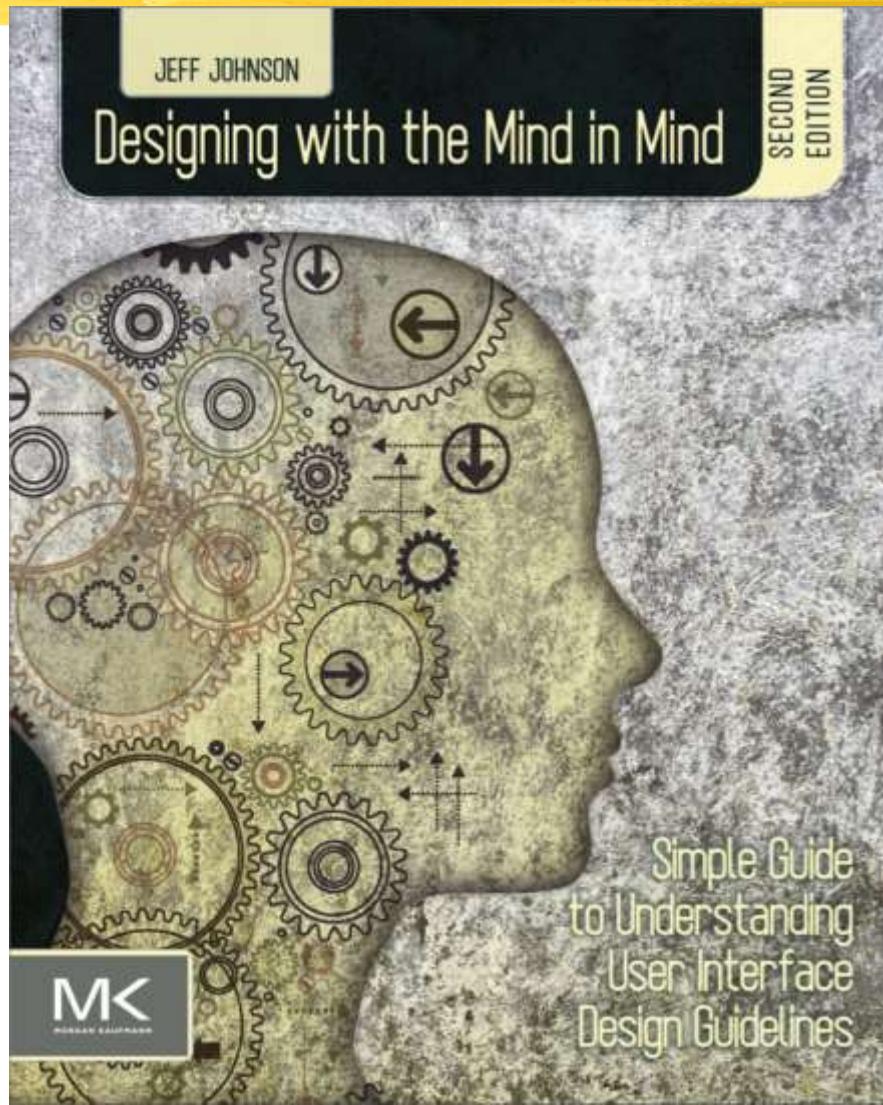


Designing with The Mind in Mind, 2nd Edition



RDS, INC.

PRODUCT USABILITY CONSULTING

Designing With the Mind in Mind:

The Psychological Basis for UI Design Guidelines

Jeff Johnson
UI Wizards, Inc.

UI Design Guidelines

(Shneiderman, 1987, 1998, ..., 2010)



- # Strive for consistency
- # Cater to universal usability
- # Offer informative feedback
- # Design task-flows to yield closure
- # Prevent errors
- # Permit easy reversal of actions
- # Make users feel *they* are in control
- # Minimize short-term memory load

UI Design Guidelines (Nielsen & Molich, 1993)



- ⌘ Visibility of system status
- ⌘ Match between system & real world
- ⌘ User control & freedom
- ⌘ Consistency & standards
- ⌘ Error prevention
- ⌘ Recognition rather than recall
- ⌘ Flexibility & efficiency of use
- ⌘ Aesthetic & minimalist design
- ⌘ Help users recognize, diagnose, & recover from errors
- ⌘ Provide online documentation & help

UI Design Guidelines (Stone *et al*, 2005)



- ⌘ **Visibility**: First step to goal should be clear
- ⌘ **Affordance**: Control suggests how to use it
- ⌘ **Feedback**: Should be clear what happened or is happening
- ⌘ **Simplicity**: as simple as possible & task-focused
- ⌘ **Structure**: content organized sensibly
- ⌘ **Consistency**: similarity for predictability
- ⌘ **Tolerance**: prevent errors, help recovery
- ⌘ **Accessibility**: usable by all intended users, despite handicap, access device, or environmental conditions

Applying Usability Guidelines



- # UI guidelines are based on how *people* perceive, think, learn, act
- # UI guidelines are *not* rote recipes
 - # E.g., “minimize short-term memory load”
- # Applying them effectively requires understanding their scientific basis
 - ↗ Determining rule applicability & precedence
 - ↗ Balancing trade-offs between competing rules

Facts about Human Perception & Cognition



Perception

- # Our perception is biased
- # Our vision is optimized to see structure
- # We seek and use visual structure
- # Our color vision is limited
- # Our peripheral vision is poor
- # Visual search is linear unless target “pops”
- # Reading is unnatural

Facts about Human Perception & Cognition (cont.)



Cognition

- ⌘ Our attention is limited; Our memory is imperfect
- ⌘ Limits on attention shape our thought & action
- ⌘ Recognition is easy; recall is hard
- ⌘ Learning from experience & learned actions are easy; problem-solving & calculation are hard
- ⌘ Many factors affect learning
- ⌘ Our hand-eye coordination follows rules
- ⌘ Human decision-making is rarely rational
- ⌘ We have real-time requirements

Our Perception is Biased



Our perception is biased by:

- ⌘ Our experience
- ⌘ The context
- ⌘ Our goals

Our Perception is Biased



Our Perception is Biased



Our Perception is Biased

Page 1

Back

Next

Page 3

Back

Next

Page 2

Back

Next

Page 4

Next

Back

Our Perception is Biased

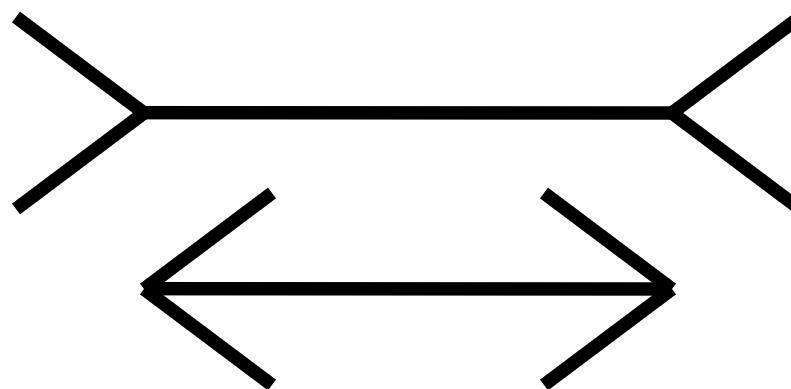


THE CHT

Our Perception is Biased

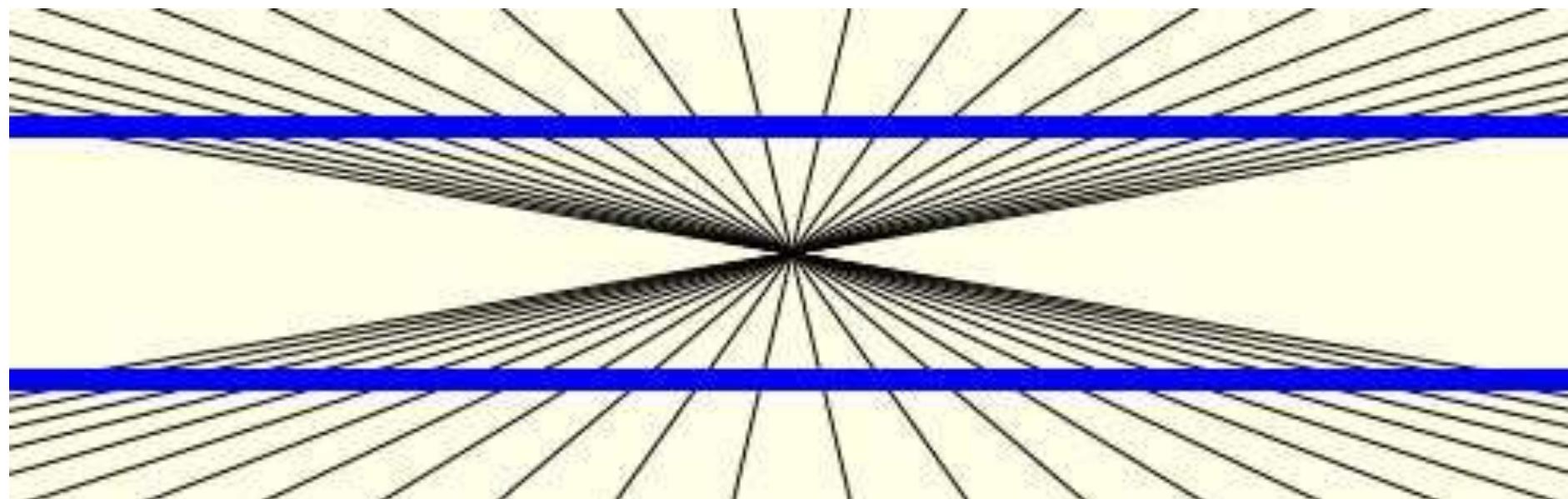


Müller-Lyer illusion



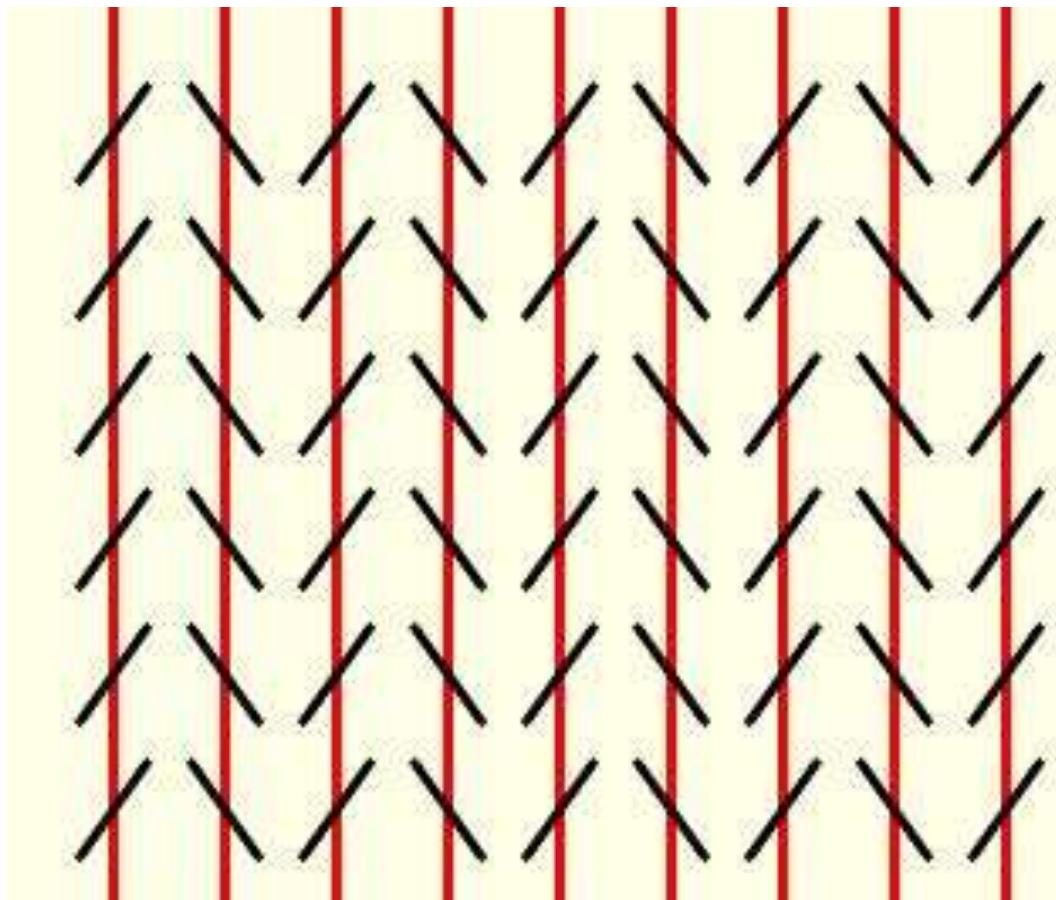
Our Perception is Biased

All lines in this image are straight!



Our Perception is Biased

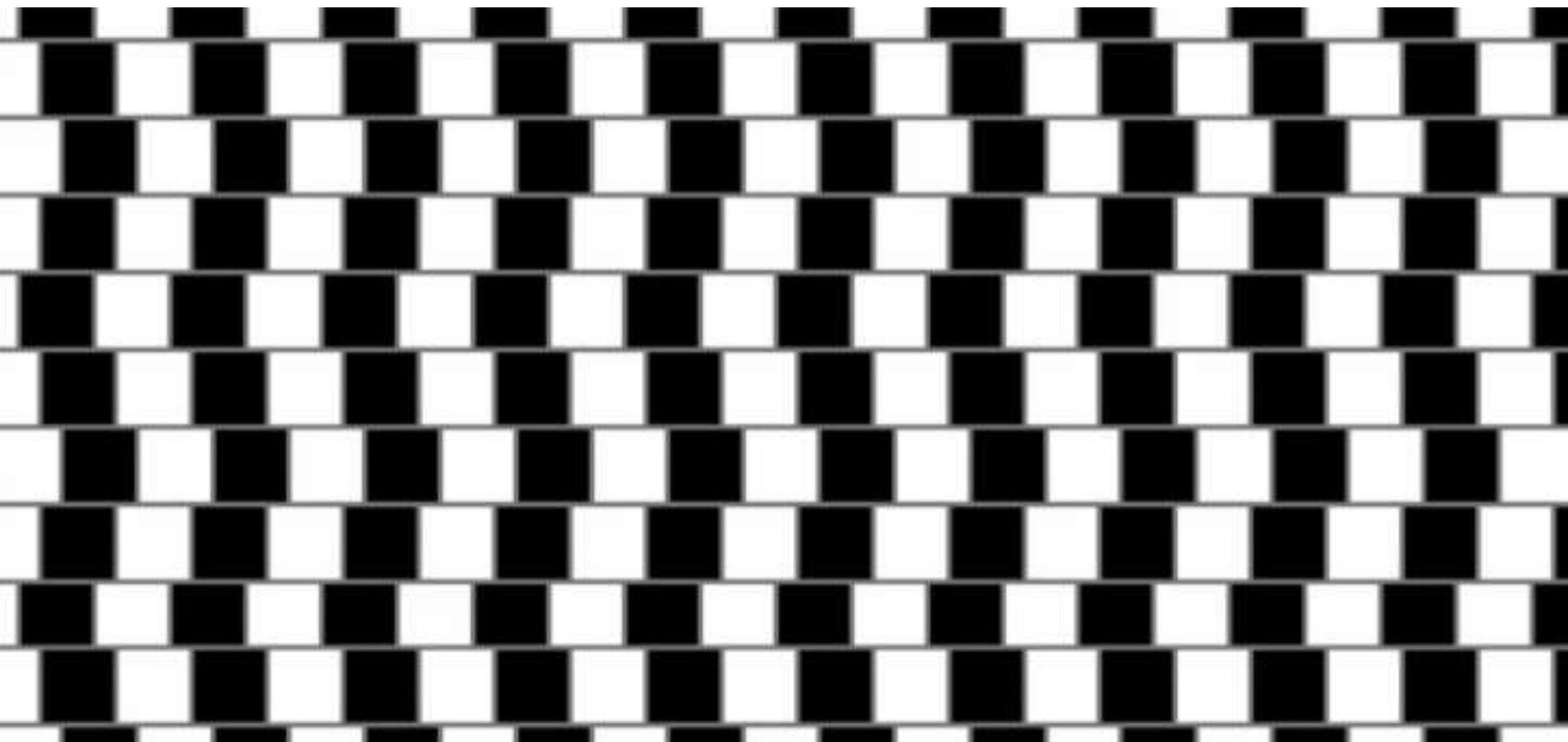
Red vertical lines are parallel!



