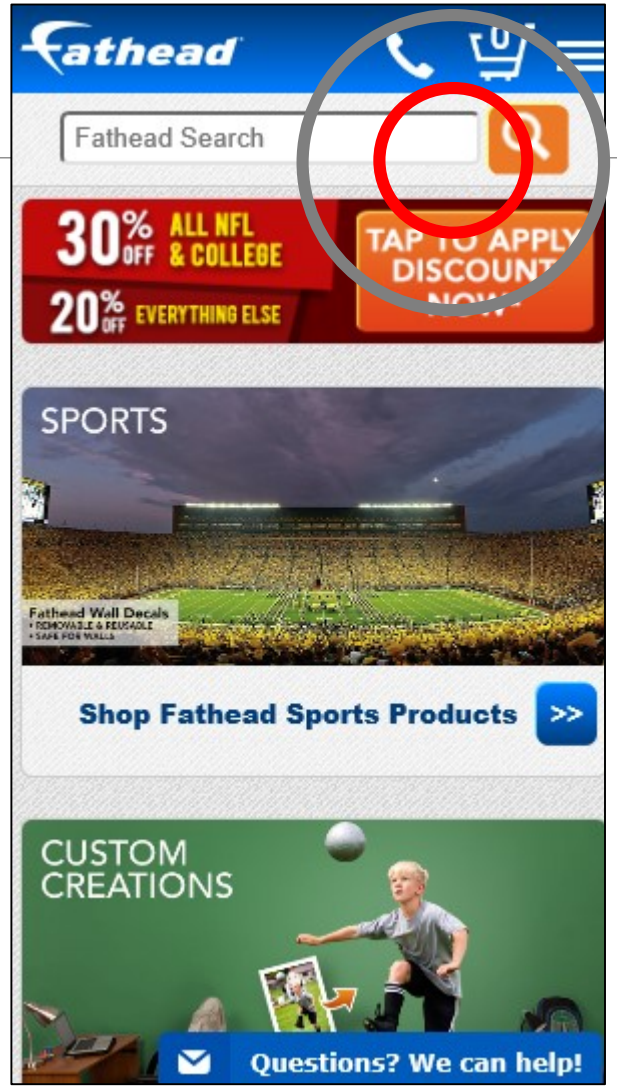


More Examples

Search

User is ready to try a search…

- ❑ What's in foveal vision?
- ❑ What's in parafoveal vision?

