

SI 388

Perception: Visual, Part 2

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

MARK THOMPSON-KOLAR

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

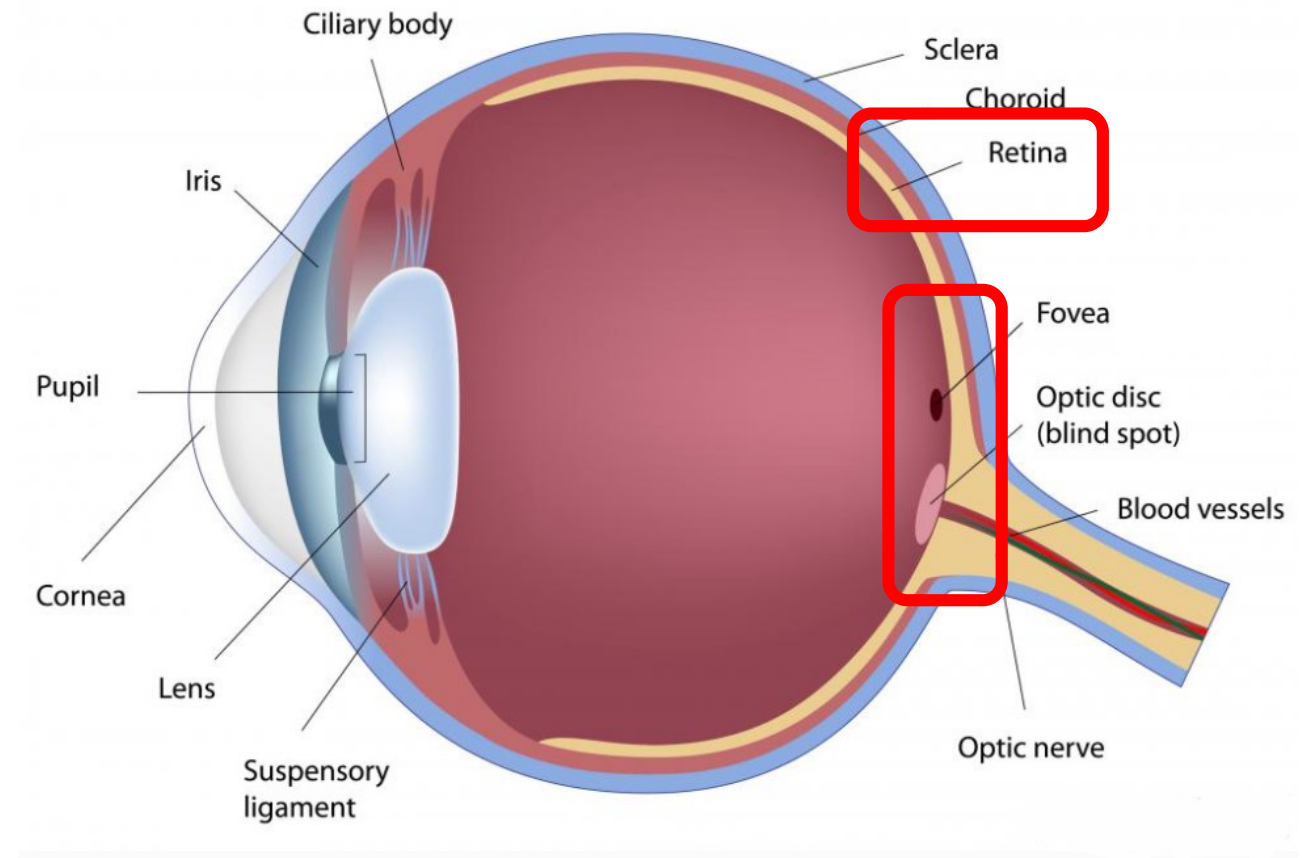
Visual Perception: So Far

- ❑ 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

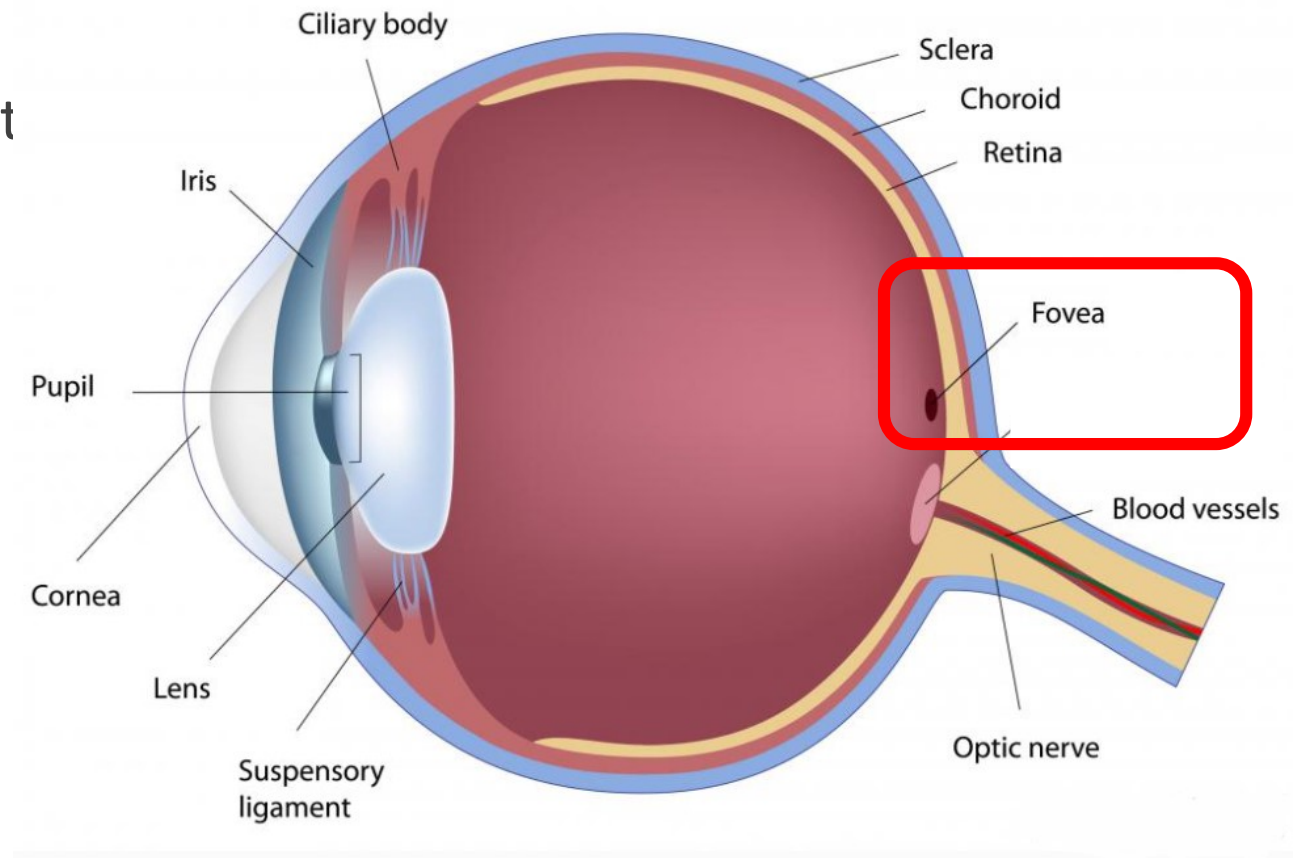
Main features for HCI (today)