Our Perception is Biased

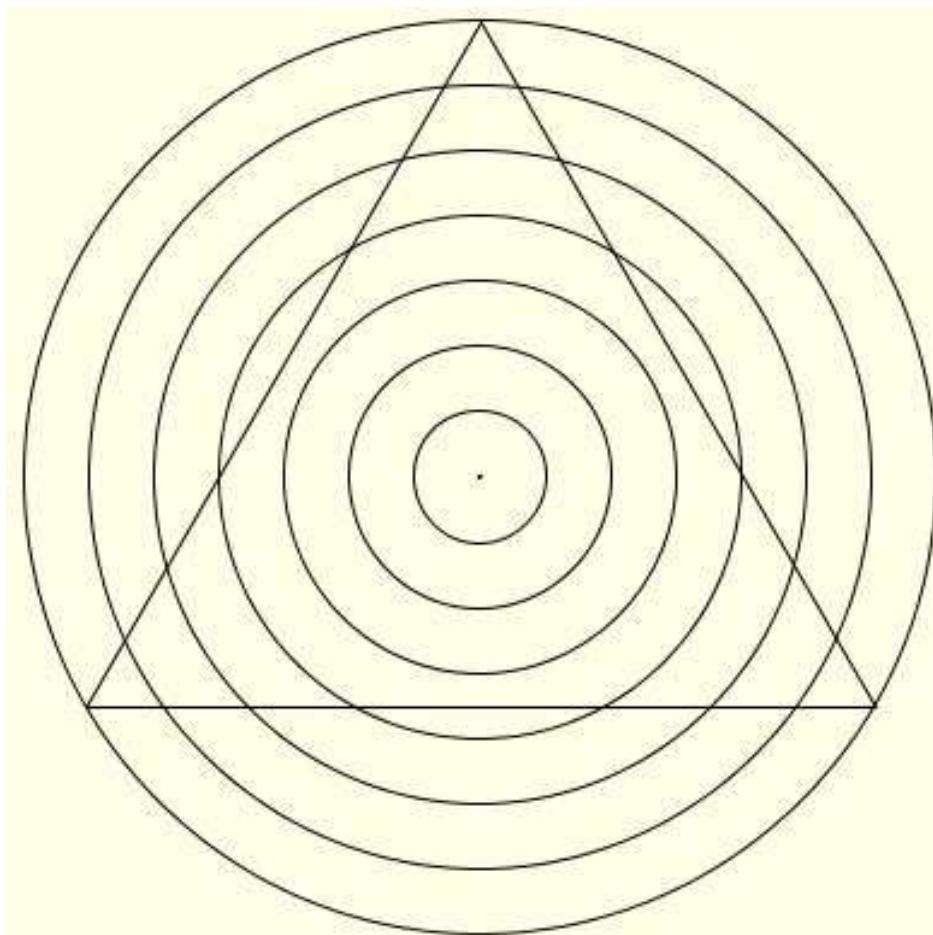


Gray lines are horizontal, straight, and parallel!



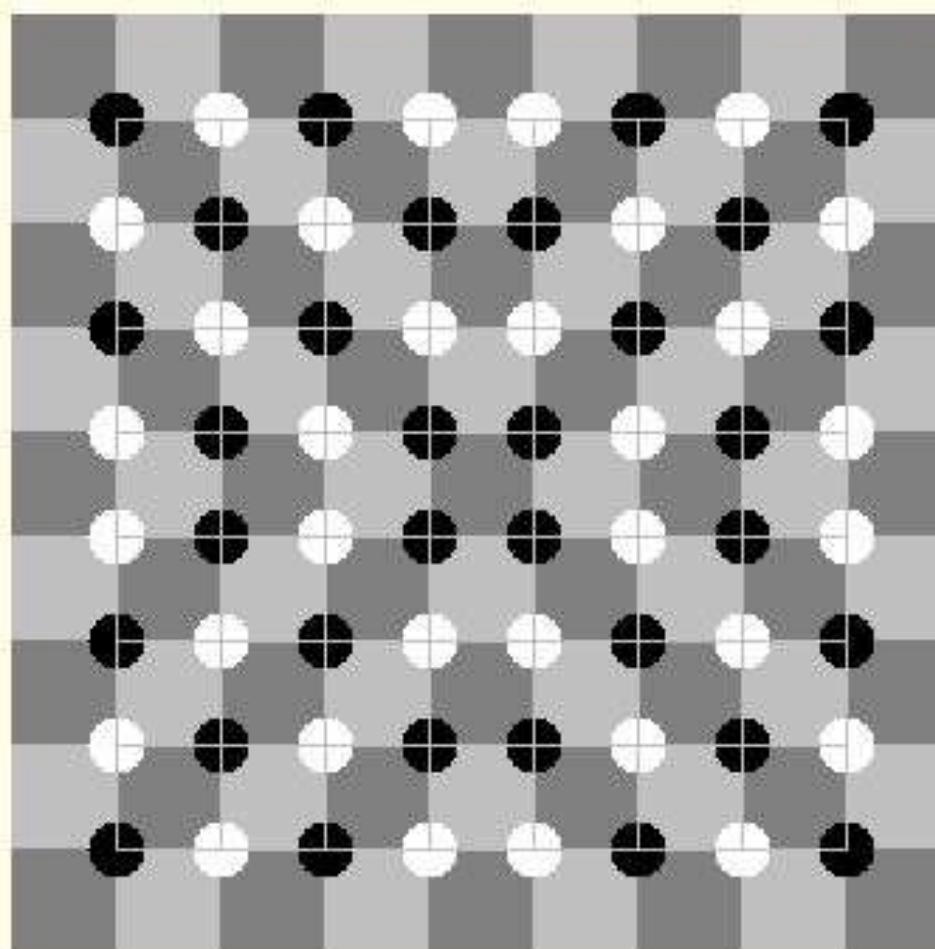
Our Perception is Biased

Triangle sides are not bent inward!



Our Perception is Biased

Checkerboard does not bulge in middle!





Video by Mark Mitton & Josh Aviner

Our Perception is Biased

- ⌘ Adults' perception & attention focuses almost totally on our goals
- ⌘ Tend not to notice things unrelated to goal



Our Perception is Biased

The University of Canterbury homepage features several sections and navigation links:

- Navigation Bar:** Home, Study, Courses, Departments, Students, Research, Teaching, Contact, Search, and a magnifying glass icon.
- UC Logo:** UNIVERSITY OF CANTERBURY, Te Whare Wānanga o Waitaha, CHRISTCHURCH NEW ZEALAND.
- Courses:** A section featuring a video thumbnail of a student and the text "Courses".
- International:** A section featuring a video thumbnail of a landscape and the text "International".
- Liaison:** A section featuring a video thumbnail of two people and the text "Liaison".
- Scholarships:** A section featuring a video thumbnail of a group of people and the text "Scholarships".
- Postgraduate:** A section featuring a video thumbnail of a computer screen and the text "Postgraduate".
- Text on the right:** Nau mai, haere mai ki te Whare Wānanga o Waitaha.

Information for dropdown menu:

- Prospective Students
- International Students
- Postgraduate Students**
- Current Students
- Visitors and Community
- Business and Industry
- Alumni and Friends
- Prospective Staff



Expert to talk about captive elephants

6 May 2013 | Erin Ivory, one of the world's leading

WHAT'S HAPPENING

Events: NEW CAREER AHEAD!

What can I do with a degree from UC?

Introducing the UC Careers Kit

Explore over 70 major subjects and discover where a UC degree can take you.

Congratulations!
You have been randomly selected to win \$100!
Claim at Bursars' Office,
with Reward Code 03D4X

Our Vision is Optimized to See Structure

2

Gestalt Principles of Visual Perception

⌘ Proximity

⌘ Similarity

⌘ Continuity

⌘ Closure

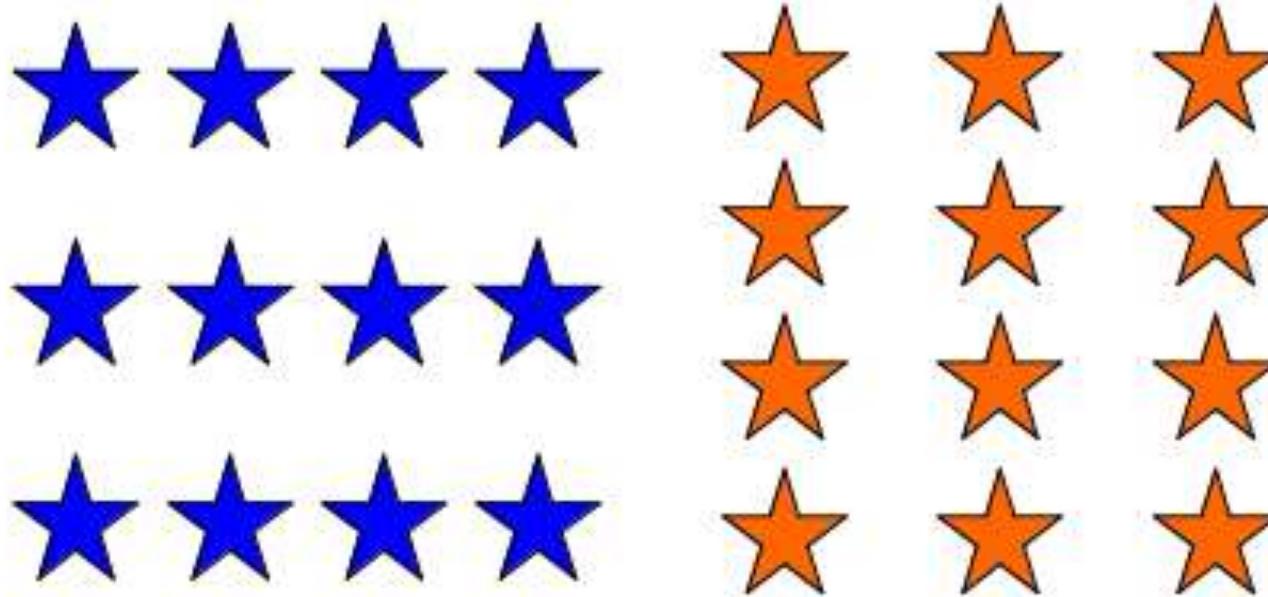
⌘ Symmetry

⌘ Figure/ground

⌘ Common fate

Gestalt Principle: Proximity

⌘ Items that are closer appear grouped

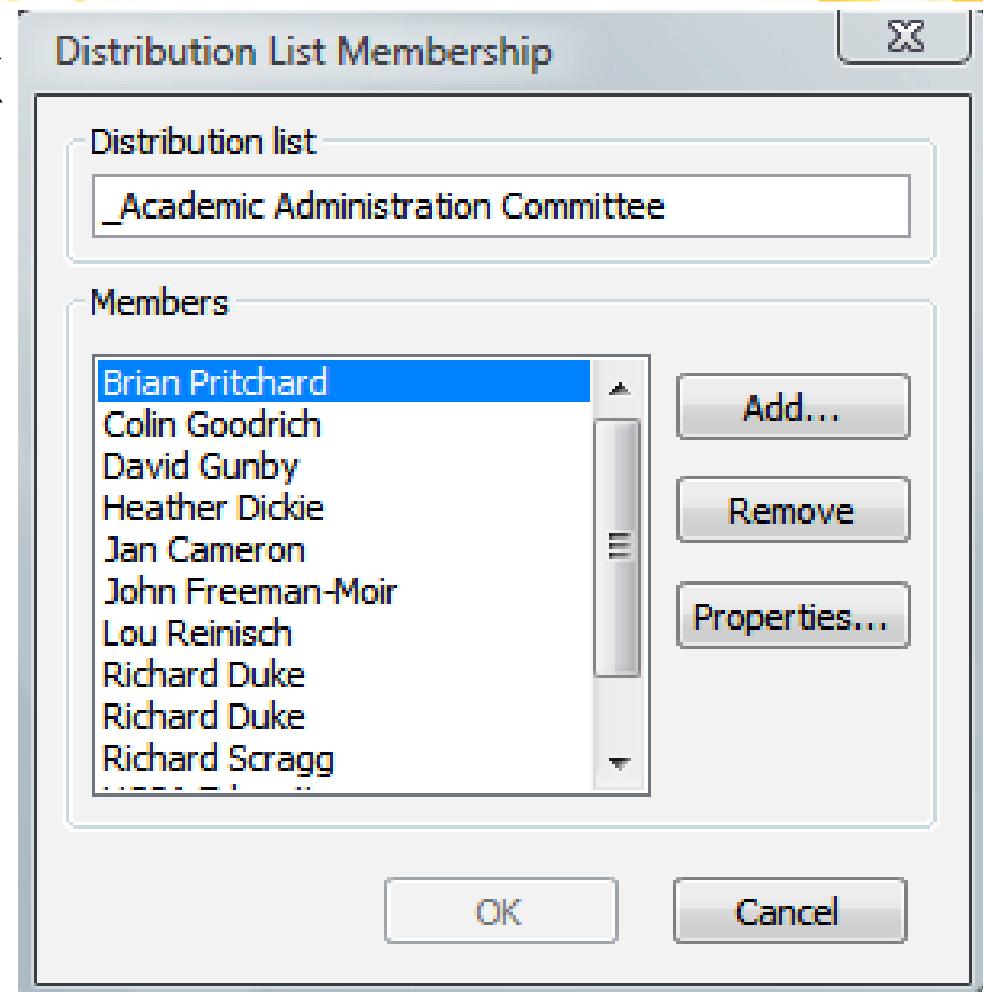


⌘ Left: rows

Right: columns

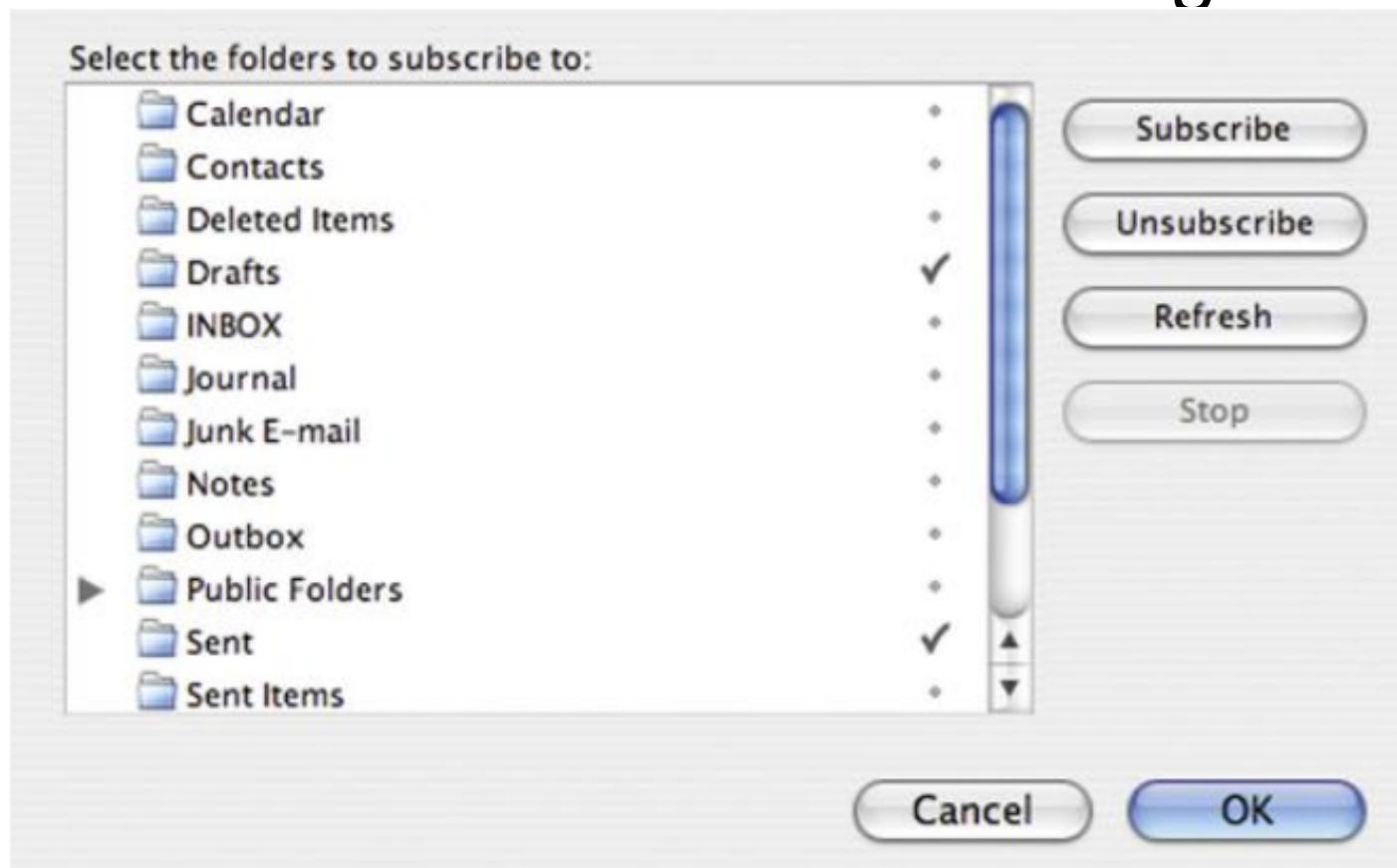
Gestalt Principle: Proximity

⌘ Outlook dialog box
uses group boxes
to separate items



Gestalt Principle: Proximity

⌘ Good: Mozilla Thunderbird dialog box



Gestalt Principle: Proximity

⌘ Google search-results

[Orchidaceae - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/Orchidaceae ▾

Orchids are easily distinguished from other plants, as they share some very evident apomorphies. Among these are: bilateral symmetry (zygomorphism), many ...