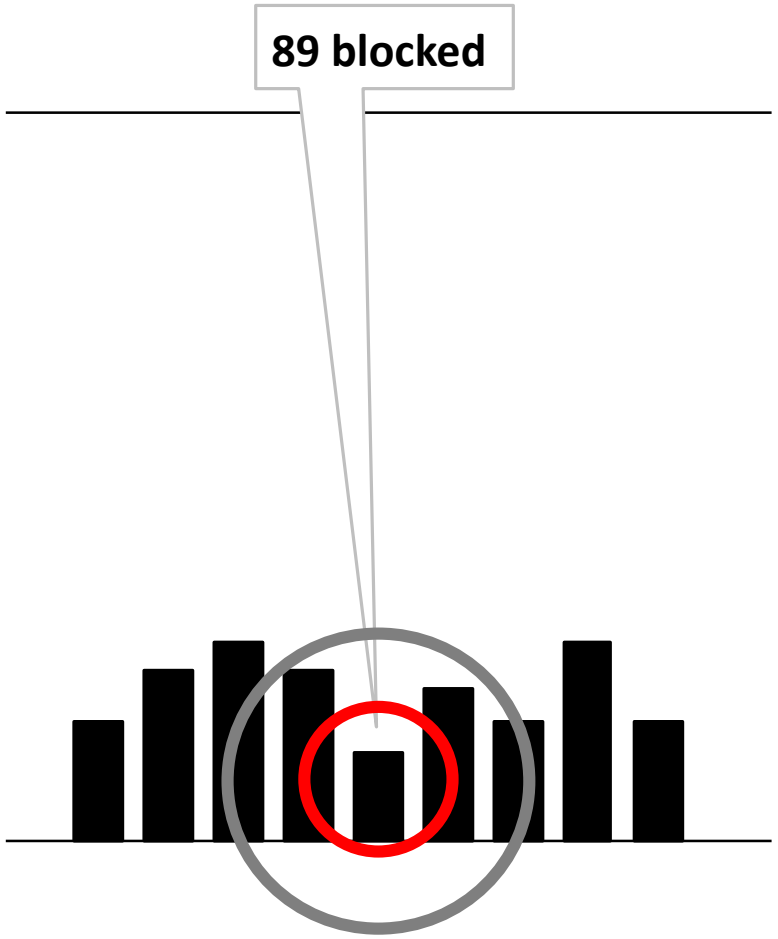


More Examples

Chart Callout

User wants to see precise data…

- What's in foveal vision?
- What's in parafoveal vision?

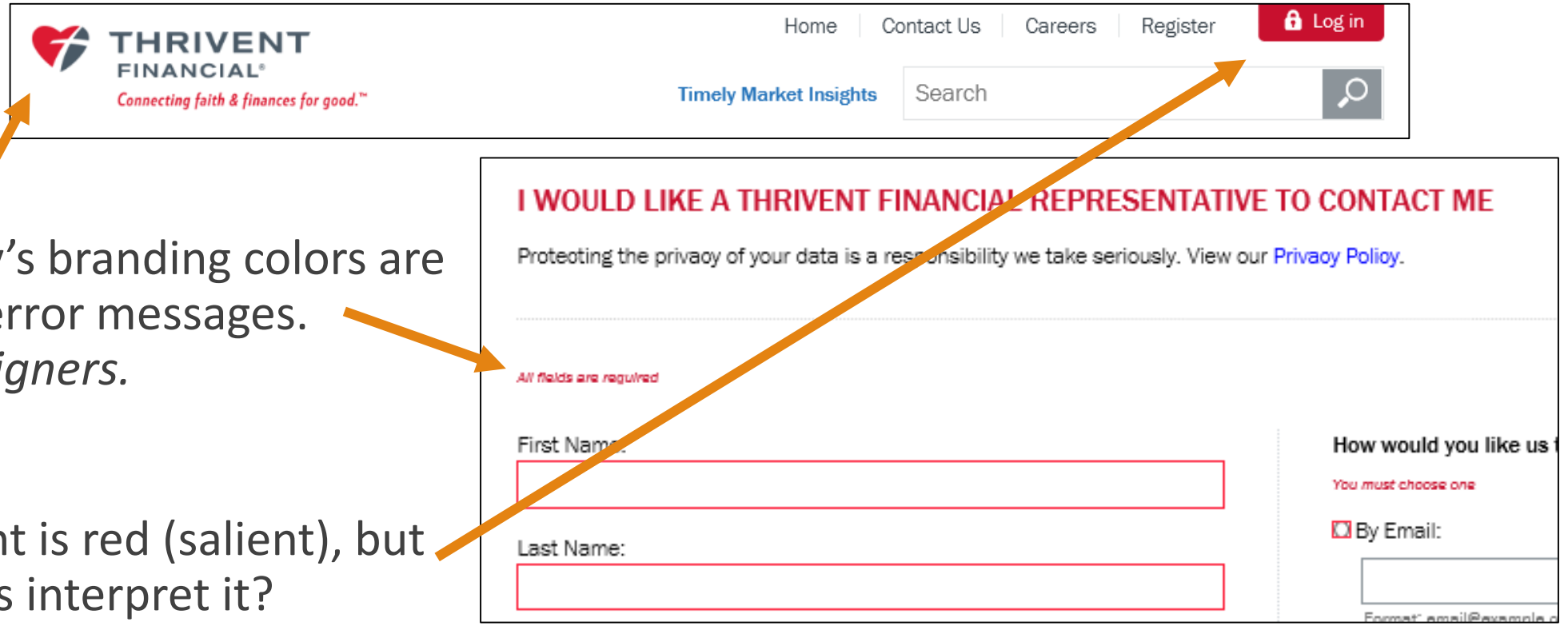


Directing Users' Eyes

Highlighting navigational elements corresponding to current page is a best practice for orientation.