- Retina
- Rods and cones
- Fovea



Fovea

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



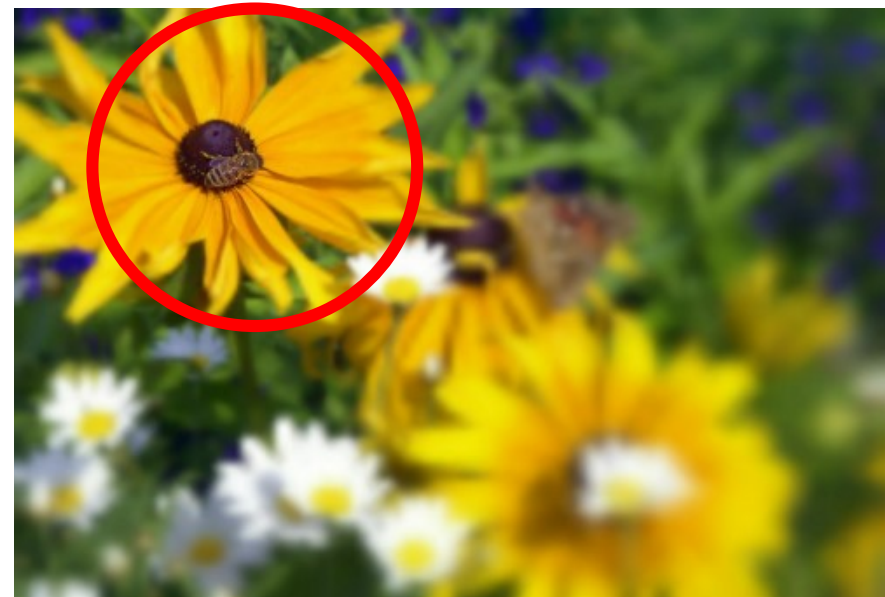
Fovea

- ❑ 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

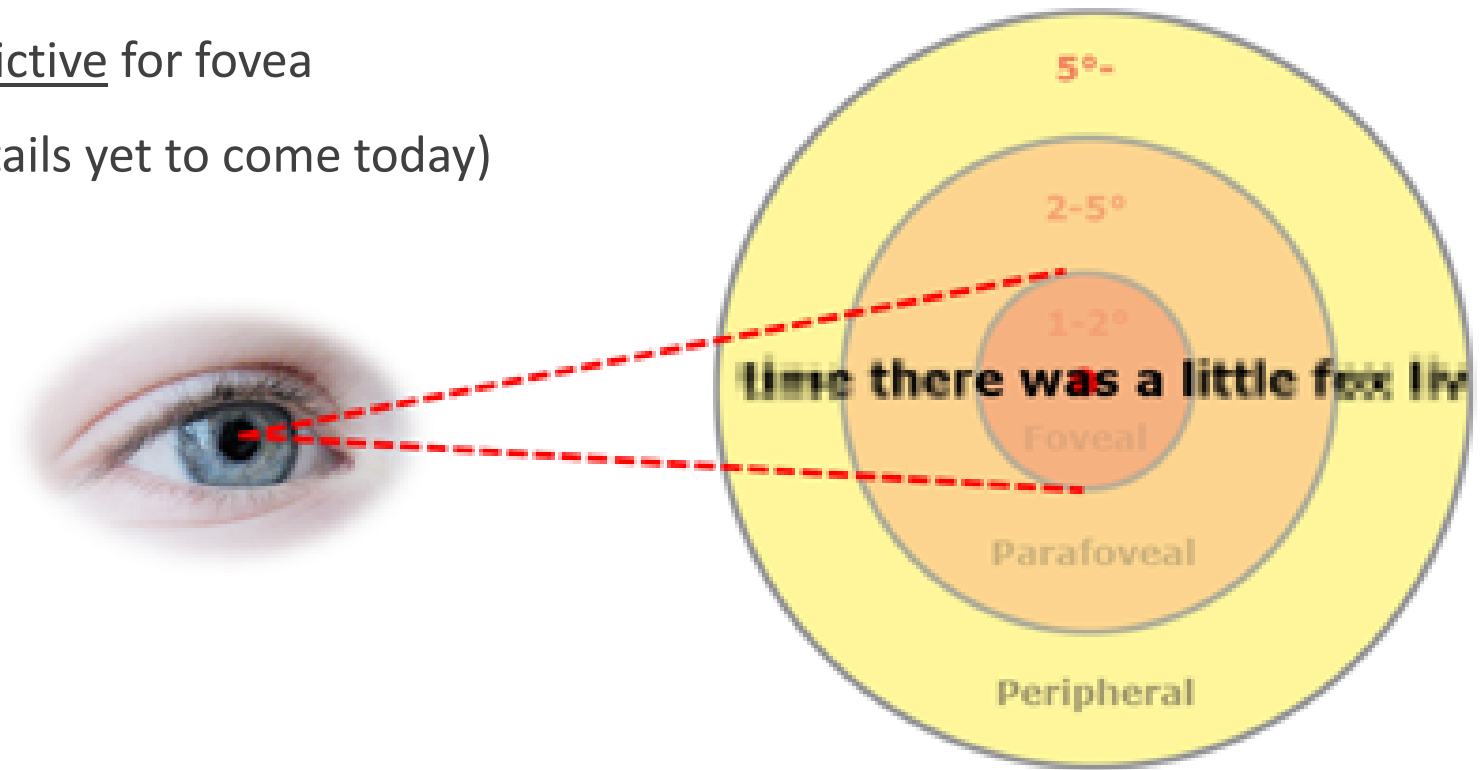
□ Why does it seem like we see better than this? ...