[Etymology](#) - [Distribution](#) - [Taxonomy](#) - [Characteristics](#)

[orchids, gift orchids, hobby growing](#)

www.orchids.com/ ▾

Orchids.com Logo, Login | Home | My Account | Customer Service · Sign In or Register | Shopping Cart. 1-888-4ORCHID (1-888-467-2443) - 9 am-5 pm (Pacific) ...

[Pacific Orchid Exposition - San Francisco Orchid Society](#)

www.orchidsanfrancisco.org/poe.html ▾

The San Francisco Orchid Society would like to express its thanks to the Taiwan Tourist Bureau CBS and KCBS for their continued support in production and ...

[Orchids in the Park - San Francisco Orchid Society](#)

www.orchidsanfrancisco.org/orchidsinthepark.html ▾

Thanks to all volunteers and attendees for a successful "Orchids In The Park" event. --
Images by Jeff Harris. --Images by Jeff Harris. <back to top> ...

Gestalt Principle: Proximity

⌘ Bad:
Fake
Google
search-
results
without
blank
space

[Orchidaceae - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/Orchidaceae ▾

Orchids are easily distinguished from other plants, as they share some very evident apomorphies. Among these are: bilateral symmetry (zygomorphism), many ...

[Etymology](#) - [Distribution](#) - [Taxonomy](#) - [Characteristics](#)

[orchids](#), [gift orchids](#), [hobby growing](#)

www.orchids.com/ ▾

Orchids.com Logo, Login | Home | My Account | Customer Service · Sign In or Register | Shopping Cart. 1-888-4ORCHID (1-888-467-2443) - 9 am-5 pm (Pacific) ...

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Thanks to all volunteers and attendees for a successful "Orchids In The Park" event. – Images by Jeff Harris. –Images by Jeff Harris. <back to top> ...

Gestalt Principle: Proximity

⌘ Bad: Discreet Software Installer

3ds max 6 components

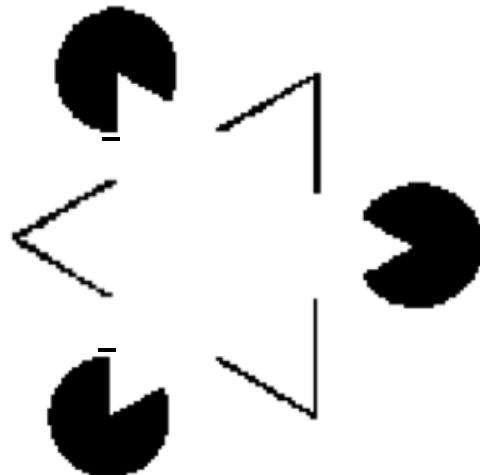
Add	Remove		installation action
<input checked="" type="radio"/>	<input type="radio"/>	3ds max 6 application	install
<input checked="" type="radio"/>	<input type="radio"/>	3ds max 6 documentation	install
<input checked="" type="radio"/>	<input type="radio"/>	3ds max 6 samples	install
<input checked="" type="radio"/>	<input type="radio"/>	3ds max 6 architectural materials	install
<input type="radio"/>	<input checked="" type="radio"/>	3ds max 6 SDK	remain uninstalled
<input checked="" type="radio"/>	<input type="radio"/>	character studio 4.2	install

Add will install any components not currently installed.

Remove will uninstall any components currently installed.

Gestalt Principle: Closure

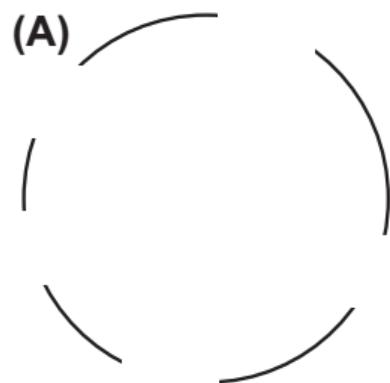
- ⌘ We tend to see whole, closed objects, not collections of fragments



- ⌘ Overlapping circles & triangles, not odd fragments

Gestalt Principle: Closure

- ⌘ We tend to see whole, closed objects, not collections of fragments

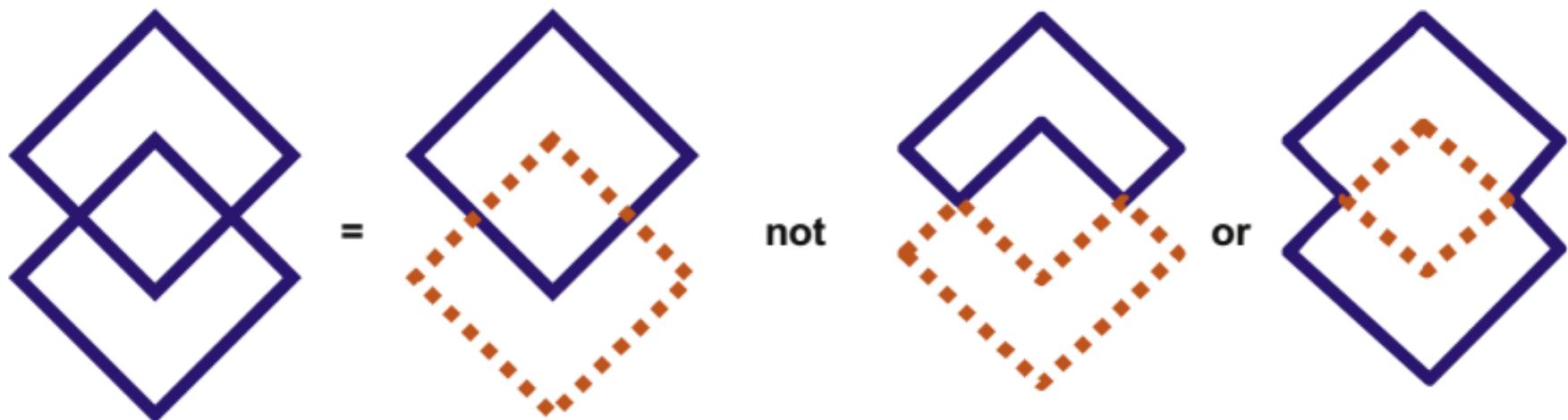


- ⌘ Stacked letters, not odd bits of images



Gestalt Principle: Symmetry

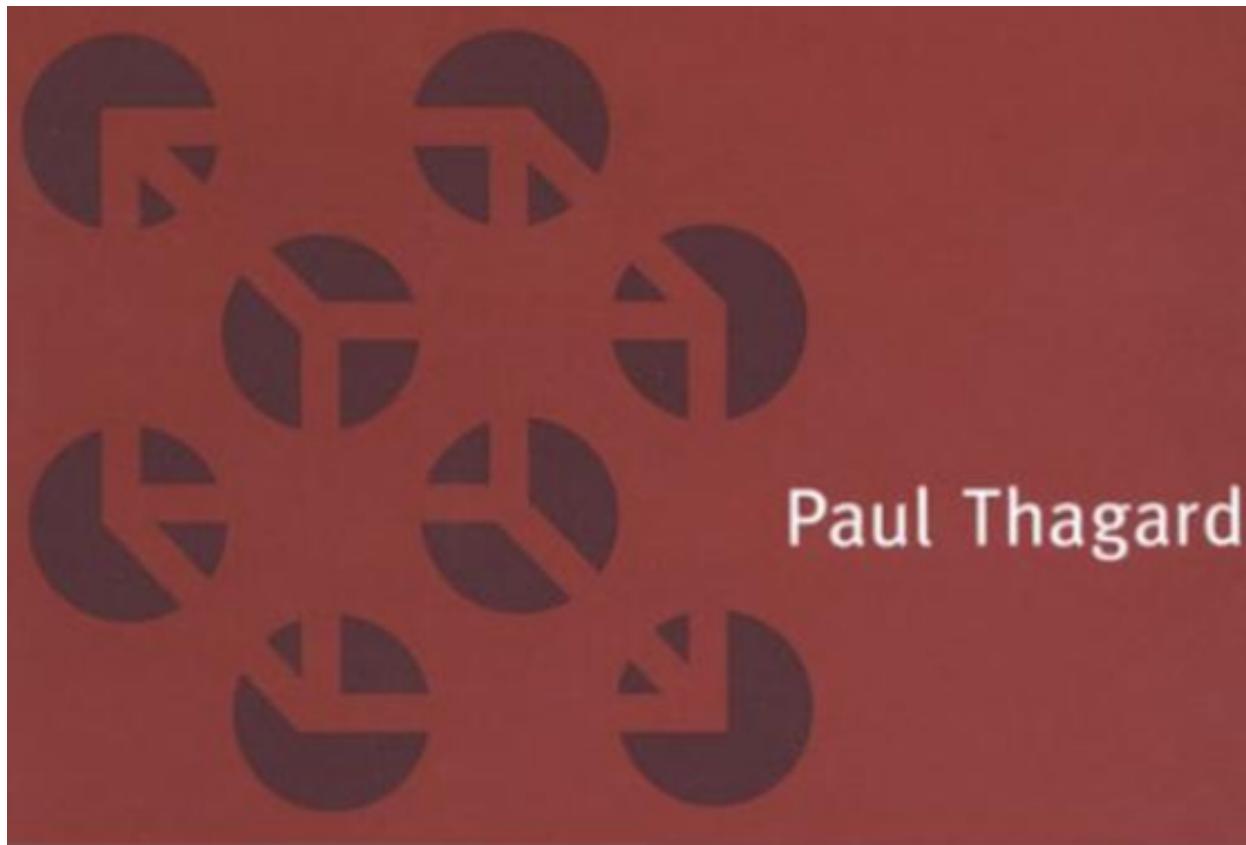
⌘ We tend to see simple figures rather than complex ones



⌘ E.g., two overlapping diamonds;
not other, more complex combinations

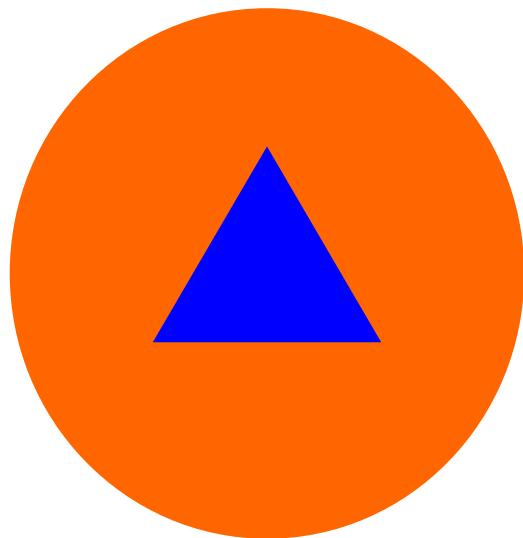
Gestalt Principle: Symmetry

⌘ Thagard: *Coherence in Thought & Action*



Gestalt Principle: Figure/Ground

- ⌘ When objects overlap, we see smaller as figure on ground (larger)



- ⌘ Escher exploited figure/ground ambiguity

Gestalt Principle: Figure/Ground



Verizon 10:17 PM 80%

PBS: Public Broadcasting Service

www.pbs.org/ Search

Don't show again

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Download on iTunes

Archives

- » May 2011
- » February 2011
- » May 2010
- » April 2010
- » February 2010

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Ande Photos

Documenting the HIV/AIDS Crisis in Sub-Saharan Africa
Photographed by Karen Ande

Home About Bookstore Portfolio Projects Press Contact

"These are the faces of children and their families living in a world of AIDS. Their spirit, their determination, and their resilience inspire all of us to join their fight. We are one world, and these children are our children, their destiny is our destiny. Each of us can make a difference." —Archbishop Desmond Tutu

Karen Ande and Ruthann Richter Receive Eric Hoffer Book Award

May 30th, 2011

The book *Face to Face: Children of the AIDS Crisis in Africa* has been honored with an Eric Hoffer Award as one of the best books in the "Culture" category, the Hoffer Award committee announced May 26.

2011 Eric Hoffer Award WINNER

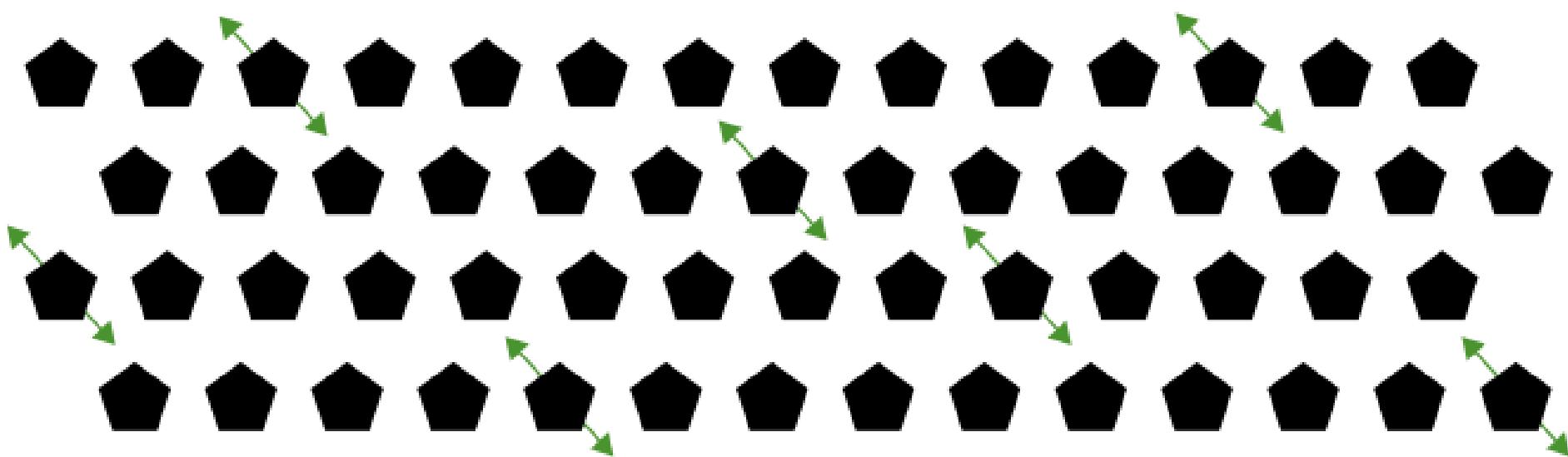
Karen Ande is independent Publishing

This book combines the compassionate personal narrative of award-winning medical writer Ruthann Richter with emotionally compelling photographs taken by documentary photographer Karen Ande. The book documents the lives of AIDS-positive children from the most deprived areas of southern Africa, living in places such as the Mama Dafne Children's Centre and the Soweto Children's Home, that have lost one or both parents to AIDS/HIV and/or have themselves contracted the disease renders an emotional and deeply personal perspective of a crisis affecting 12 million children living in sub-Saharan Africa.

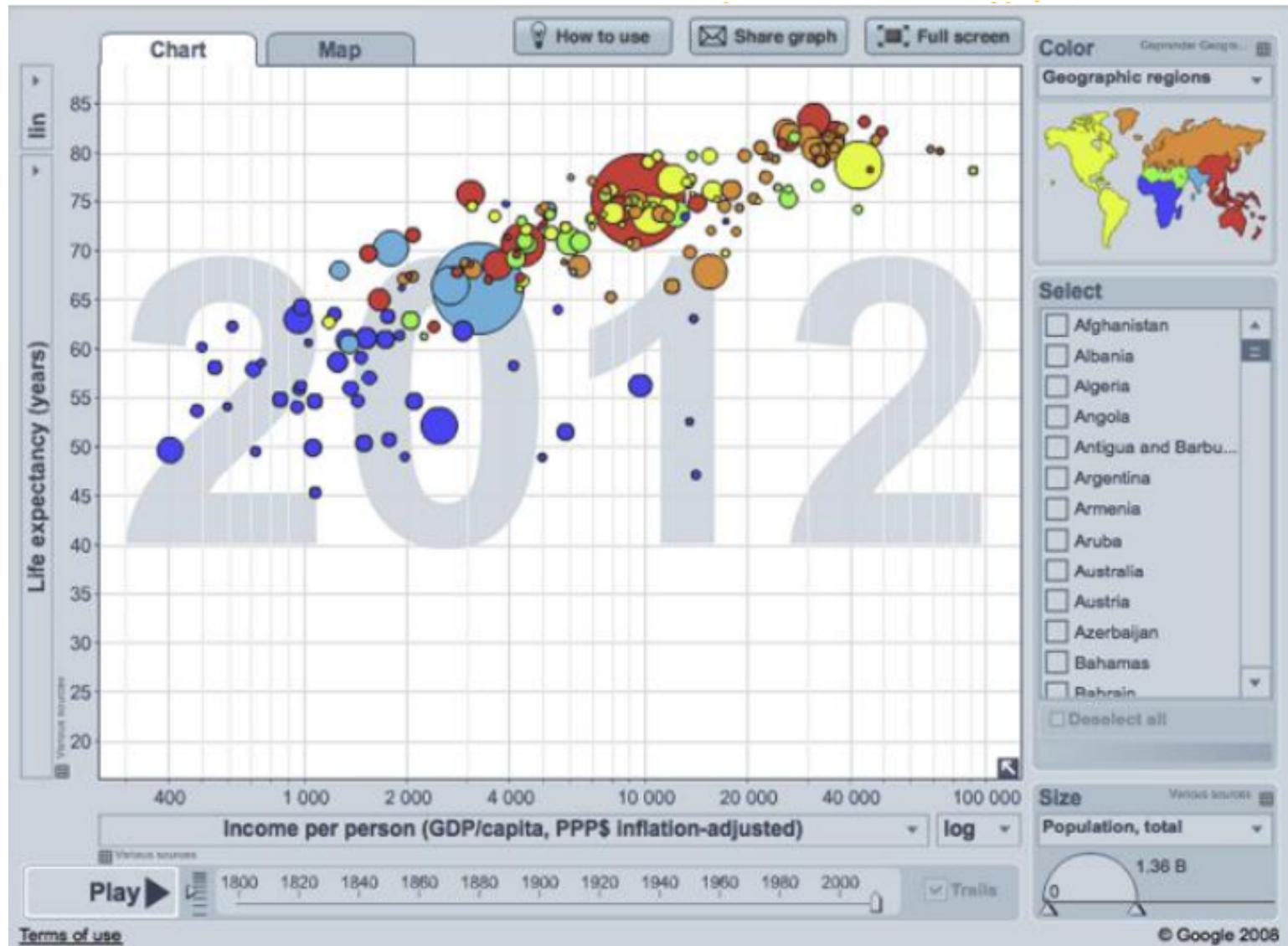
Posted in Uncategorized | No Comments »

Gestalt Principle: Common Fate

⌘ Items that move together appear grouped



Gestalt Principle: Common Fate



We Seek & Use Visual Structure

Structured info is easier to perceive

⌘ Unstructured:

You are booked on United flight 237, which departs from Auckland at 14:30 and arrives at San Francisco at 11:40 Tuesday 15 Oct.