- Color highlight = Salient
- Sidebar navigation elements present in parafoveal view. …

Directing Users' Eyes



This company's branding colors are the same as error messages. *Tricky for designers.*

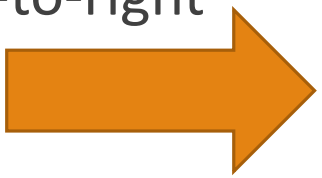
Log in element is red (salient), but how will users interpret it?

Expectations Influence Where Users Look

Vision is only part of the story with interface visuals

Weinschenk (“100 things…”):

- People quickly scan the screen, then move to the center, or wherever they are used to finding what they’re looking for.
- Put most important elements in the top 1/3 of the screen. (Above the “fold”)
- Assume Westerners will seek information left-to-right

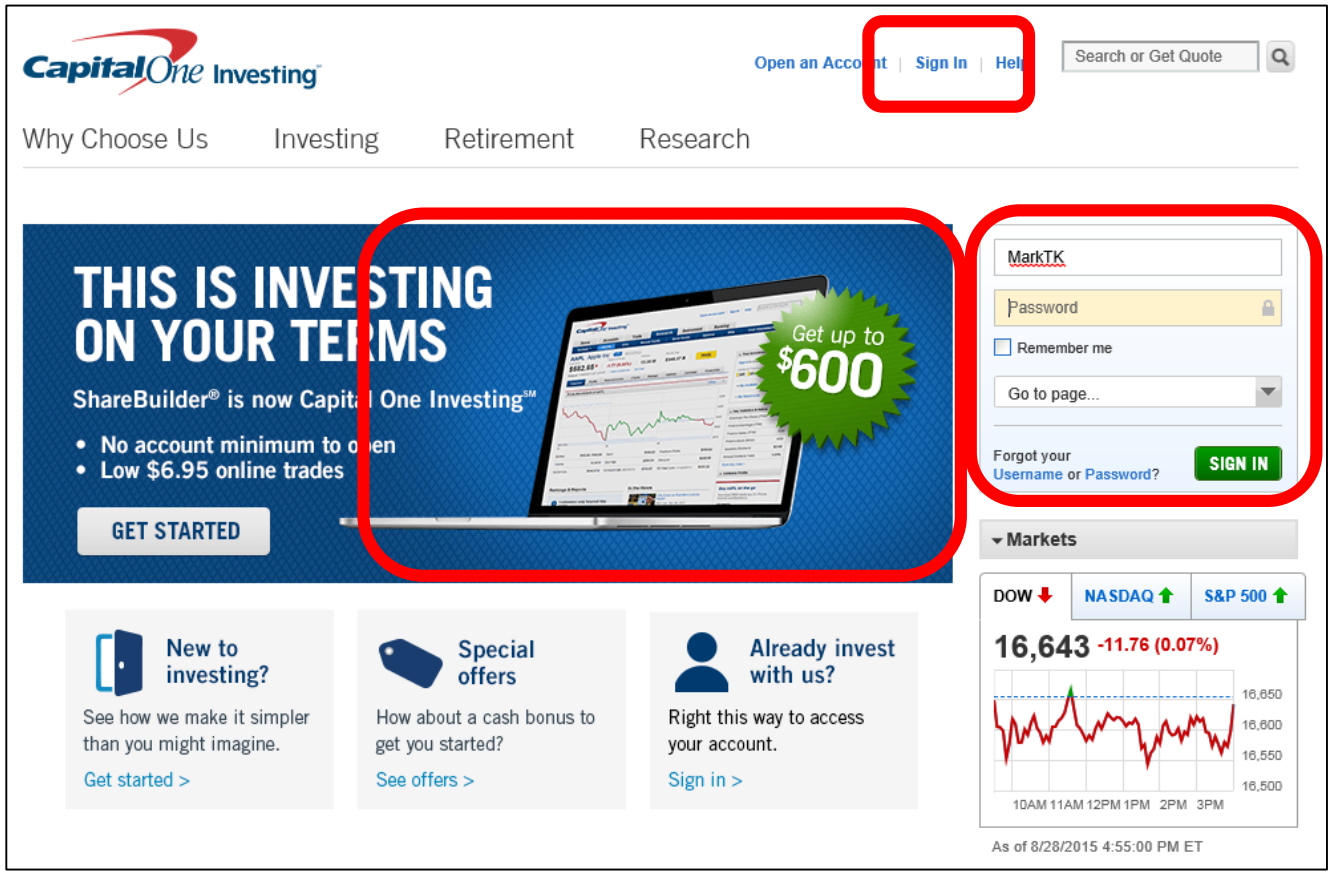


Examples …

Expectations Influence Where Users Look

People quickly look where they expect to find what they want

Login



Weinschenk, S. (2011). *100 Things Every Designer Needs to Know About People*.