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



Try it



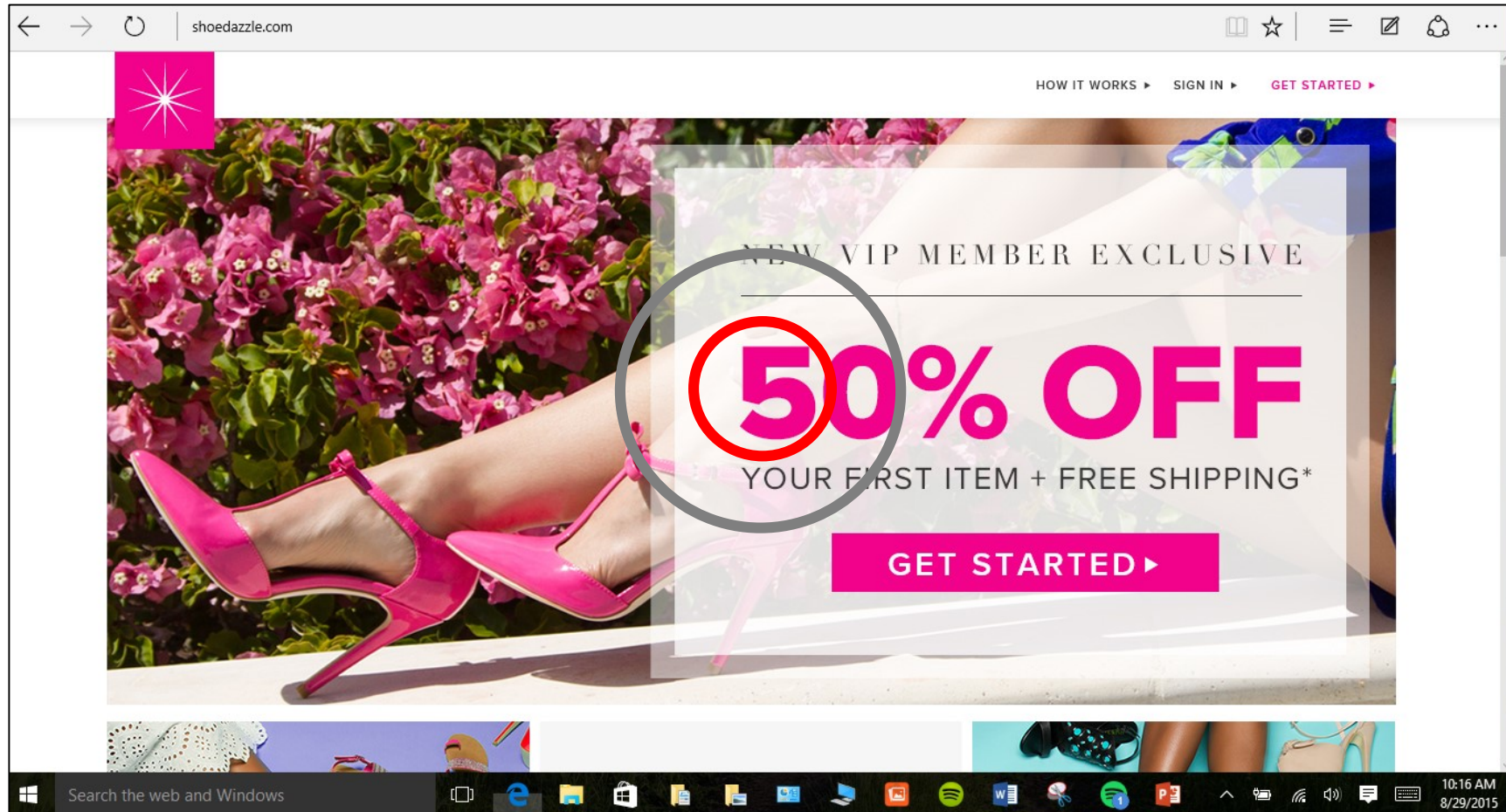
<https://people.cs.umass.edu/~mahadeva/papers/book-chapter.htm>

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

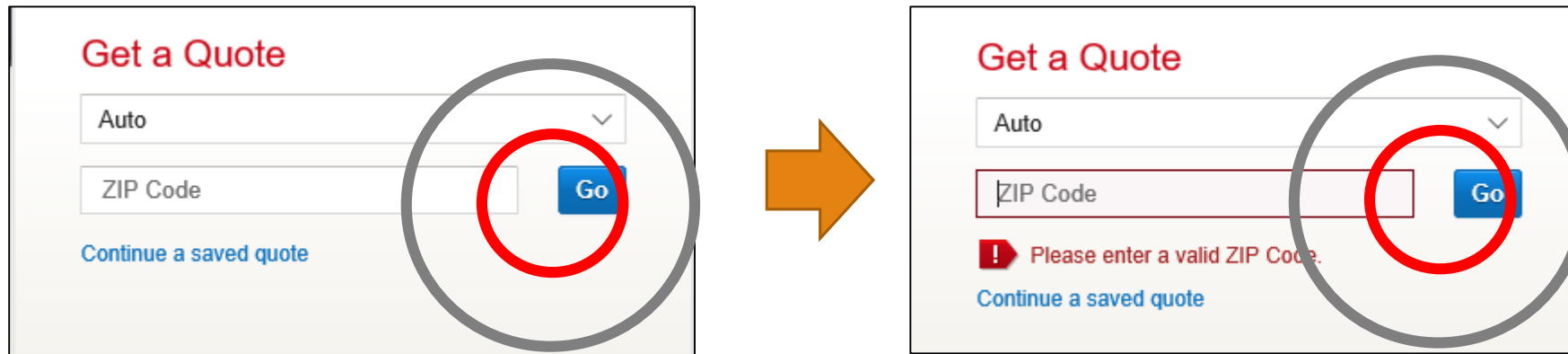


- ❑ What's in the foveal field at middle of the centerwell?
- ❑ ~2 cm
- ❑ What's in the parafoveal field?
- ❑ Why?

Designing for Foveal Vision

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

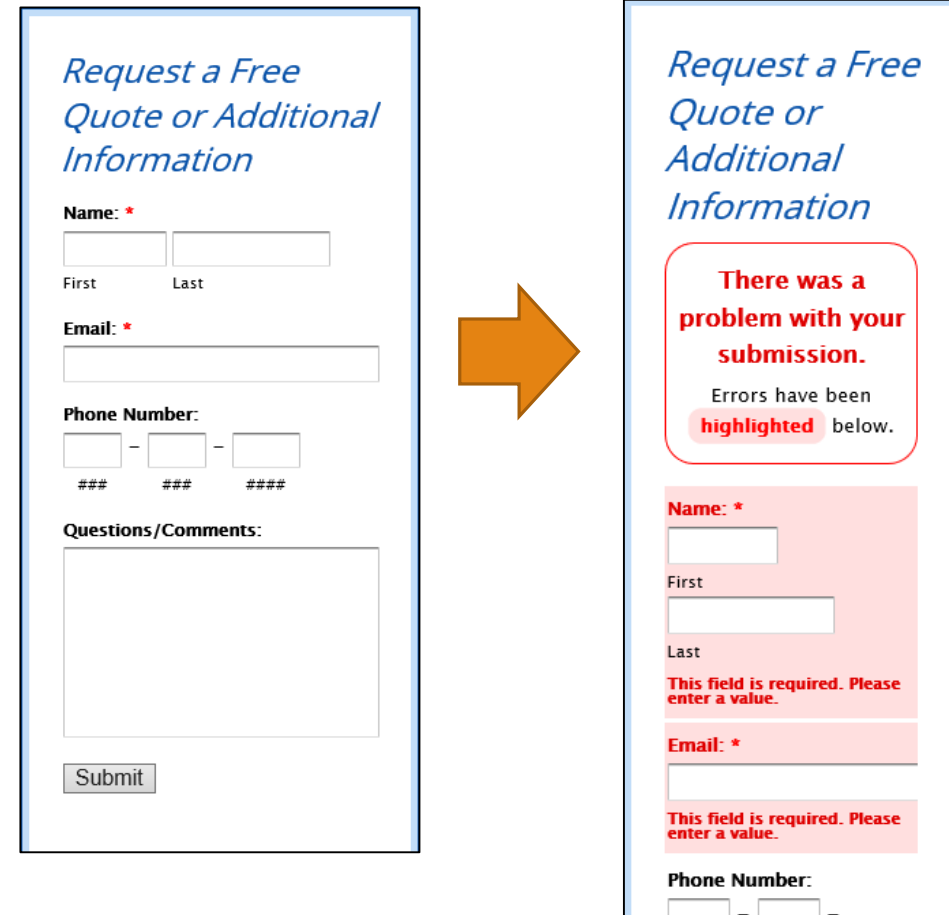
That's where the foveal vision is ...