⌘ Structured:

Flight: UA 237, Auckland => San Francisco

Depart: 14:30 Tue 15 Oct

Arrive: 11:40 Tue 15 Oct

We Seek & Use Structure

Visual hierarchy gets people to goal faster

Create a Clear Visual Hierarchy.

Organize and prioritize the contents of a page by using size, prominence and content relationships. Let's look at these relationships more closely: The more important a headline is, the larger its font size should be. Big bold headlines help to grab the user's attention as they scan the Web page. The more important the headline or content, the higher up the page it should be placed. The most important or popular content should always be positioned prominently near the top of the page, so users can view it without having to scroll too far. Group similar content types by displaying the content in a similar visual style, or in a clearly defined area.

Create a Clear Visual Hierarchy

Organize and prioritize the contents of a page by using size, prominence and content relationships.

Let's look at these relationships more closely:

- **Size**

The more important a headline is, the larger its font size should be. Big bold headlines help to grab the user's attention as they scan the Web page.

- **Prominence**

The more important the headline or content, the higher up the page it should be placed. The most important or popular content should always be positioned prominently near the top of the page, so users can view it without having to scroll too far.

- **Content Relationships**

Group similar content types by displaying the content in a similar visual style, or in a clearly defined area.

We Seek & Use Structure



Structured info is easier to perceive

Renewals, Duplicates, and Information Changes for Driver Licenses and/or ID Cards

- [How to renew your driver license in person](#)
- [How to renew your driver license by mail](#)
- [How to renew your driver license by Internet](#)
- [How to renew your instruction permit](#)

- [How to renew your driver license in person](#)
- [How to renew your driver license by mail](#)
- [How to renew your driver license by Internet](#)
- [How to renew your instruction permit](#)

Renewals, Duplicates, and Changes: Licenses & ID Cards

- Renew license: [in person](#) [by mail](#) [by Internet](#)
- Renew [instruction permit](#)
- Apply for duplicate: [license](#) [ID card](#)
- Change of: [name](#) [address](#)
- Register as [organ donor](#)

Structured Numbers Are Easier to Scan and Read



⌘ Easy: (415) 123-4567

⌘ Hard: 4151234567

⌘ Easy: 1234 5678 9012 3456

⌘ Hard: 1234567890123456

Structured Numbers Are Easier to Scan and Read

⌘ Bad: SFGov.org

Payment Information

Credit Card Number: (No Spaces)

⌘ Good: Democrats.org

Credit Card Number:
1234 5678 9012 3456

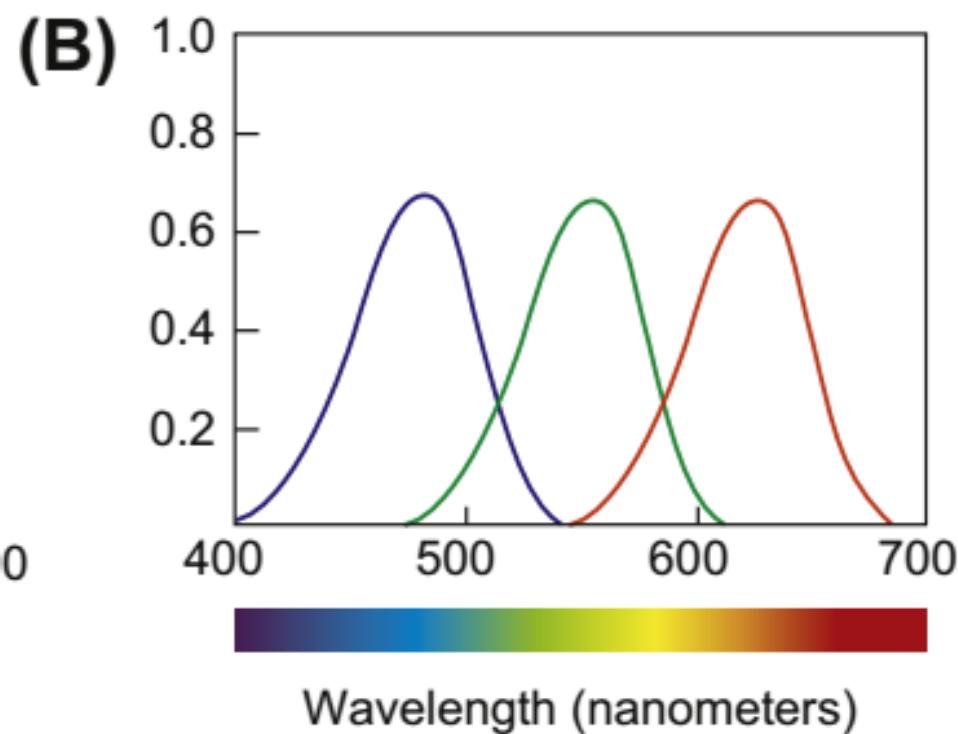
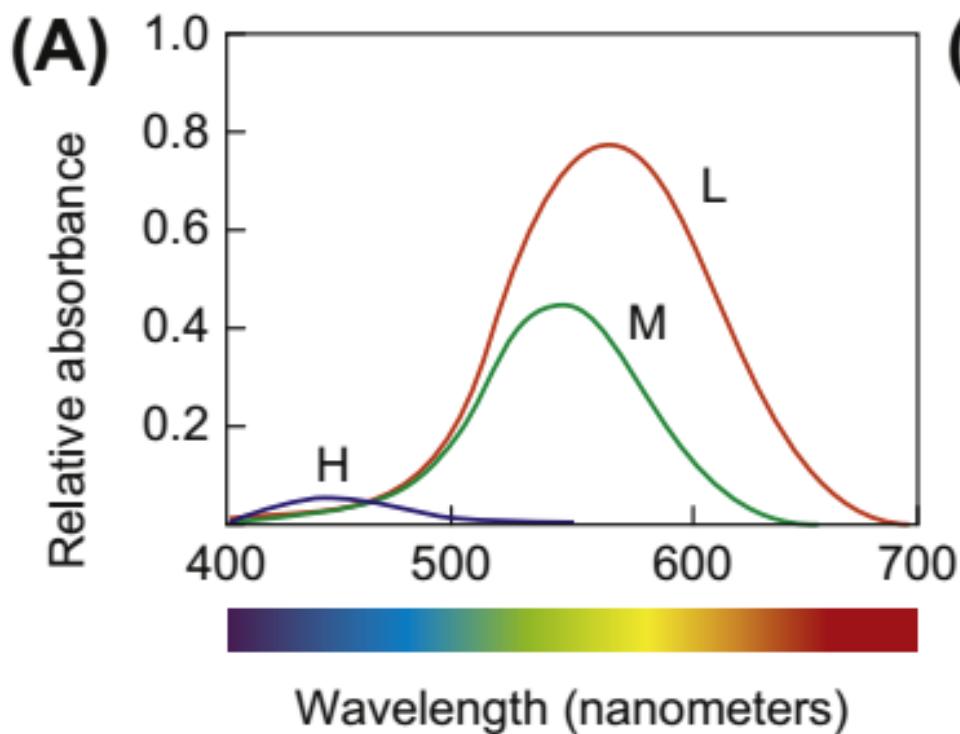
Expiration Date:
Month Year

Questions?



Our Color Vision is Limited

⌘ Our color vision is based on *differences*



Our Color Vision is Limited



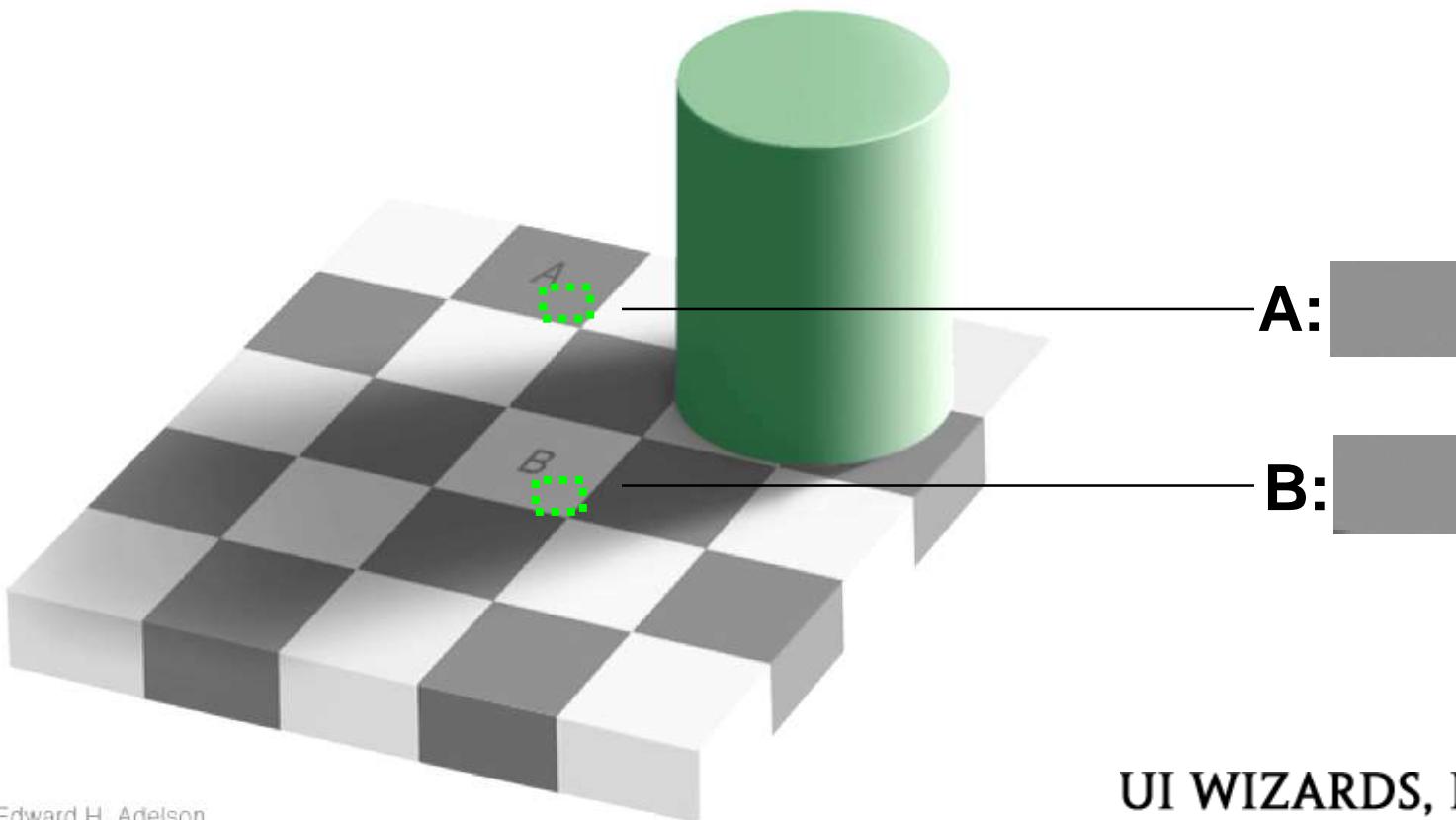
⌘ Our vision is optimized to see *contrasts* --
edges & changes, not absolute levels

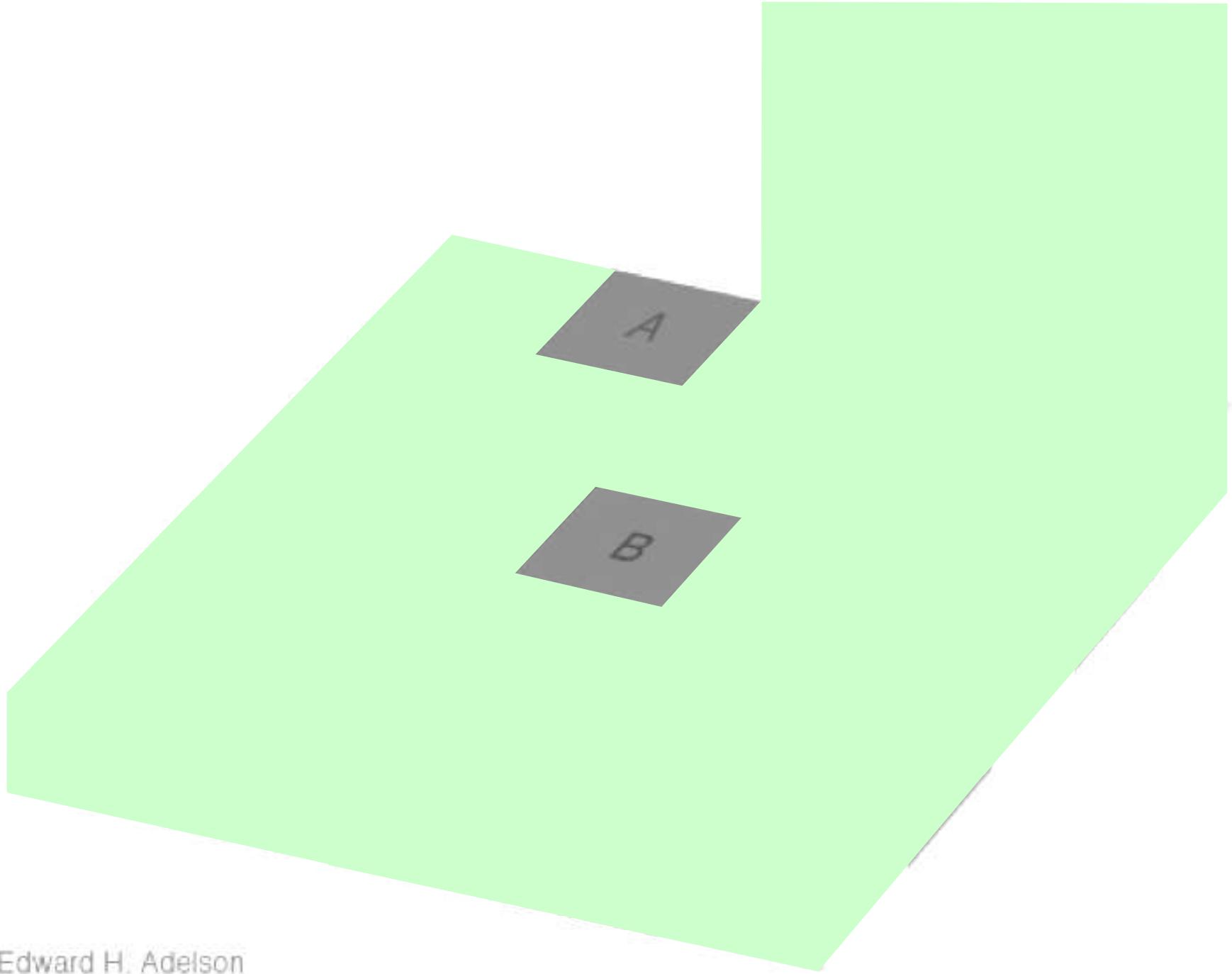


⌘ The inner bar is all one solid grey!