Directing Users' Eyes (Peripheral Vision)

Ideas from Johnson, some best practices …

❑ Reserve red text for errors	Caution: site's branding colors
❑ Pop-up message in dialog box	Caution: jarring, negative affect
❑ Sounds	Caution: also can be annoying
❑ Blinking / bouncing	Caution: very distracting (90s blink tag)
❑ Differentiate by highlights/color	Effective, best practice done …

Examples …

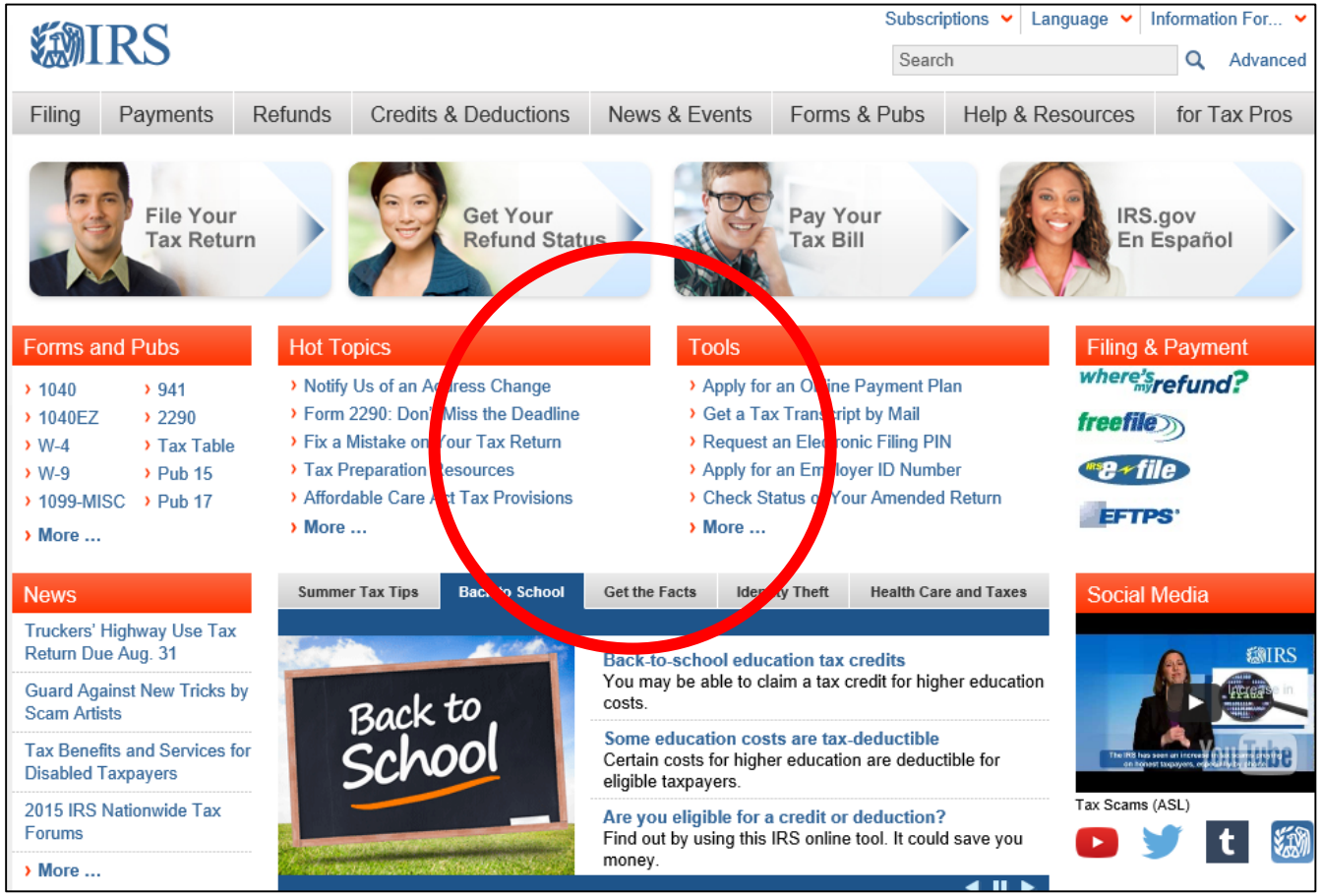
Expectations Influence Where Users Look

Westerners typically read
left to right in an ‘F’ pattern

Weinschenk, S. (2011). *100 Things Every Designer Needs to Know About People*.