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)



The diagram illustrates a transition from a standard form to an error state. On the left, a form titled "Request a Free Quote or Additional Information" contains fields for Name (First and Last), Email, Phone Number, and Questions/Comments, with a Submit button. An orange arrow points to the right, where the same form is shown in an error state. In this state, the form fields are highlighted in red, and a red box at the top contains the message: "There was a problem with your submission. Errors have been highlighted below." The error messages for the Name and Email fields are: "This field is required. Please enter a value."

Request a Free Quote or Additional Information

Name: *
First Last

Email: *

Phone Number:
- -
####

Questions/Comments:

Submit

Request a Free Quote or Additional Information

There was a problem with your submission.
Errors have been highlighted below.

Name: *
First Last
This field is required. Please enter a value.

Email: *
This field is required. Please enter a value.

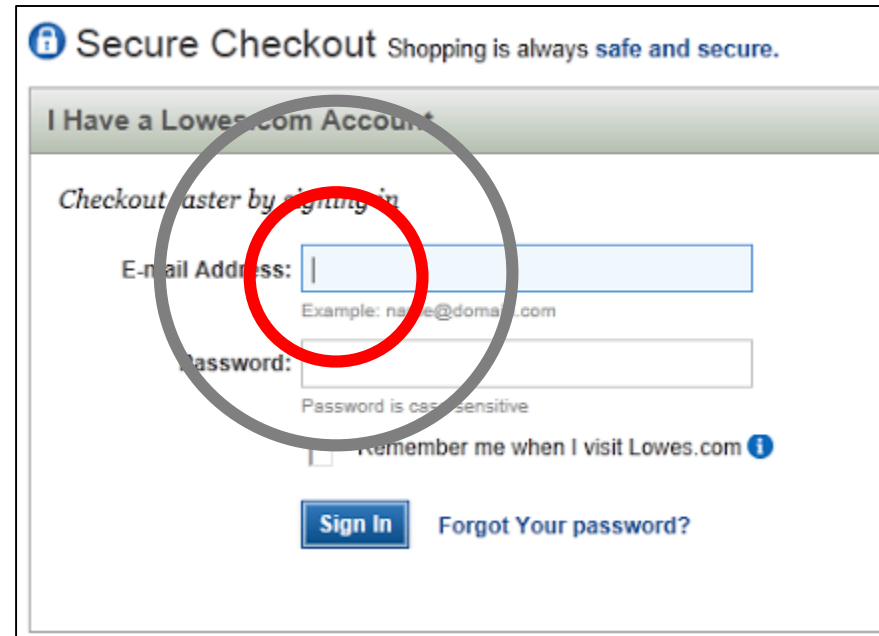
Phone Number:
- -

More Examples

Forms

What's in foveal vision?

What's in parafoveal vision?



The image shows a screenshot of a web form titled "Secure Checkout" with the subtext "Shopping is always safe and secure." Below this is a section header "I Have a Lowe's.com Account". The main heading for the form is "Checkout faster by signing in". There are two input fields: "E-mail Address:" and "Password:". The "E-mail Address:" field is highlighted with a red circle, and the "Password:" field is highlighted with a gray circle. Below the "E-mail Address:" field is an example: "Example: name@domain.com". Below the "Password:" field is the text "Password is case sensitive". At the bottom of the form is a checkbox labeled "Remember me when I visit Lowe's.com" with an information icon. Below the checkbox are two buttons: "Sign In" and "Forgot Your password?".

More Examples


Detail page

When user is interacting with the Width dropdown...


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

L.L.Bean > Men's > Footwear > Boots > Hiking ☒


Men's Gore-Tex Cresta Hiking Boots, Leather

★★★★★  [343 Reviews](#) | [Write a Review](#)


FREE \$10 Gift Card WITH PURCHASE OF \$50 OR MORE **\$10** [Details](#)



Item #: TA156659 **\$239.00**
FREE SHIPPING no minimum order.

Width:
Narrow B  [SIZE CHART](#)

Shoe Size:
11

 **Color:** Dark Brown

[Enter zip code](#) for delivery date.
(Most orders will arrive in 2-5 business days)


More Examples

Shopping Bag page

What's in foveal vision?

What's in parafoveal vision?

Added to Your Shopping Bag



Men's Gore-Tex Cresta Hiking Boots, Leather
Width: Narrow B
Shoe Size: 11
Color/Style: Dark Brown
\$239.00
Qty: 1

1 Item in Shopping Bag:	\$239.00
Est. Shipping & Handling:	FREE
Estimated Subtotal*:	\$239.00

This order qualifies for a Free \$10 Gift Card for use on your next order; limit one card per customer per 24-hour period (all applicable discounts are included in prices shown)*

[▶ CONTINUE SHOPPING](#)[▶ CHECK OUT](#)

*Excluding taxes, oversized delivery charges and L.L.Bean Visa Card savings, if applicable.

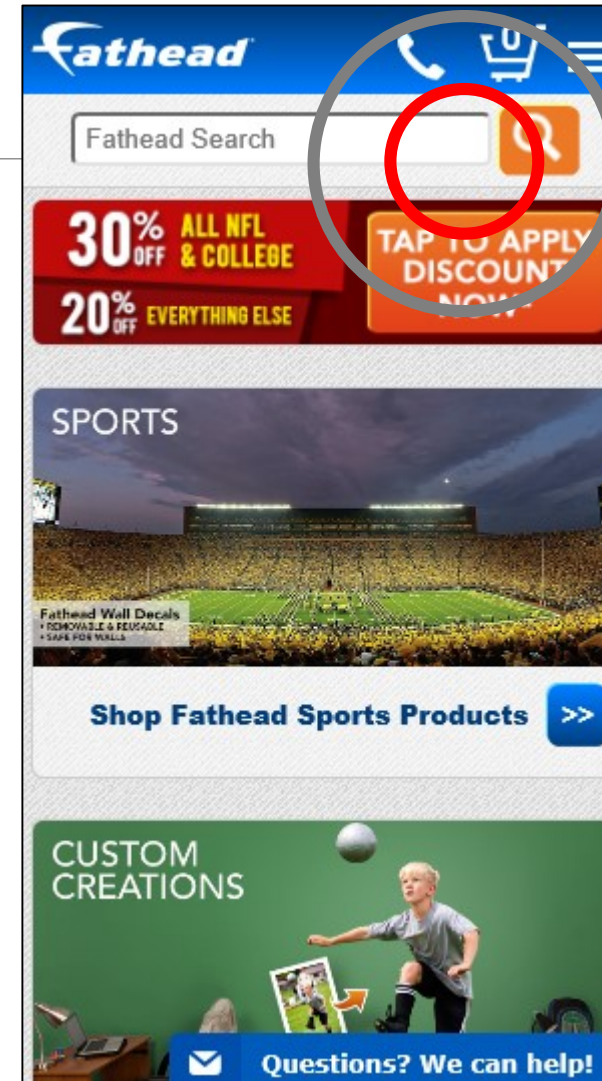
Customers Also Purchased

More Examples

Search

User is ready to try a search...