Our Color Vision Is Limited

⌘ Our vision is optimized to see *contrasts* -- edges & *changes*, not absolute levels





Edward H. Adelson

Our Color Vision is Limited

⌘ We have trouble discriminating:

⌘ pale colors

⌘ small color patches

⌘ separated patches



Our Color Vision is Limited

⌘ Federal Reserve Bank (Minn)

- [Housing Units Authorized, Percent Change October 2005 Year-to-Date Compared With a Year Earlier](#)
- [Electricity Consumption per Capita, 2001](#)
- [Drinking and Wastewater Needs per Capita, 2003 Dollars](#)
- [Manufactured Homes as a Percent of Total Homes, 2000](#)
- [Percent of Occupied Housing Units That Are Owner Occupied](#)
- [Percent Change in Private Employment Due to Growth/Decline in Establishments, 2000-2001](#)
- [Labor-Force Participation Rate, 2002](#)
- [Number of Bank Offices per 10,000 People, 2003](#)
- [Total Foreign-Born, 2000](#)
- [Retail Gasoline Prices, May 17, 2004](#)
- [Total Manufactured Exports per Capita, 2003](#)
- [House Price Index, Percent Change-Third Quarter 2002 to Third Quarter 2003](#)
- [State and Local Government Per Capita General Fund Expenditure, 1977-2000](#)

⌘ ITN.net



Air Availability	1	Search	2	Availability	3	Itinerary Review	4	Final Confirmation
------------------	---	--------	---	--------------	---	------------------	---	--------------------

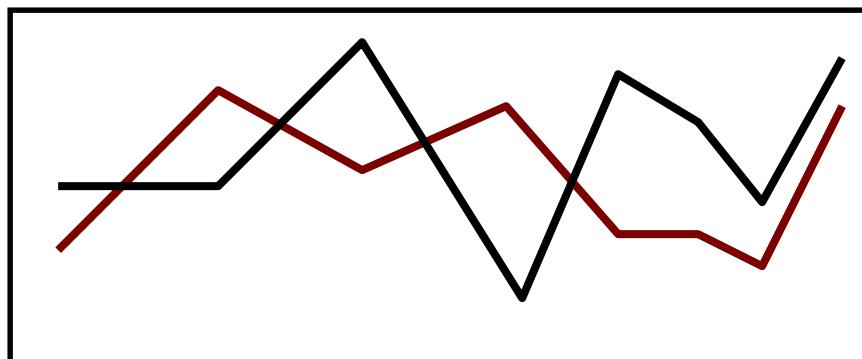
Our Color Vision is Limited

⌘ Some people have color-blindness

└─~ 8% of males

└─~ 0.5% of females

⌘ E.g., colors that would be hard for red-green colorblind people to distinguish



Our Color Vision is Limited



⌘ Google: normal

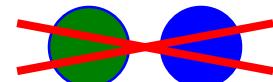


⌘ Google: deuteranopia



Our Color Vision is Limited, so

⌘ Don't rely solely on color



⌘ Use *redundantly* with other cues



⌘ E.g., Let's improve ITN.net



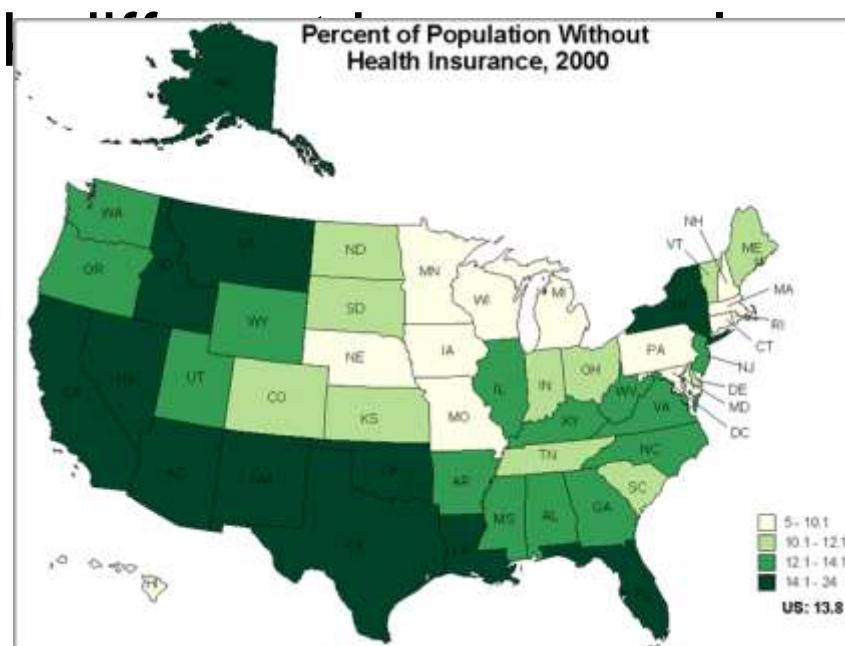
⌘ How *they* improved it:

FLIGHT RESERVATIONS

SEARCH — SELECT — REVIEW — PURCHASE — CONFIRM

Our Color Vision is Limited, so

- ⌘ Avoid subtle color differences
 - ─ Make colors differ in saturation as well as hue
 - ─ Should still look good
- ⌘ E.g., FRB.org



Our Color Vision is Limited, so



- ⌘ Most distinctive colors:      

- ⌘ Other distinctive colors:     

Our Peripheral Vision is Poor

Client internal Web-app

Invalid Pin No. Please try again.

Login

For best results, Netscape Navigator 3.x or higher is recommended.

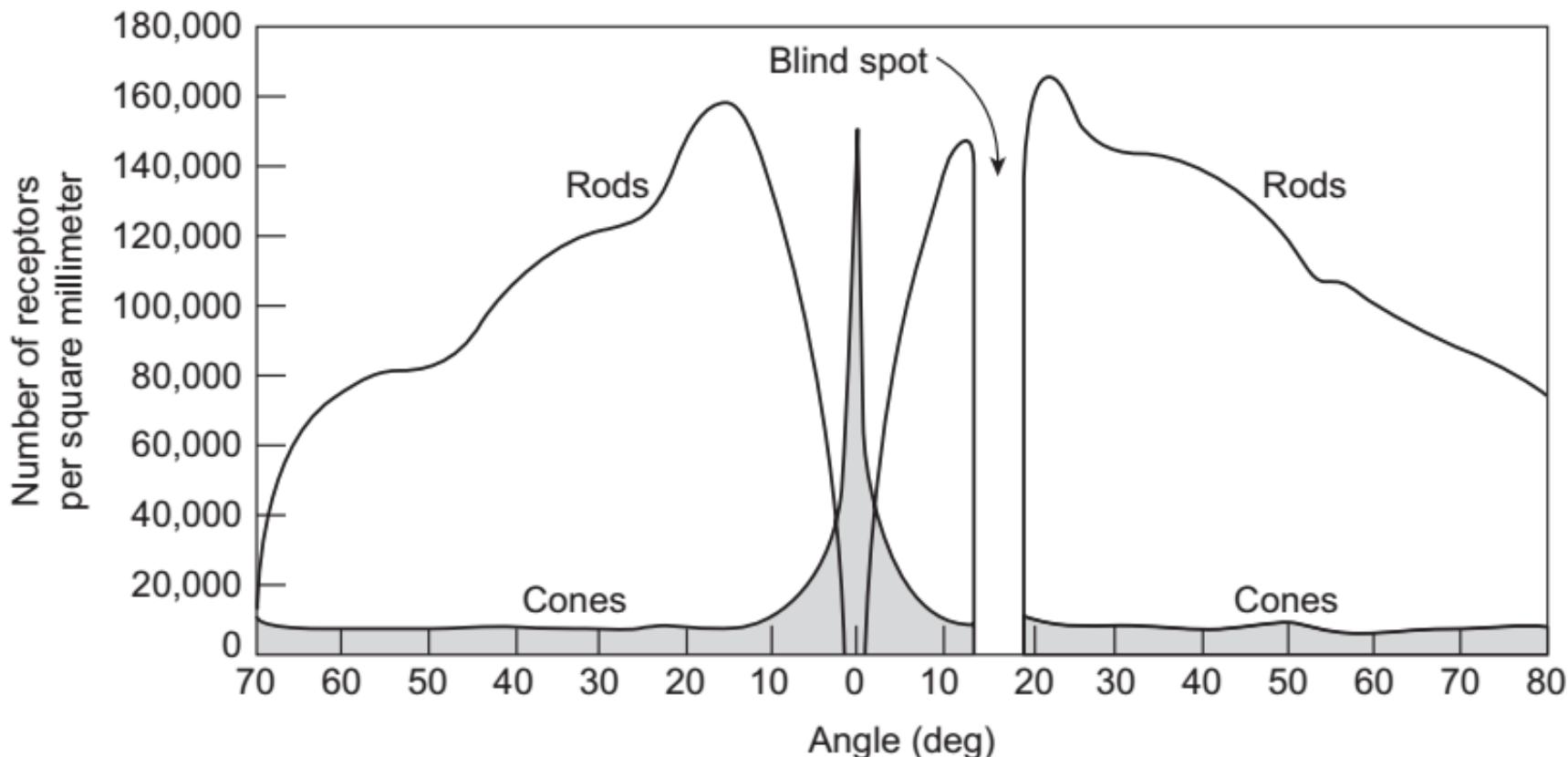
ID

Pin No

[Change your PIN](#)

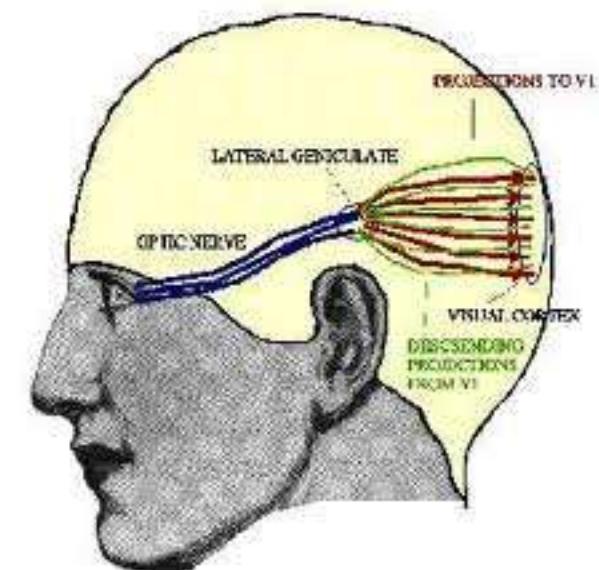
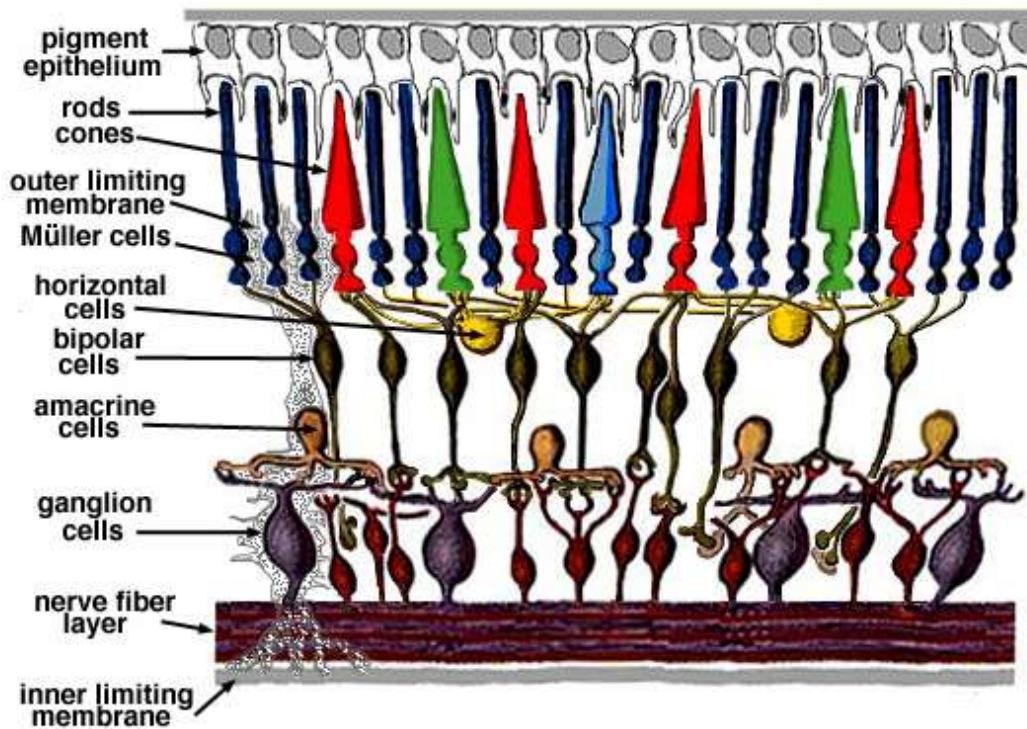
Our Peripheral Vision is Poor

⌘ Reason 1. Pixels *much* denser in fovea



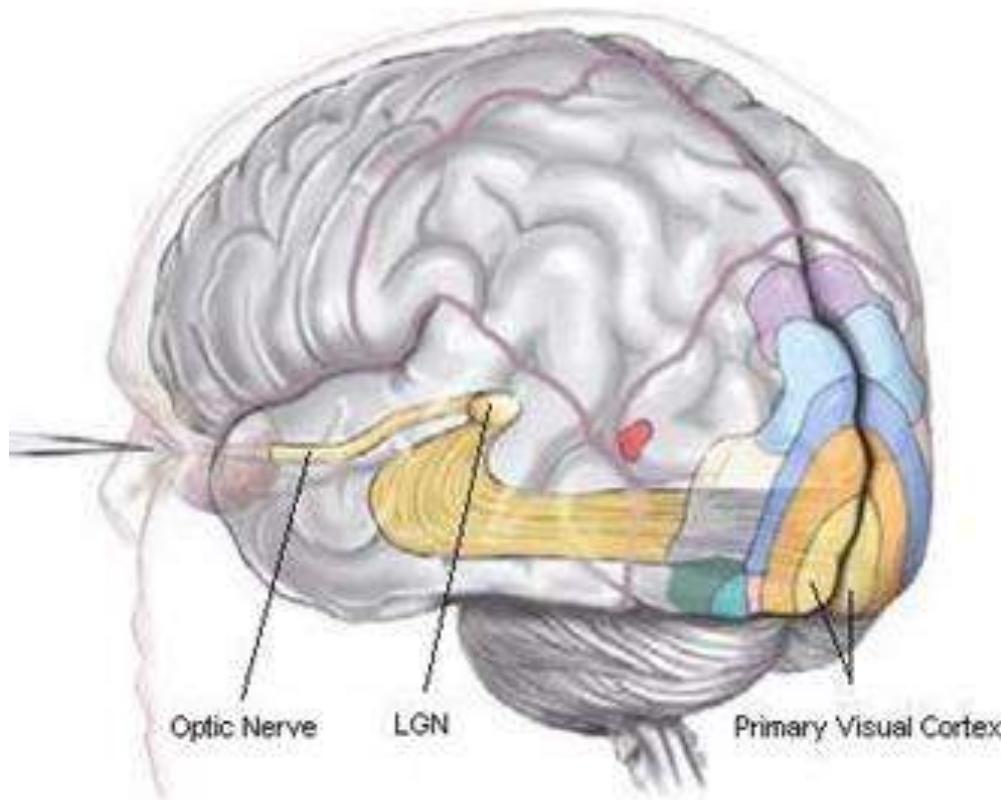
Our Peripheral Vision is Poor

⌘ Reason 2. Data from fovea uncompressed;
Data from periphery *is* compressed



Our Peripheral Vision is Poor

⌘ Reason 3. *Half of visual cortex serves fovea*



Our Peripheral Vision is Poor



- # Reason 1. Pixels *much* denser in fovea
 - # Reason 2. Data from fovea uncompressed;
Data from periphery *is* compressed
 - # Reason 3. *Half* of visual cortex serves
fovea
-
- # Resolution at center is 300 dots/inch
 - # What is resolution at vision's edge?

Exercise: See Blind Spot in Retina



Draw this on a piece of paper:

+

@

Cover left eye.

Focus right eye on +.

Adjust distance of paper from eye.

Voila: the @ disappears!