Expectations Influence Where Users Look

People look to the center of web pages when they're not sure where to find information they seek



Weinschenk, S. (2011). *100 Things Every Designer Needs to Know About People*.

Color Vision is Limited

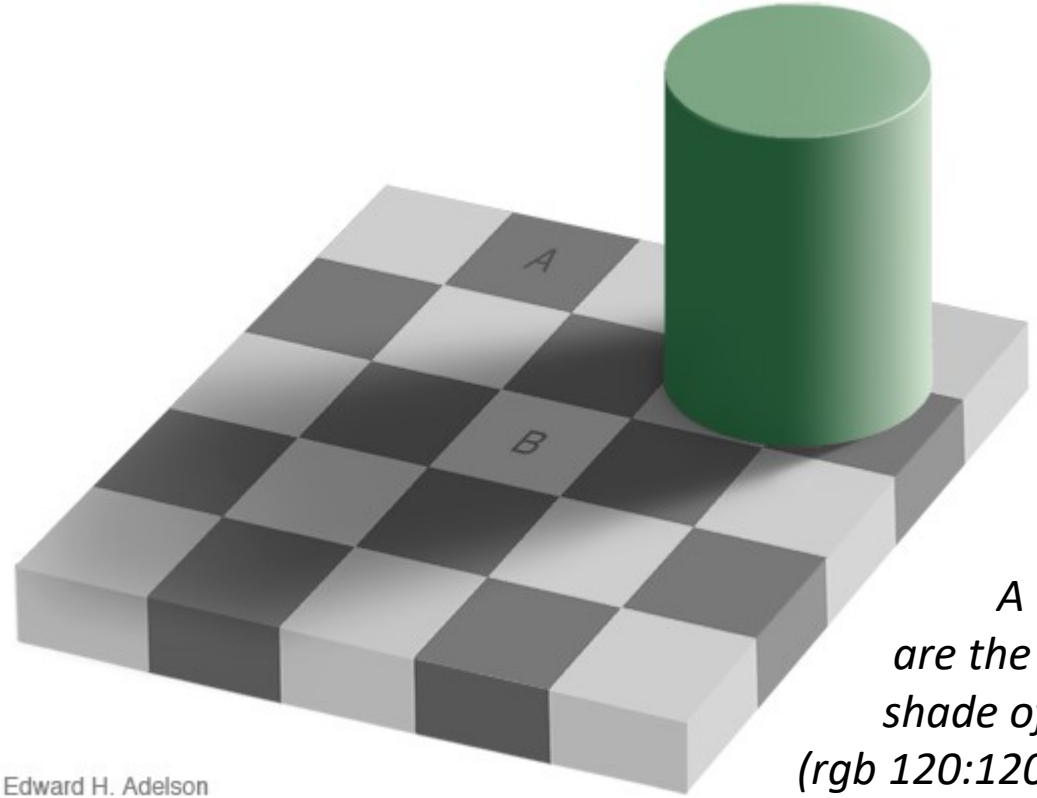
How we sense light:

- **Rods.** Detect light levels only, e.g. black and white
- **Cones**:
  - Low frequency. Entire range of visible light wavelengths, mostly **yellow** and **red**.
  - Medium frequency. High through low wavelengths.
  - High frequency. **Violets**, **blues**, and **greens**.

Now on to color and perception.

We Perceive Contrast

- Visual system not optimized to absolute brightness levels.
- Optimized for contrasts (differences)
- We perceive color constancy: Colors understood as "same" but in different light



A and B are the same shade of gray (rgb 120:120:120)

Edward H. Adelson (1995) at http://web.mit.edu/persci/people/adelson/ checkershadow_illusion.html

Factors that Affect Color Perception

- **Separation**. Harder to differentiate when farther apart.