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

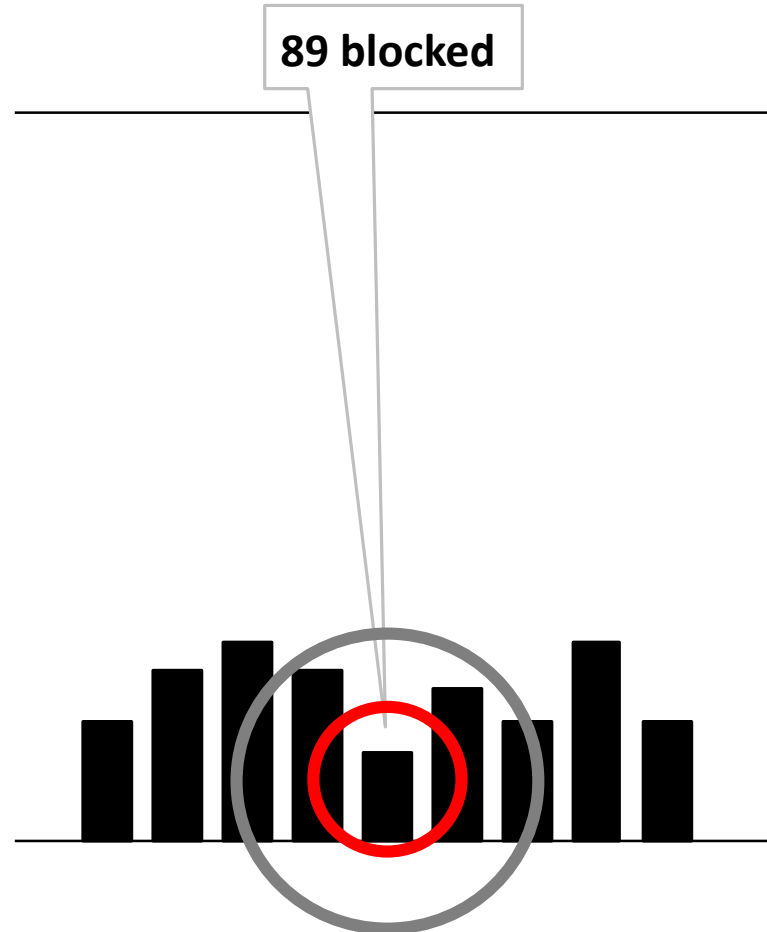


More Examples

Chart Callout

User wants to see
precise data...

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

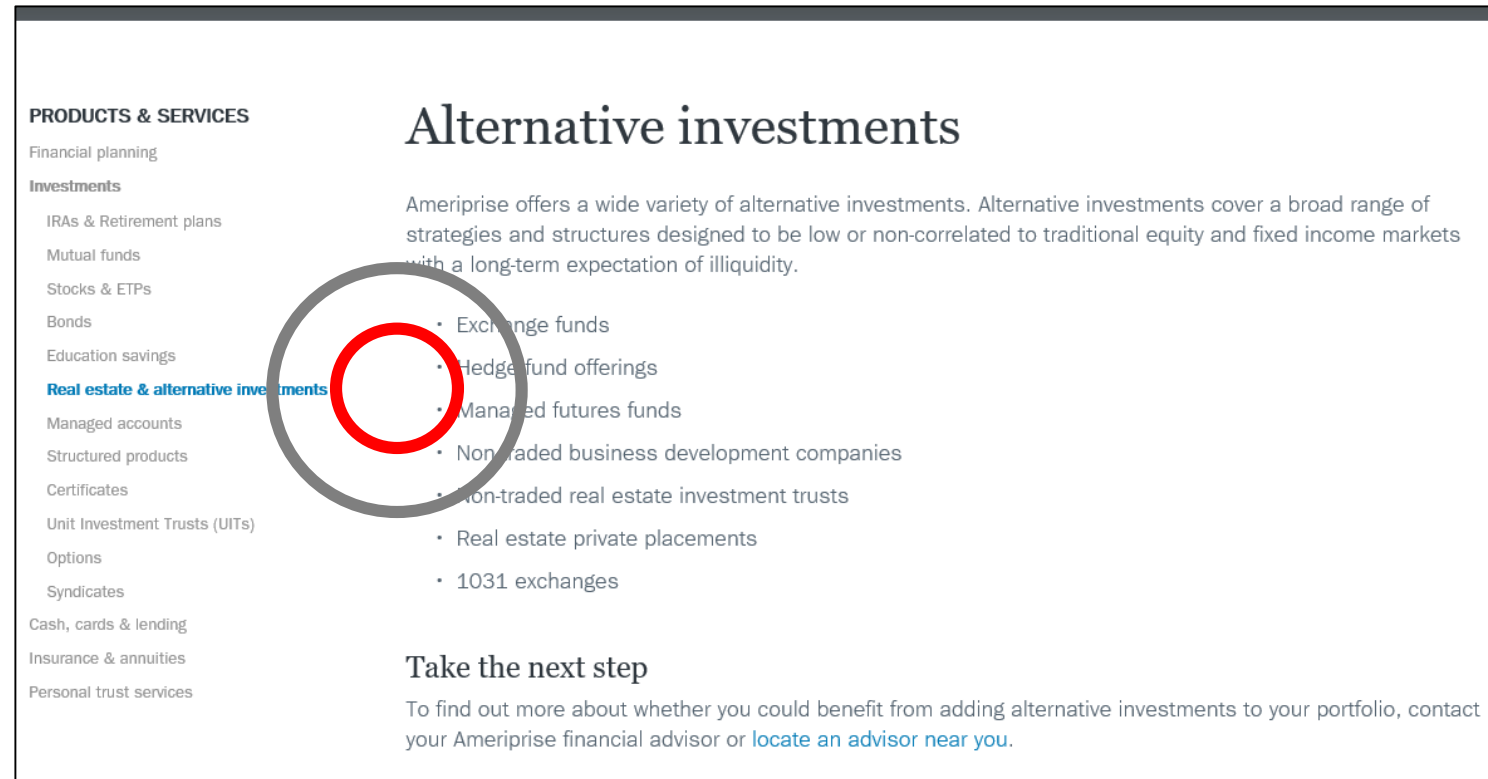


Directing Users' Eyes

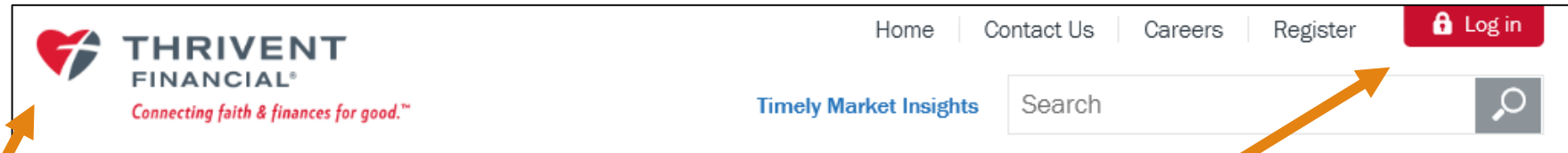
Highlighting navigational elements corresponding to current page is a best practice for orientation.