Our Peripheral Vision is Poor



⌘ Airborne.com



Our Peripheral Vision is Poor, so

⌘ Common methods of getting seen

└ Put where users are looking

└ Put near the error

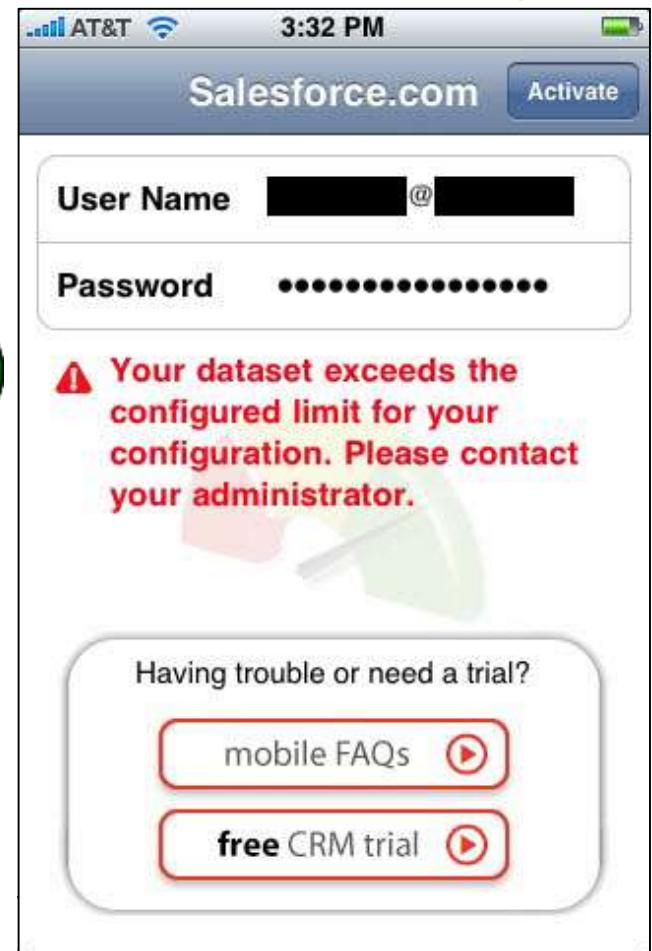
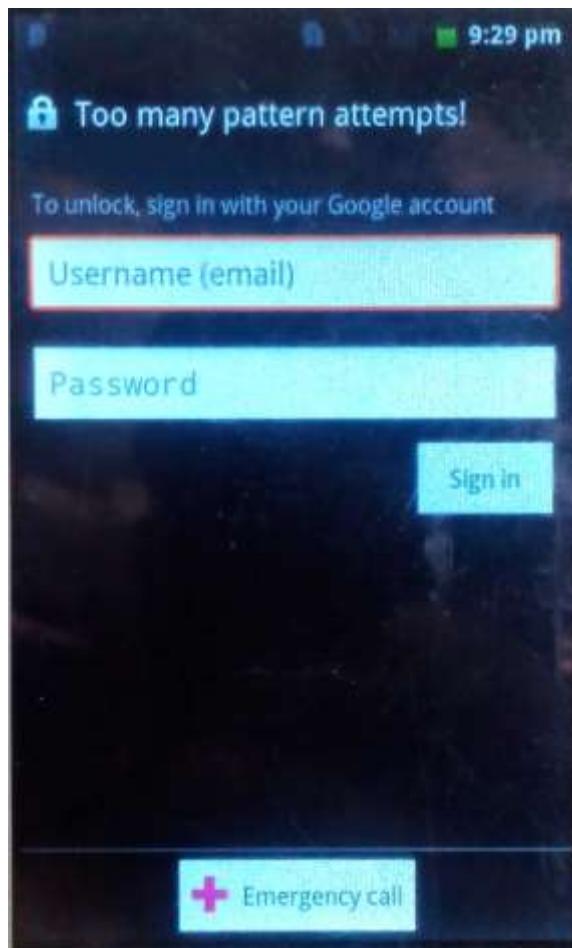
└ Use **red** for errors

└ Use error symbol



Our Peripheral Vision is Poor, so

⌘ Place error msg where users are looking



Our Peripheral Vision is Poor, so



⌘ Common methods of getting seen

- └ Put where users are looking

- └ Put near the error

- └ Use red for errors

- └ Use error symbol

⌘ Heavy artillery: use sparingly

- └ *Popup* in error dialog box

- └ *Audio*: beep

- └ *Flash* or wiggle *briefly* (not continuously)

Our Peripheral Vision is Poor, so

⌘ Client internal web-app, improved

Login



For best results, Netscape Navigator 3.x or higher is recommended.

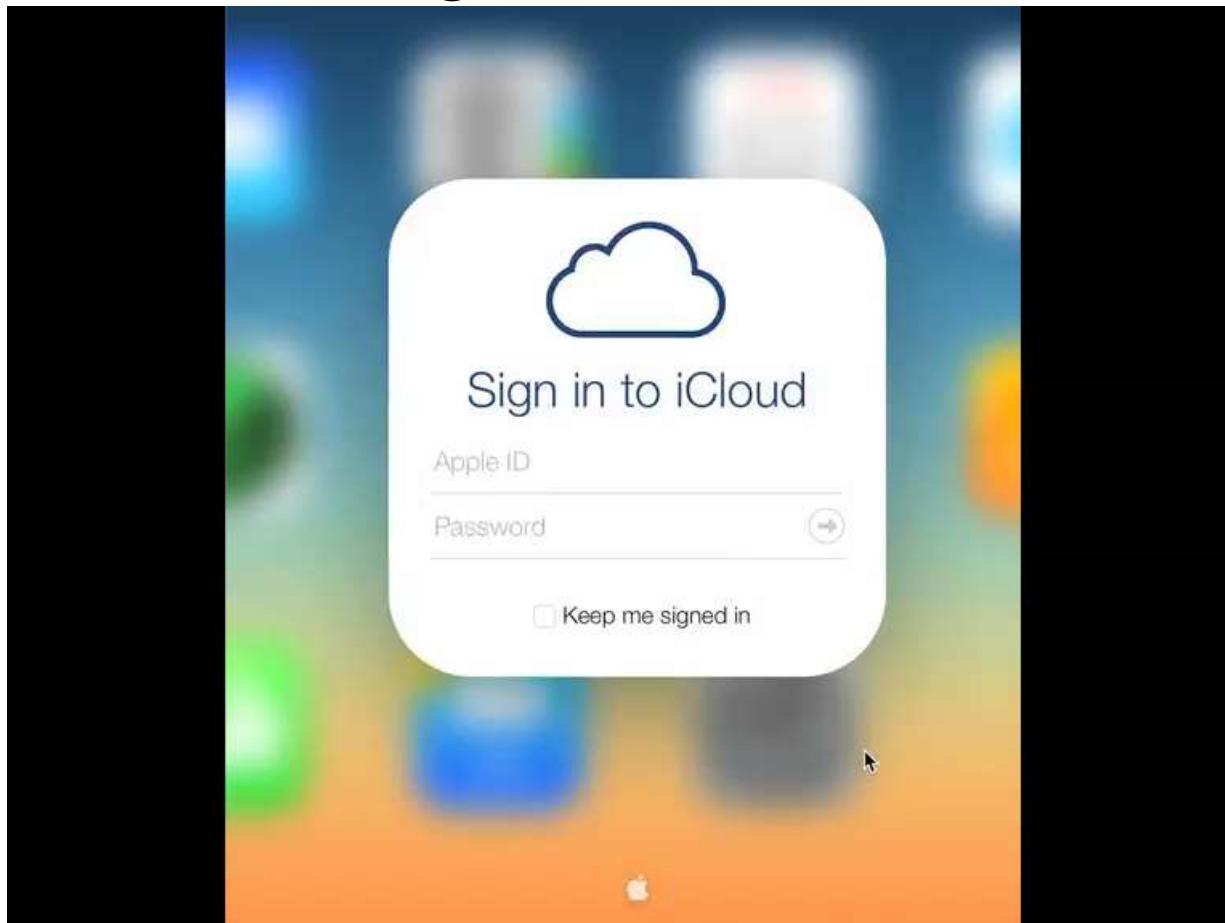
ID

Pin No

[Change your PIN](#)

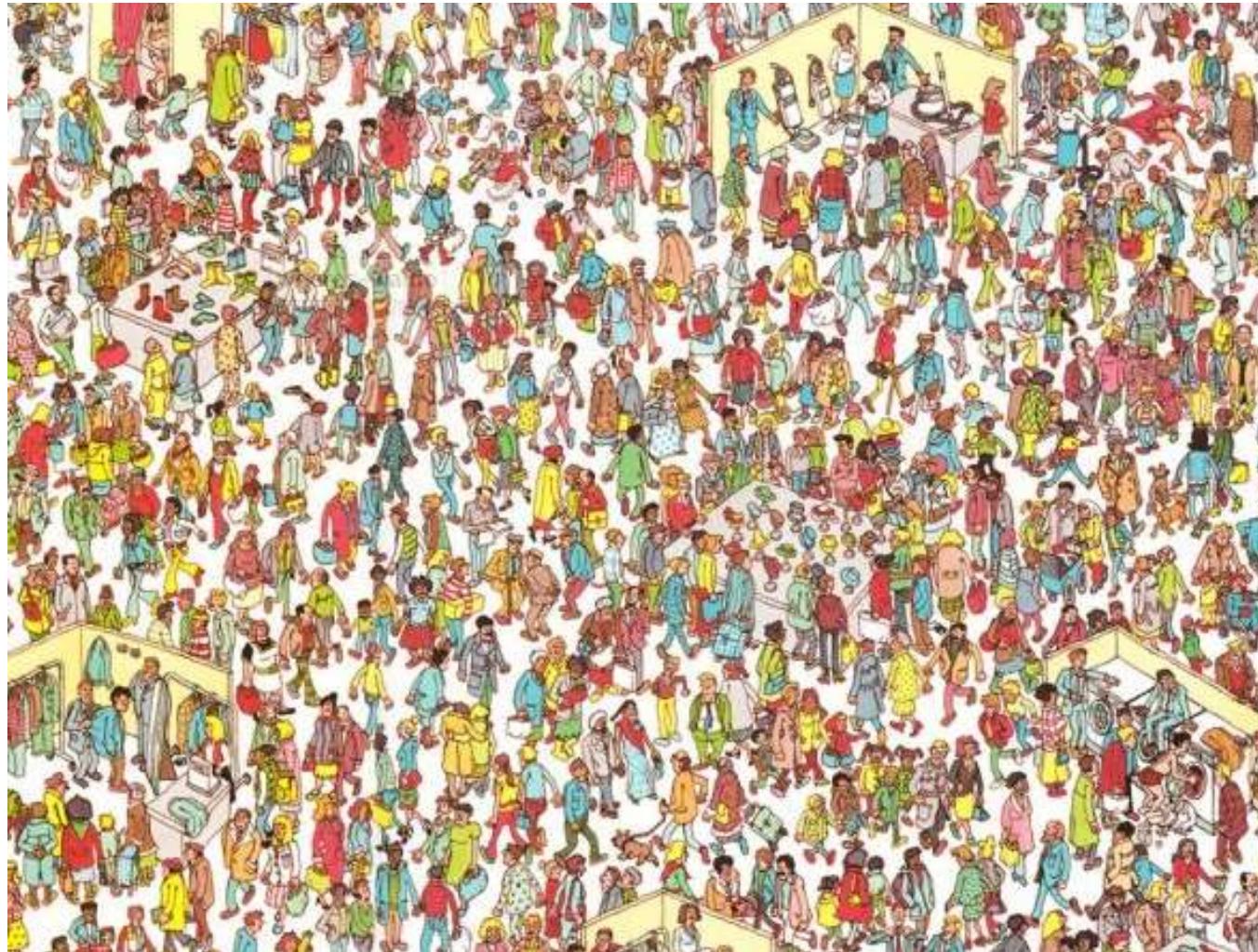
Our Peripheral Vision is Poor, so

⌘ iCloud, when login info is invalid



C.

Visual Search is Linear Unless Target “Pops”



⌘ Where's
Waldo?



Visual Search is Linear Unless Target “Pops”



Visual Search is Linear Unless Target “Pops”



⌘ Linear: Find letter in pile of characters

L	Q	R	B	T	J	P	L	F	B	M	R	W	S
F	R	N	Q	S	P	D	C	H	K	U	T		
G	T	H	U	J	L	U	9	J	V	Y	I	A	
E	X	C	F	T	Y	N	H	T	D	O	L	L	8
G	V	N	G	R	Y	J	G	Z	S	T	6	S	
3	L	C	T	V	B	H	U	S	E	M	U	K	
W	Q	E	L	F	G	H	U	Y	I	K	D	9	

Visual Search is Linear Unless Target “Pops”



⌘ Nonlinear: Find font-style in pile of letters

G	T	H	U	J	L	U	9	J	V	Y	I	A	
L	Q	R	B	T	J	P	L	F	B	M	R	W	S
3	L	C	T	V	B	H	U	S	E	M	U	K	
F	R	N	Q	S	P	D	C	H	K	U	T		
W	Q	E	L	F	G	H	B	Y	I	K	D	9	
G	V	N	G	R	Y	J	G	Z	S	T	6	S	
E	X	C	F	T	Y	N	H	T	D	O	L	L	

Visual Search is Linear Unless Target “Pops”



⌘ Linear: Counting letters in pile of letters

L	Q	R	B	T	J	P	L	F	B	M	R	W	S
F	R	N	Q	S	P	D	C	H	K	U	T		
G	T	H	U	J	L	U	9	J	V	Y	I	A	
E	X	C	F	T	Y	N	H	T	D	O	L	L	8
3	L	C	T	V	B	H	U	S	E	M	U	K	
G	V	N	G	R	Y	J	G	Z	S	T	6	S	
W	Q	E	L	F	G	H	U	Y	I	K	D	9	

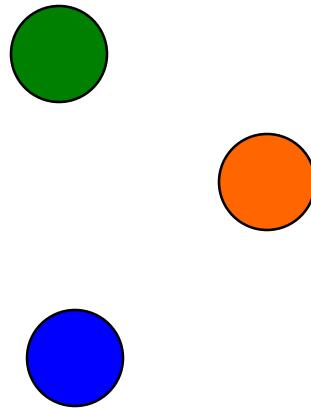
Visual Search is Linear Unless Target “Pops”

⌘ Nonlinear: Counting colored symbols

W	Q	E	L	F	G	H	U	Y	I	K	D	9
F	R	N	Q	S	P	D	C	H	K	U	T	
3	L	C	T	V	B	H	U	S	E	M	U	K
G	T	H	U	J	L	U	9	J	V	Y	I	A
L	Q	R	B	T	J	P	L	F	B	M	R	W
E	X	C	F	T	Y	N	H	T	D	O	L	L8
G	V	N	G	R	Y	J	G	Z	S	T	6	S

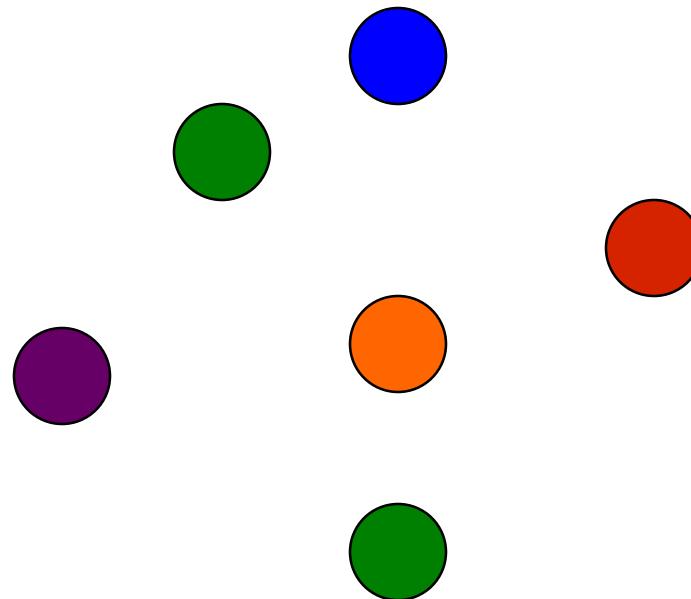
Visual Search is Linear Unless Target “Pops”

⌘ Nonlinear: Color “pops out”



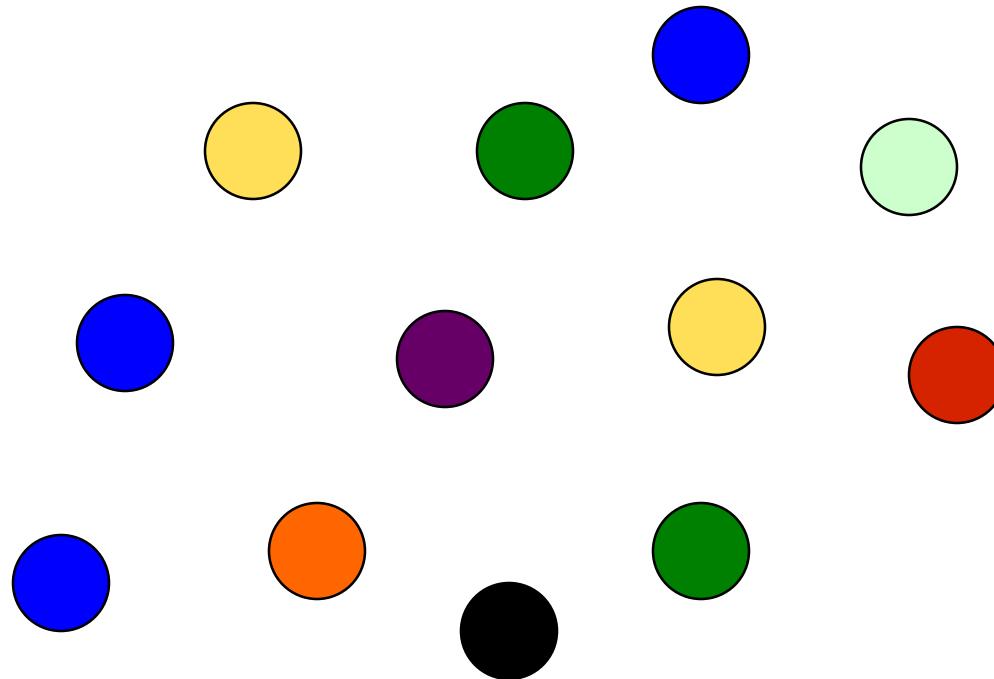
Visual Search is Linear Unless Target “Pops”