- **Saturation**. Less-saturated colors harder to differentiate.

- **Object size**. Smaller areas are harder to differentiate colors.

Color ‘Blindness’

- Not unable to see colors, not ‘blind’ to colors
- Have difficulty seeing differences in some pairs of colors
- Affects ~5-8% of men (rule of thumb “about 8%”)
- Affects ~0.5% of women (rule of thumb “about 1%”)

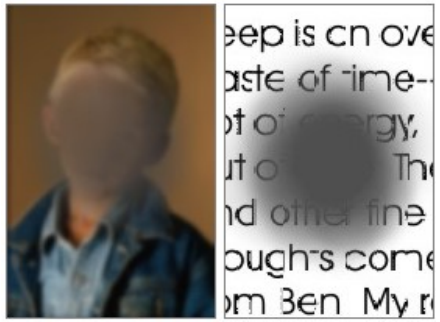
Types of Color Vision Deficiency (Color Blindness)

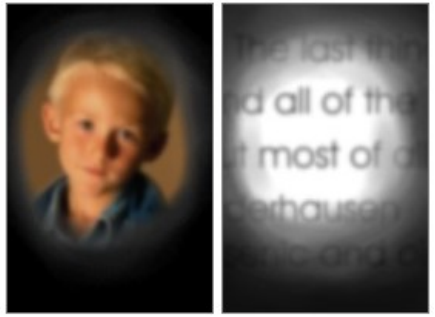
- **Red-Green**
  - Protanomaly – lower sensitivity to red
  - Protanopia – no ability to see red
  - Deuteranomaly – inability to differentiate red and green hues (5% of males)
  - Deuteranopia – moderate inability to differentiate red and green hues (1% of males)
- **Blue-Yellow (very rare = 0.01% of all people)**
  - Tritanomaly – reduced ability to distinguish some yellow and blue hues
  - Tritanopia – inability to distinguish some blues with greens, and some yellows with violet
- **Total**
  - Rod monochromacy – total inability to distinguish any color
  - Cone monochromacy – total inability to distinguish any color

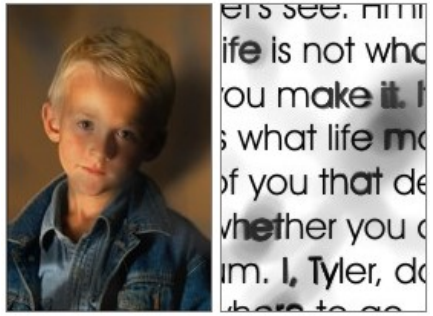
https://nei.nih.gov/health/color_blindness/facts_about

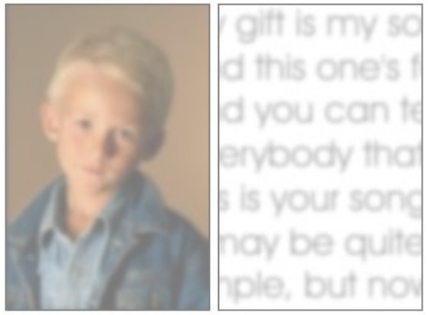
Low Vision

- Condition in which a person's vision cannot be fully corrected by glasses.
- Common in elderly, can occur in people any age as a result of:
  1. Macular degeneration (thinning of macula in center of retina)
  2. Glaucoma (damage to optic nerve due to pressure inside eye)
  3. Diabetic retinopathy (leaking of retinal blood vessels)
  4. Cataracts (opacity in lens).