❑ 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.*

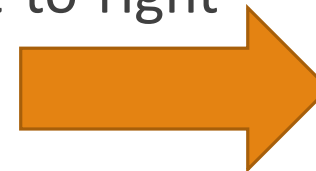
Log in element is red (salient), but how will users interpret it?

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



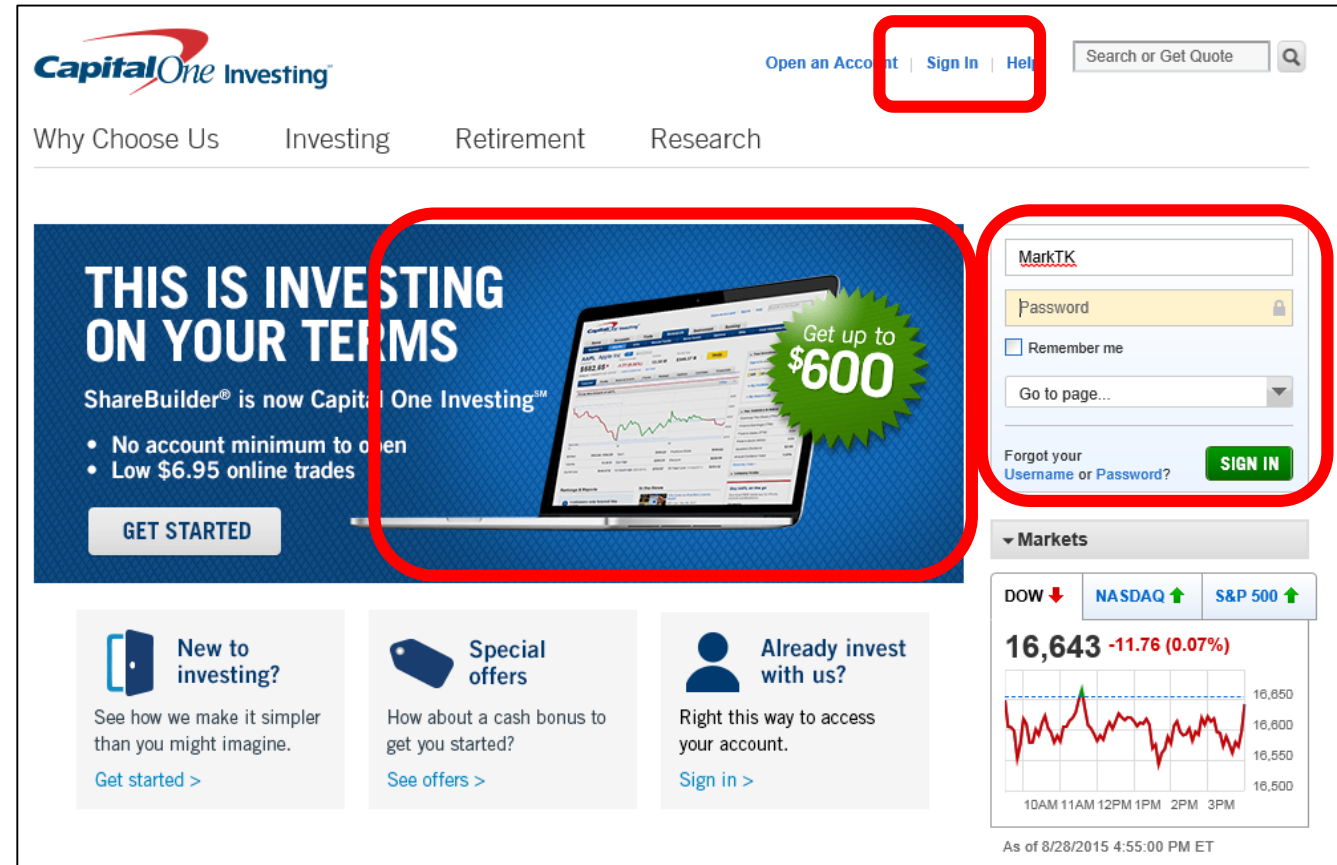
Examples ...

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 ...

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

Examples ...

Expectations Influence Where Users Look

Westerners typically read left to right in an 'F' pattern

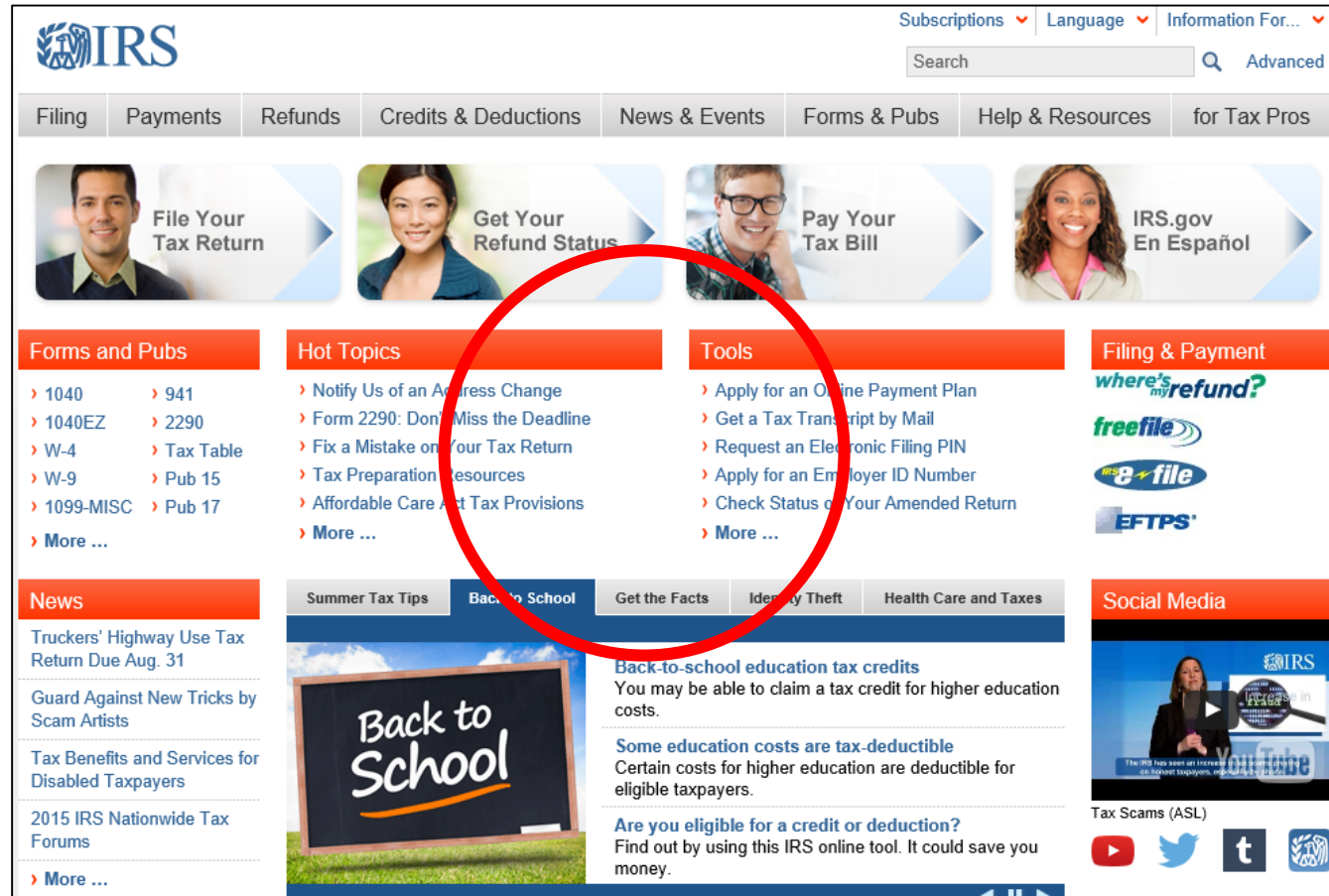
Weinschenk, S. (2011). *100 Things Every Designer Needs to Know About People*.