⌘ Nonlinear: Color “pops out”



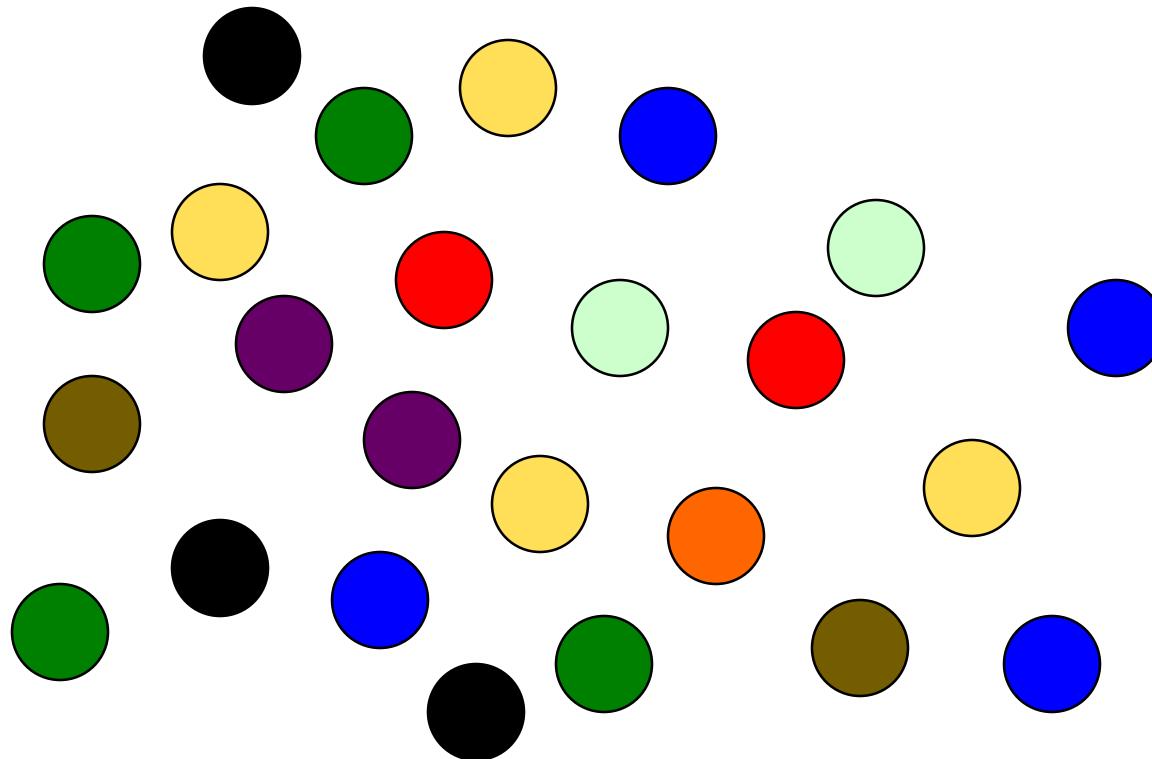
Visual Search is Linear Unless Target “Pops”

⌘ Nonlinear: Color “pops out”



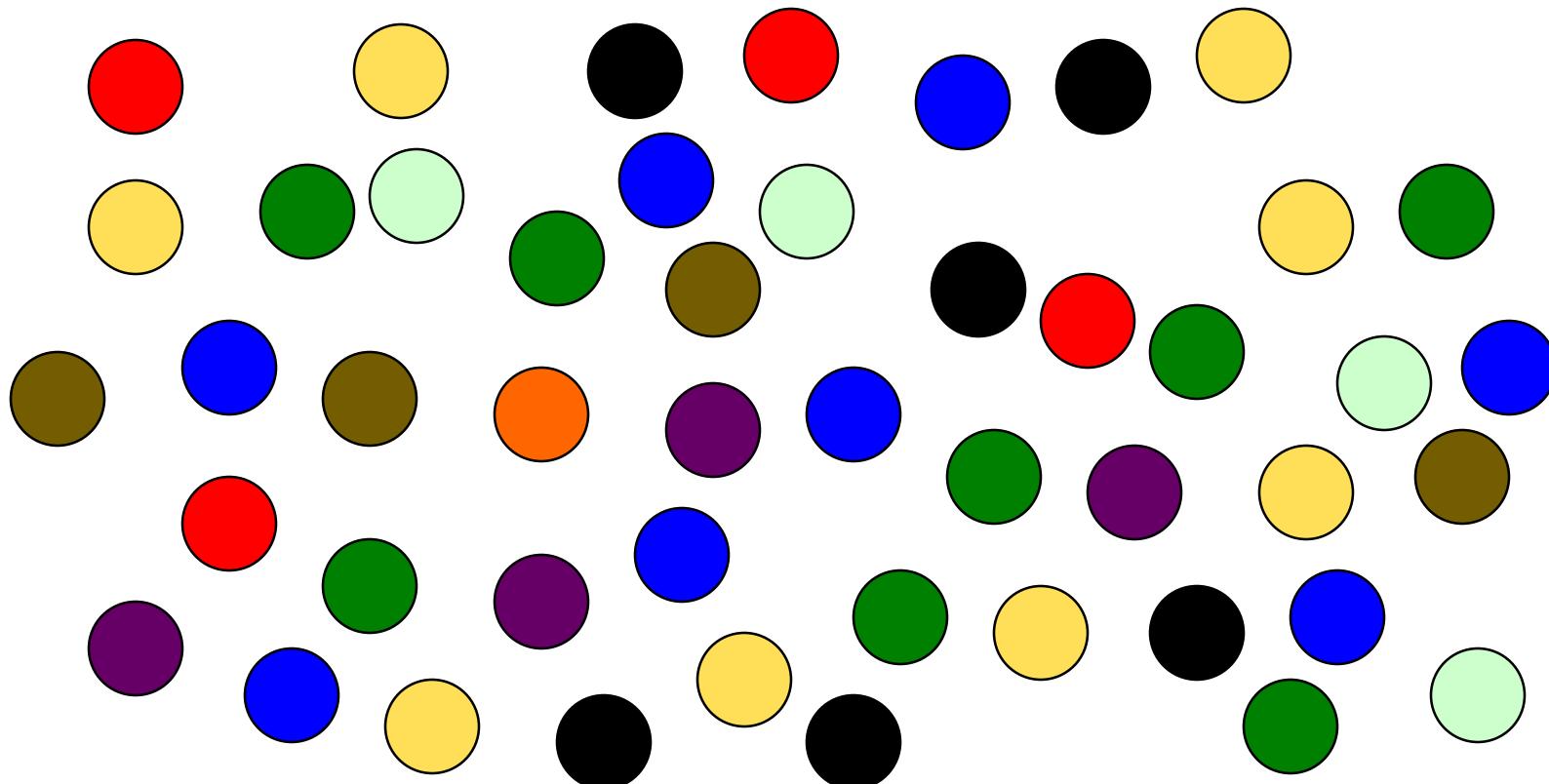
Visual Search is Linear Unless Target “Pops”

⌘ Nonlinear: Color “pops out”



Visual Search is Linear Unless Target “Pops”

⌘ Nonlinear: Color “pops out”



Visual Search is Linear Unless Target “Pops”



⌘ Non-linear: headings & bullets pop-out

Create a Clear Visual Hierarchy

Organize and prioritize the contents of a page by using size, prominence and content relationships.

Let's look at these relationships more closely:

- **Size**

The more important a headline is, the larger its font size should be. Big bold headlines help to grab the user's attention as they scan the Web page.

- **Prominence**

The more important the headline or content, the higher up the page it should be placed. The most important or popular content should always be positioned prominently near the top of the page, so users can view it without having to scroll too far.

- **Content Relationships**

Group similar content types by displaying the content in a similar visual style, or in a clearly defined area.

Using Visual “Pop” to Help User Spot Faulty Servers

The screenshot displays the PRTG Network Monitor application interface. At the top, there's a navigation bar with links for Home, Devices, Sensors, Alarms, Maps, Reports, Log, ToDo, and Setup. A red button labeled "Create Snapshot" and a blue button labeled "New Network Diagram" are also present. Below the navigation bar, a yellow brushstroke highlights the main content area.

The main content area is titled "Group Root". It shows a hierarchical tree structure under "Root" with "Probe 1" expanded. Under "Probe 1", there are sections for "Local Probe", "** Mission Critical ** (Probe 2)", "Firewalls and Data Line Infrastructure (Probe 2)", and "100 Mbit/s WAN Connection (Probe 2)".

- Local Probe:** A grid of 16 items, each with a green checkmark icon and a status indicator (e.g., "OK", "Warning", "Error"). Some items have small icons next to them.
- ** Mission Critical ** (Probe 2):** Contains three sub-sections: Firewall 1, Firewall 2, and Firewall 3. Each section lists several network components with their status and values.
- Firewalls and Data Line Infrastructure (Probe 2):** Contains three sub-sections: Firewall 1, Firewall 2, and Firewall 3. Each section lists several network components with their status and values.
- 100 Mbit/s WAN Connection (Probe 2):** Contains two sub-sections: Sat Line and Dsl Line. Each section lists several network components with their status and values.

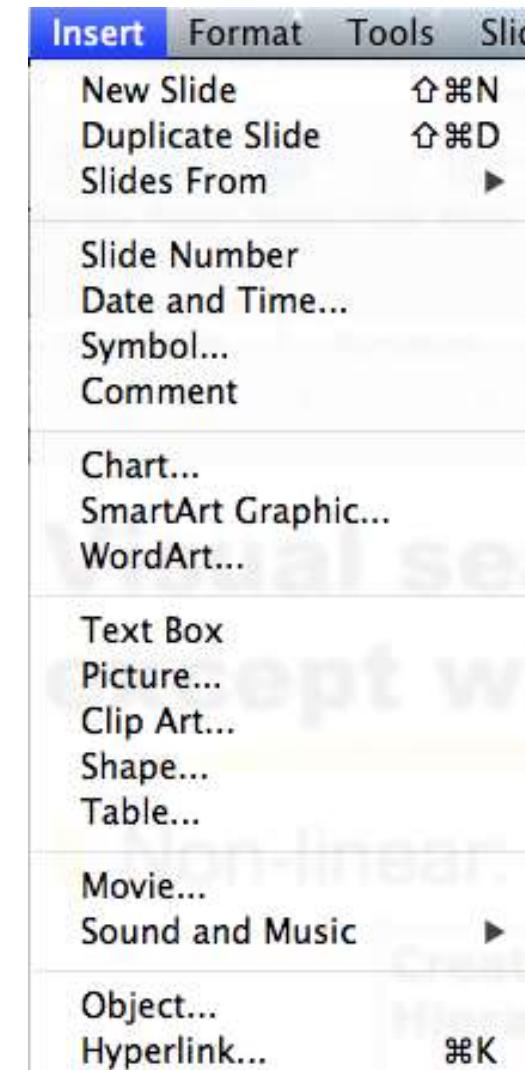
To the right of the tree view, there is a "Google" map showing various monitoring locations with colored pins (green, red, blue). A legend below the map provides information about the pin colors and symbols.

On the far right, there are two line graphs titled "Group Router (Probe 1) System" and "Group Router (Probe 2) System". These graphs track metrics over time, with data points represented by colored dots (red, green, blue, yellow) and lines connecting them. A legend at the bottom of each graph identifies the metrics: "Alarms (n)" (red), "Assigned Time Index (%)" (green), "CPU Load Pulse (n)" (blue), and "Traffic Index (%)" (yellow).



Visual Search is Linear Unless Target “Pops”

⌘ Linear: find item in unfamiliar menu



⌘ With experience, people learn item-positions, so search becomes non-linear

Visual Search is Linear Unless Target “Pops”

⌘ Non-linear: alphabetical & some pop-out



Visual Search Slows with Age

The screenshot shows the Amazon.com homepage with several promotional sections:

- Top Navigation:** Includes the Amazon logo, Try Prime button, search bar, and links for Your Amazon.com, Today's Deals, Gift Cards, Sell, and Help.
- Header Promotions:**
 - A "Year-End Deals" banner with a "Sponsored by SanDisk" note.
 - A "Hello, Sign in Your Account" link.
 - A "Cart" icon with 0 items and a "Wish List" link.
- Department Navigation:** "Shop by Department" dropdown.
- Search Bar:** "Search" button, "All" dropdown, and a search input field.
- Product Feature:** A section for the "kindle fire HDX" with a "Mayday" button, showing a tablet displaying a photo of a woman.
- Year-End Deals:**
 - A banner for "Return or replace a gift" with "Extended holiday returns until January 31" and a "Go to the Returns Center" link.
 - A "New Year's Eve Deals" section with a "Shop now" link.
 - A "CLOTHING" section offering "UP TO 70% OFF" with "Select styles. Prices as marked." and a "See more" link.
 - A "LifeProof Cases" section for iPhone 4 & 5 with a "Learn more" link.
 - A "Holiday Favorites" section from Marketplace Sellers with a "Shop now" link.
 - A promotional offer for "amazon.com research" credit cards with "\$30 Off Instantly".
- Bottom Promotions:**
 - "The Perfect Clip" section.
 - "Year-End Deals" banner with "Low prices on markdowns, clearance items, and more" and a "Shop now" link.
 - A section for Prime members showing "Included with Prime Membership at No Additional Cost" featuring movie covers for "CHRISTMAS VACATION", "HUNGER GAMES", "SKYFALL", "007", and "SCROOGE".

Reading is Unnatural

- We're pre-wired for language
 - Brain learns language easily *in childhood*
 - Nearly everyone learns a language
- We are *not* pre-wired for reading
 - Brain has *no* special facility for reading
 - Learning reading is like learning other skills:
Writing, arithmetic, reading music, kung fu
 - Same brain areas mediate
 - Many people never learn to read well, or at all

Many people never learn to read well, or at all

(A)

አዲስ አበባ ስ/መ 15/93/አ.ሸ/ -- ኢትዮጵያውያን የ375 መሬታ
ደንብ ቁጥር ፪፭፻፭፻፭ መተከናዣ አዲስ አበባ የሚገኘው የአገልግሎት አዋጅ

(B)

དිගුවන්ම පාක්ෂ දැක්වා යුතු සිංහල පාක්ෂ දැක්වා යුතු සිංහල පාක්ෂ දැක්වා
පාක්ෂ දැක්වා යුතු සිංහල පාක්ෂ දැක්වා යුතු සිංහල පාක්ෂ දැක්වා යුතු ||

FIGURE 6.1

To see how it feels to be illiterate, look at text printed in a foreign script: (A) Amharic and (B) Tibetan.

How we read

Closest to the fixation point is where word recognition takes place. This zone is usually large enough to capture the word being fixated, and often includes smaller function words directly to the right of the fixated word. The next zone extends a few letters past the word recognition zone, and readers gather preliminary information about the next letters in this zone. The final zone extends out to 15 letters past the fixation point. Information gathered out this far is used to identify the length of upcoming words and to identify the best location for the next fixation point.

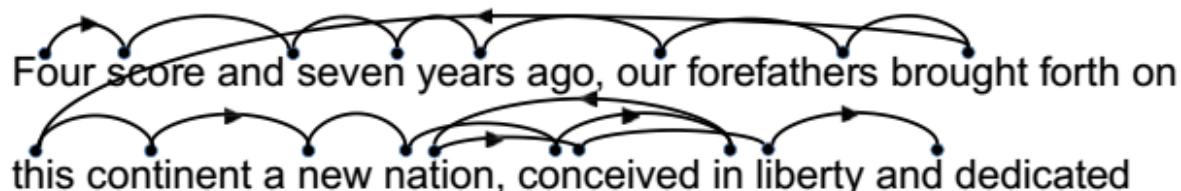


FIGURE 6.2

Saccadic eye movements during reading jump between important words.



FIGURE 6.3

Visibility of words in a line of text, with fovea fixed on the word "years."

IS READING FEATURE-DRIVEN OR CONTEXT-DRIVEN?

The rain in Spain falls
manly in the the plain

FIGURE 6.4

Top-down recognition of the expression can inhibit seeing the actual text.

(A)

Mray had a ltilte lmab, its feclee was withe as sown. And ervey
wehre taht Mray wnet, the lmab was srue to go.

(B)

Twinklo twinklo little star, how I wonder what you are

FIGURE 6.5

Top-down reading: most readers, especially those who know the songs from which these text passages are taken, can read these passages even though the words **(A)** have all but their first and last letters scrambled and **(B)** are mostly obscured.

IS READING FEATURE-DRIVEN OR CONTEXT-DRIVEN?