1 

2 

3 

4 

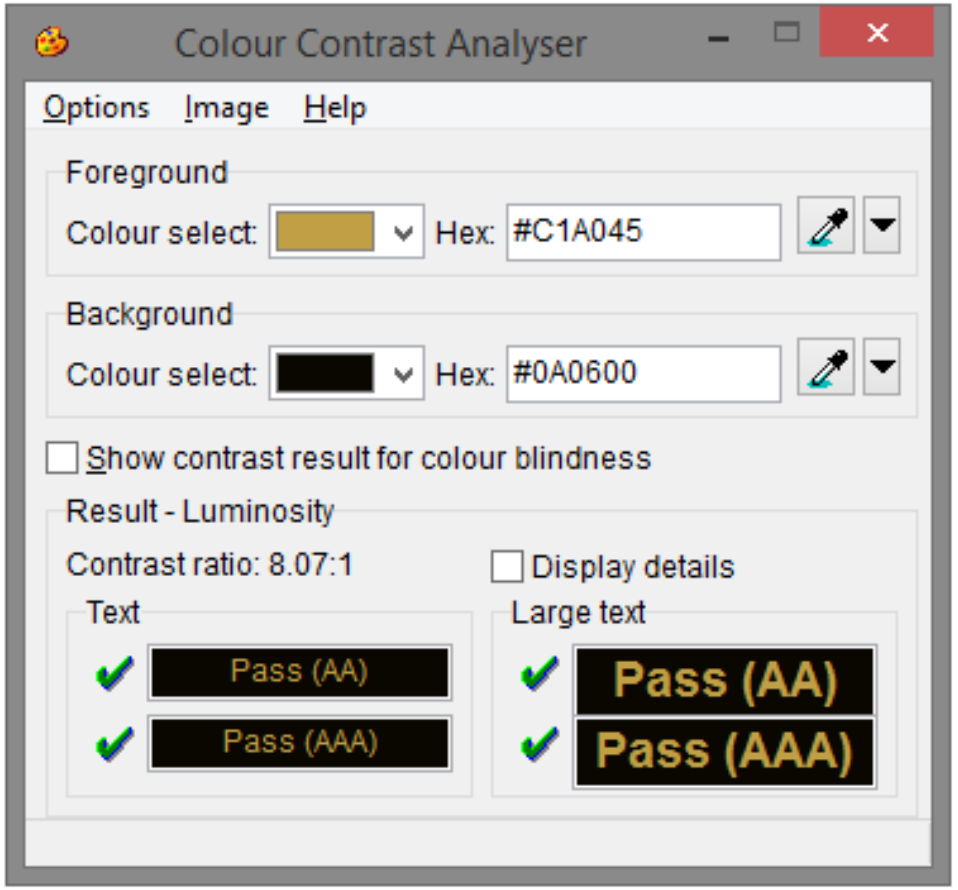
http://webaim.org/articles/visual/lowvision

Low Vision

- Mostly a concern of accessibility.
- Usually handled by users or their employers via technologies:
  - Screen readers
  - Browser and/or operating system settings
- Important to be aware of as UX designers