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

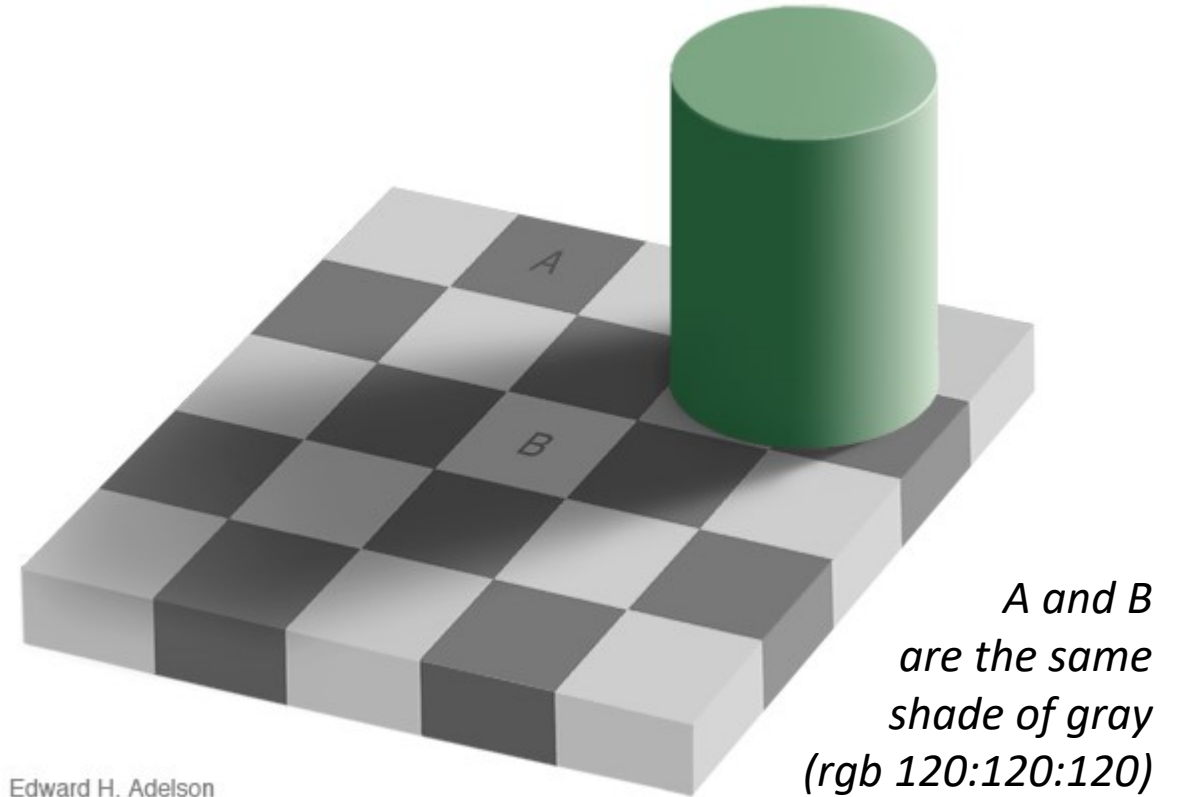
□ **Cones:**

- 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

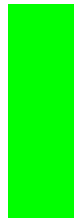


Edward H. Adelson

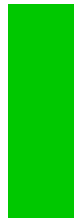
Edward H. Adelson (1995) at http://web.mit.edu/persci/people/adelson/checkershadow_illusion.html

Factors that Affect Color Perception

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

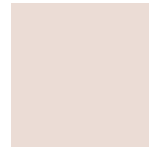


0/255/0

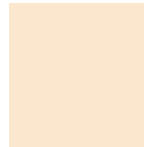


0/200/0

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



Brown



Orange

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



Tan



Gray

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).



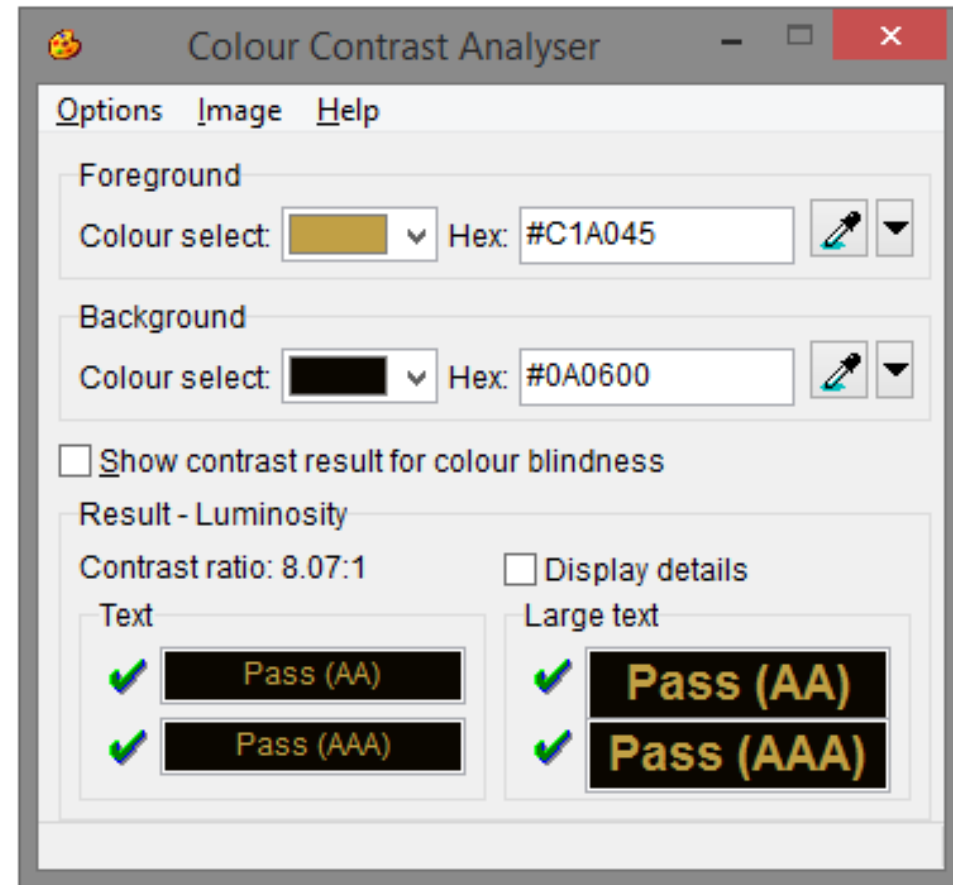
<http://webaim.org/articles/visual/lowvision>