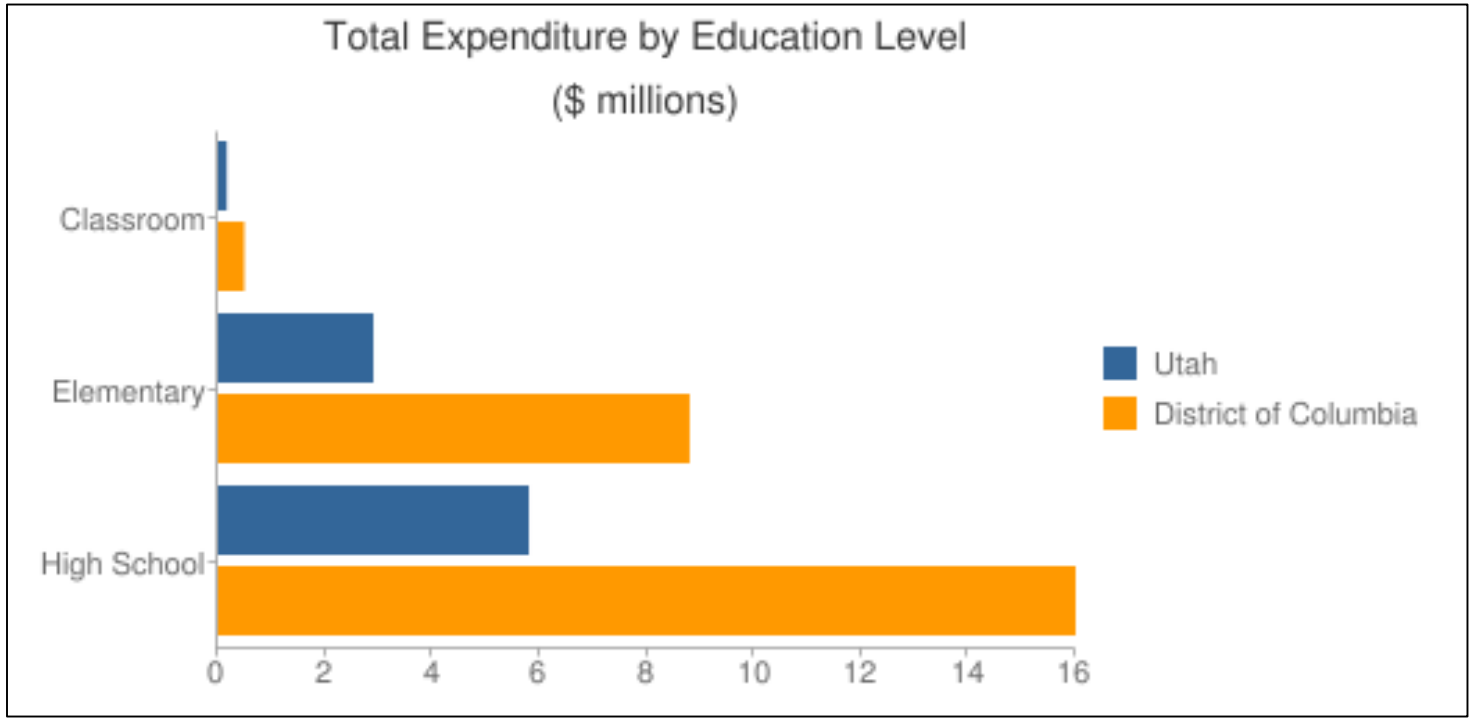
Using Color in Design Effectively

- Use a color blindness simulator tool, such as **Colour Contrast Analyzer**. There are several free ones.
- They show how interface appears to color-blind users.



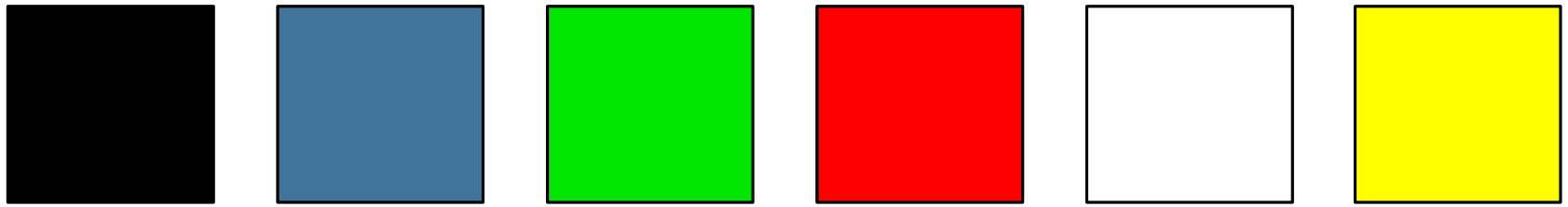
Using Color in Design Effectively

- Use color **with** text labels and/or icons or shapes. Don't let color stand alone to express meaning.



Using Color in Design Effectively

- Use distinctive colors: black, blue, green, red, white, yellow.



- Avoid subtle variations
  - Distinguish by brightness and saturation, not just hue.

Visual Perception: Summary, part 2

- Foveal vision = details (~2 cm circle on screen)
- Parafoveal vision assists foveal (~6 cm circle around foveal field)
- Effective design is aware of all 3: peripheral, parafoveal, and foveal
- Groupings and proximity are key tools for designers to leverage
- Users bring expectations to ***every*** interface
- We perceive contrast very well
- Avoid using color alone to express meanings (use text or shape)

Sensitivity of Perception

A few examples of perception sensitivity:

A typical person who possesses the following senses can …

- **Sight** – see a candle 30 miles away in total darkness
- **Sound** – in a silent room, hear a watch ticking 20 ft away
- **Smell** – smell a drop of perfume in about 800 sq. ft. of space
- **Touch** – feel one human hair on their skin
- **Taste** – a teaspoon of sugar in 2 gallons of water

Weinschenk, S. For People to Pay Attention to Something, They Must First Perceive It. *In 100 Things Every Designer Needs to Know About People*. pp. 112