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

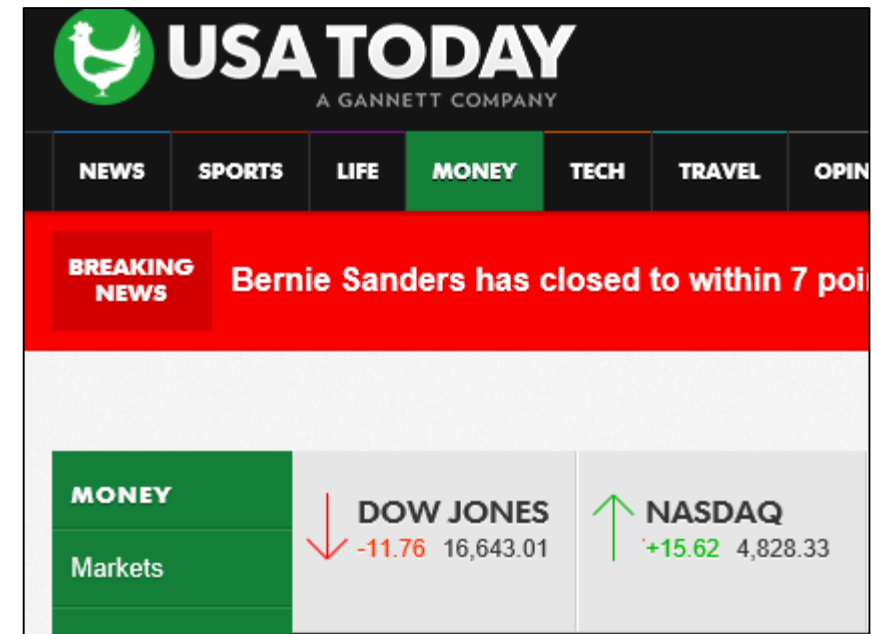
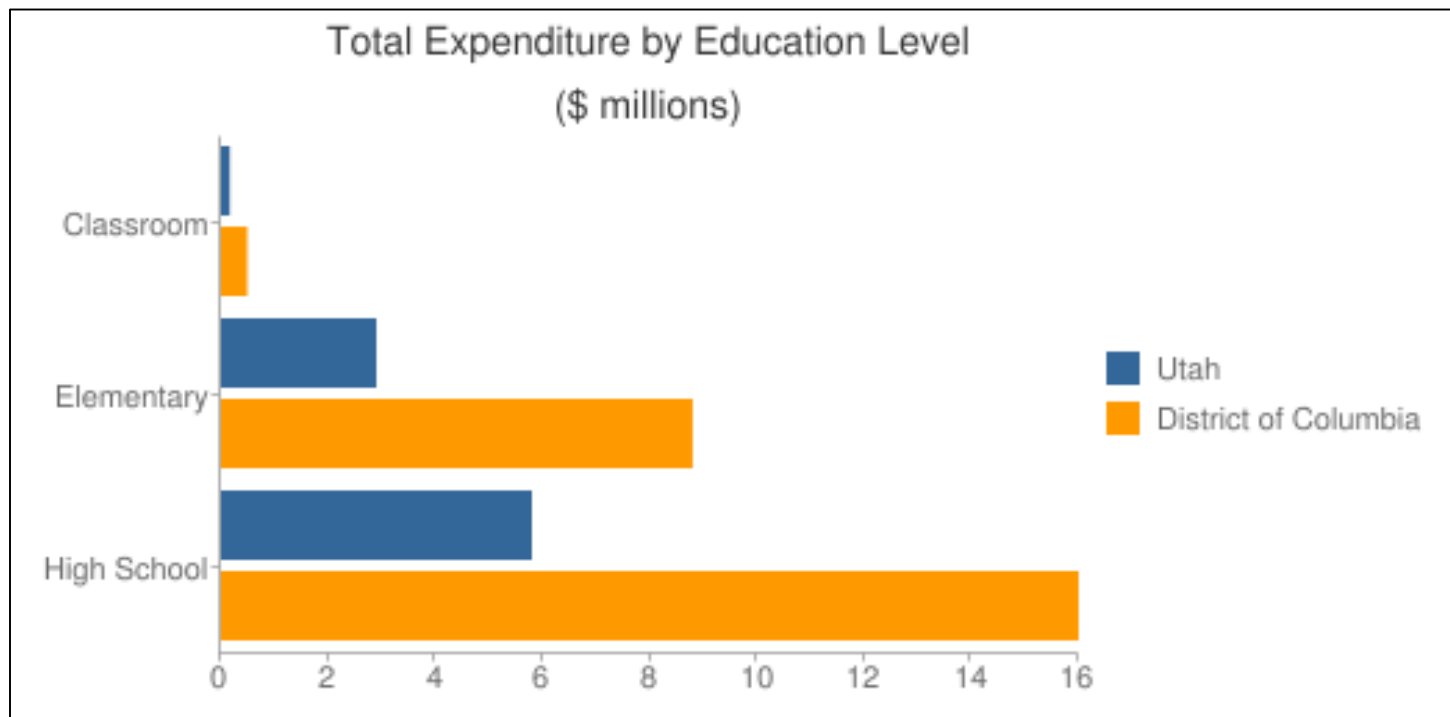
Using Color in Design Effectively

- ❑ 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.



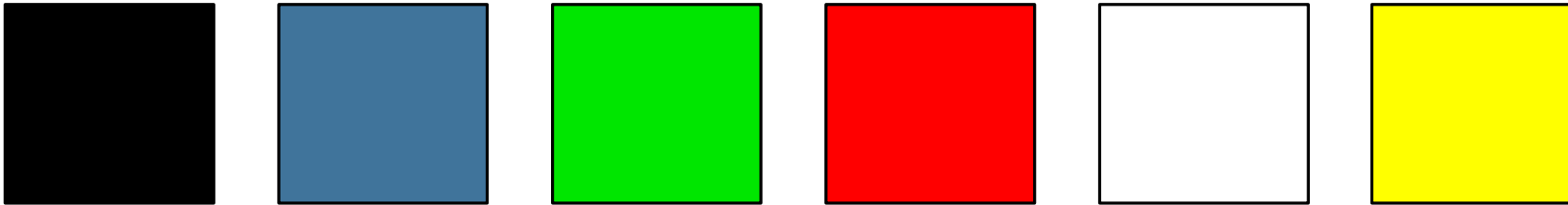
Using Color in Design Effectively

- 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