Word shape is no longer a viable model of word recognition. The bulk of scientific evidence says that we recognize a word's component letters, then use that visual information to recognize a word.

reading researcher : Kevin Larson (2004)

Context [is] important, but it's a more important aid for the poorer reader who doesn't have automatic context-free recognition instantiated.

reading researcher : Keith Stanovich (Bolton, 2009)

SKILLED AND UNSKILLED

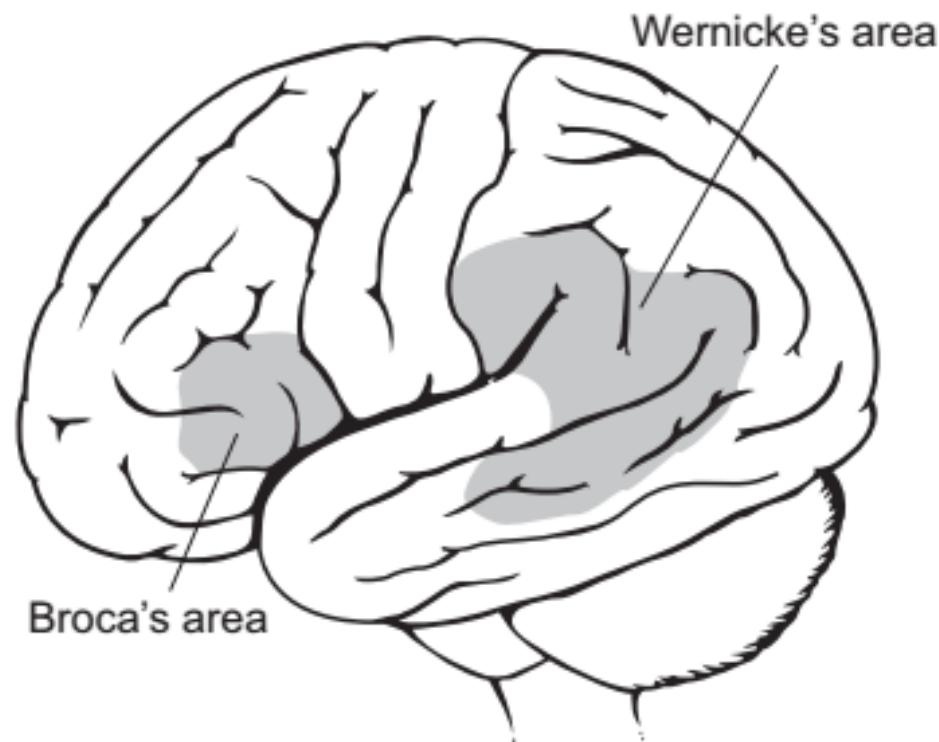


FIGURE 6.6

The human brain, showing Broca's area and Wernicke's area.

Reading is Unnatural

- Poor text presentation can *disrupt* reading
- Unfamiliar words: Your session has expired. Please reauthenticate
Bailiwick, penultimate, heretofore, defragment
- Difficult typefaces
TEXT IN ALL CAPS, ESPECIALLY IN A FANCY FONT
- Patterned background or poor contrast

Hero Amps

Hero Amps is the direct result of two Colorado Springs guitar players in search of the perfect tones. The tones needed by today's musicians. Given our technical backgrounds, this product is the result of three years of research and development in pursuit of the ultimate guitar amplifier. Our goal is to build solid, great sounding amplifiers. Amps built using quality parts and construction with the features player want and need. Legends are made with a Hero!

Reading is Unnatural

- Poor text presentation can *disrupt* reading
- Centered text

*Four score and seven
years ago our forefathers brought forth on
this continent a new
nation, conceived in liberty and dedicated
to the proposition
that all
men are created equal.*

Poor text presentation can disrupt reading

Information buried in repetition

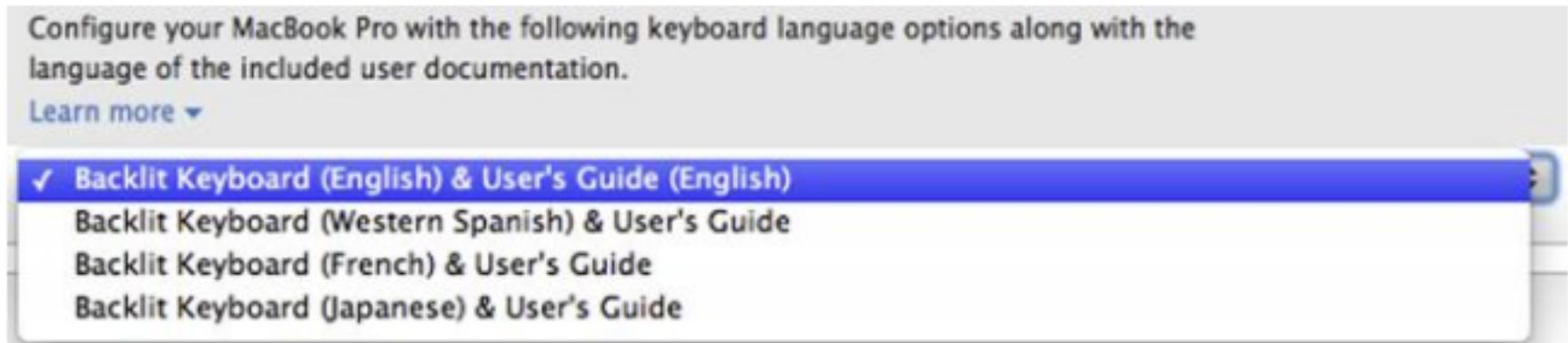


FIGURE 6.12

Apple.com's "Buy Computer" page lists options in which the important information (keyboard language compatibility) is buried in repetition.

Design implications: Don't disrupt reading; support it!

Designers of interactive systems can support both reading methods by following these guidelines:

- 1) Ensure that text in user interfaces allows the feature-based automatic processes to function effectively by avoiding the disruptive flaws described earlier: difficult or tiny fonts, patterned backgrounds, centering, etc.
- 2) Use restricted, highly consistent vocabularies—sometimes referred to in the industry as *plain language*⁴ or *simplified language* (Redish, 2007).
- 3) Format text to create a visual hierarchy (see Chapter 3) to facilitate easy scanning: use headings, bulleted lists, tables, and visually emphasized words (see Fig. 6.15).

Word Help Home

Popular topics

- » What's new in Office
- » Learning roadmap for Word
- » Change page margins
- » Set the default font for new documents
- » Recover text from a damaged document

Ask someone

- » Post a question or search for an answer in the user community
- » Contact Microsoft

FIGURE 6.15

Microsoft Word's "Help" homepage is easy to scan and read.

MUCH OF THE READING REQUIRED BY SOFTWARE IS UNNECESSARY

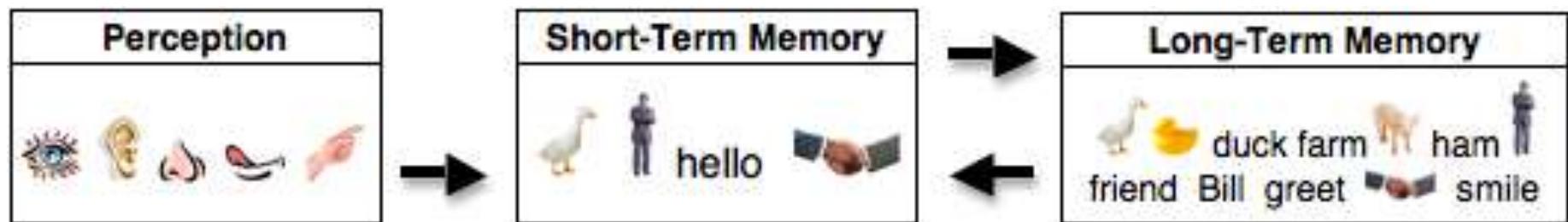


FIGURE 6.17

Between 2002 and 2007, [Jeep.com](#) drastically reduced the reading required by "Find a Dealer."

Our Attention is Limited; Our Memory is Imperfect

- ⌘ Short-term memory (STM or WM)
- ⌘ Long-term memory (LTM)



Our Attention is Limited; Our Memory is Imperfect

- ⌘ Short-term memory (STM or WM)
- ⌘ Long-term memory (LTM)



Our Attention is Limited; Our Memory is Imperfect



Short-term memory (STM)

⌘ Represents conscious mind

- ─ ▲ *Attention*: what we're attending to **NOW**

- ─ ▲ Not a separate store; *Foci of attention* in LTM

⌘ Capacity: 3-5 unrelated items

- ─ ▲ “Magical number 7” was over-estimate

⌘ New items can “grab” attention from old

⌘ Easy to forget goals or info

Our Attention is Limited; Our Memory is Imperfect



Short-term memory (STM) test:

⌘ Memorize: [REDACTED]

⌘ Say your phone number backwards

⌘ Memorize: [REDACTED]

⌘ Memorize: [REDACTED]

⌘ Memorize: [REDACTED]

⌘ Memorize: [REDACTED]

Our Attention is Limited; Our Memory is Imperfect

⌘Slate.com



⌘Blooper:
Search terms
not shown
(short-term
memory)

Search for: 

Advanced Search Options

Topics
Departments
Authors
Publication Date
from
to 

Found 968 matches. << 1 - 25 of 968 >>

Rank	Headline	Author	Published	Department
***	Defendant DeLay? Part 2 Who blurted out, "\$100,000"? A hypothesis.	Timothy Noah	Oct 06, 2004	Chatterbox
***	The Tom DeLay Scandals A scorecard.	Nicholas Thompson	Apr 07, 2005	Gist, The
***	The Wall Street Journal vs. Tom DeLay Has the editorial page gotten ... nice?	Timothy Noah	Dec 12, 2001	Chatterbox
***	Defendant DeLay? Nick Smith's bribery accusations	Timothy Noah	Oct 01, 2004	Chatterbox

Our Attention is Limited; Our Memory is Imperfect

⌘ Microsoft Windows



Wireless configuration



The selected network [REDACTED] home network is an access point network. Your wireless connection is currently configured to not connect to access point networks. To allow your wireless connection to connect to access point networks, follow these steps:

1. Click OK to dismiss this dialog, and then click Advanced.
2. On the wireless connection properties that appear, click Advanced.
3. On the Advanced option page, change which networks your wireless connection can connect to.
4. Click OK on the Advanced dialog and OK on the wireless connection properties to apply this change.



⌘ Blooper: Instructions go away too soon

Our Memory is Imperfect



Long-term memory (LTM)

- ⌘ Memories = broad patterns of neural activity
 - ◻ Experiences trigger patterns corresponding to features
 - ◻ Similar experience triggers same pattern → *recognition*
 - ◻ Internal neural activity triggers pattern → *recall*
- ⌘ Stores a lifetime of experience, but...
 - ◻ error-prone, impressionist, free-associative, easily biased
 - ◻ Memories change when features are dropped or added
 - ◻ See whale-shark, remember whale
 - ◻ Seldom-followed routines hard to recall
 - ◻ Reason for written food recipes, pilot checklists, etc.

Our Memory is Imperfect



Long-term memory (LTM) test:

- ⌘ Was there a roll of tape in the toolbox?
- ⌘ What was your *previous* phone number?
- ⌘ Pollack painting or dalmatian?



Our Memory is Imperfect, so...

Don't burden long-term memory

Instruction:

Change your PIN to a number that is easy for you to remember. A PIN can be 6-10 digits and cannot start with 0.

Your PIN must be numeric.



New PIN:

Confirm New PIN:

Remember: Please write down your PIN.

Our Memory is Imperfect, so...

Provide external memory aids



A screenshot of a Mac OS X Software Update window. The title bar says "Software Update". Below it is a table of available updates:

Install	Name	Version	Size
<input type="checkbox"/>	Backup	3.1	6.0 MB
<input type="checkbox"/>	iTunes Phone Driver	1.0	380 KB
<input type="checkbox"/>	Backup	3.1.2	7.1 MB
<input type="checkbox"/>	iTunes	7.6	44.7 MB
<input checked="" type="checkbox"/>	QuickTime	7.4	53.3 MB

At the bottom, it says "QuickTime" and "Installing: Installing QuickTime 7". A progress bar is mostly filled blue. Buttons at the bottom right are "Stop" and "Install 2 Items".

Limits on Attention Shape Our Thought & Action

8

- ⌘ We barely pay attention to computer tools
 - ↗ Focus attention on own goals, data
- ⌘ Think about computer, UI very superficially
 - ↗ Krug: *Don't Make Me Think* (about your software)
- ⌘ Focused on achieving goal
 - ↗ Prefer familiar paths over exploration
 - ↗ User: “I’m in a hurry, so I’ll do it the long way.”
- ⌘ Very *literal* in following “scent” toward goal

Limits on Attention Shape Our Thought & Action



Limits on Attention Shape Our Thought & Action

- ⌘ Keeping track of features in STM is work
- ⌘ We track only features crucial to task
- ⌘ → We are often “blind” to changes



Limits on Attention Shape Our Thought & Action



- ⌘ Keeping track of things in STM is *work*
- ⌘ When we reach goal, we often let everything related to it fall out of STM
- ⌘ → We often forget “loose ends” of tasks:
 - ↗ Removing last page of document from copier
 - ↗ Turning car headlights *OFF*
 - ↗ Switching device or software back to normal mode
- ⌘ Therefore:
 - ↗ Systems should remind users of loose ends
 - ↗ Modes should revert to “normal” automatically

Recognition is Easy; Recall is Hard

9

>We evolved to recognize things quickly

We assess situations very fast

We recognize faces blindingly fast

We recognize complex patterns



Recognition is Easy; Recall is Hard

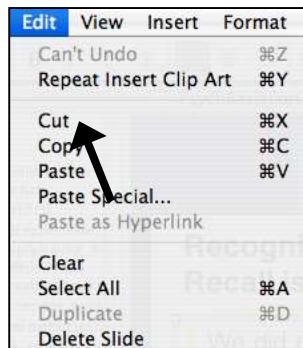


⌘ We did *not* evolve to recall arbitrary facts

- ─ Tricks for memorizing use *recognition* to stimulate *recall*, e.g., Greek “method of loci”
- ─ Developed writing to *avoid* memorizing
- ─ We rely on external memory aids, e.g., PDAs

⌘ Implication for UI design:

- ─ See & choose easier to learn than *remember* & *type*



> Remove

Questions?



System 1 and System 2



⌘ System 1: old brain + midbrain

- Collection of automatic “zombie” processes
- Can run many processes in parallel
- Fast but approximate, “satisficing”
- Doesn’t use working memory
- Unconscious; governs most of our behavior

⌘ System 2: cerebral cortex (mainly frontal)

- Slow but precise
- Uses working memory
- One serial processor; cannot multi-task
- Conscious, self-aware; *believes* it governs our behavior

Example: System 1 vs. System 2



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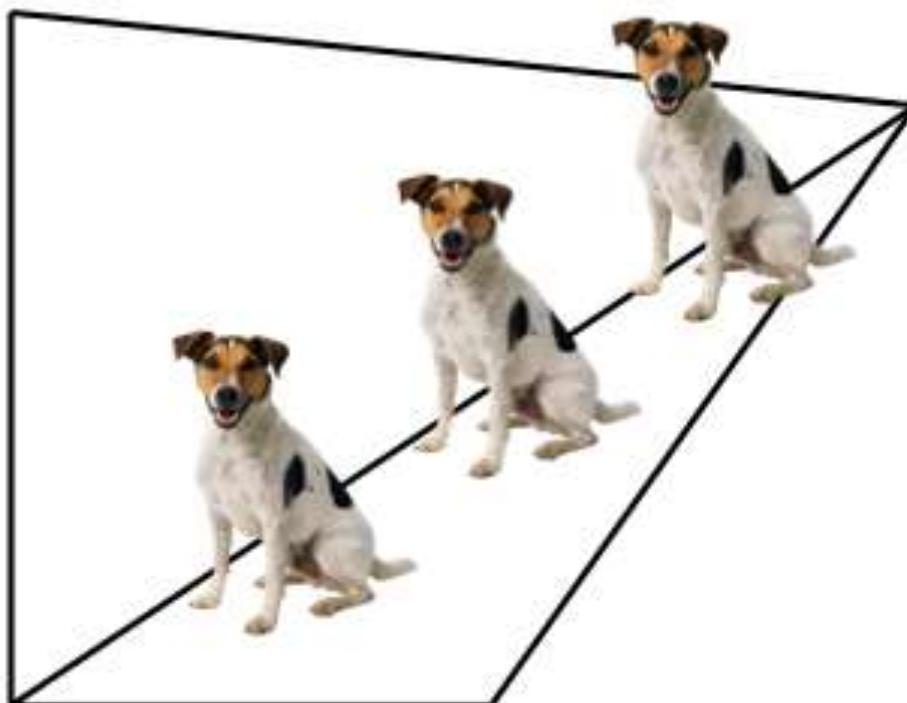
Example: System 1 vs System 2



- # A baseball and a bat together cost \$110.
The bat costs \$100 more than the ball.
How much does the ball cost?
- # System 1's instant answer: \$10 (wrong)
- # System 2 may reject that answer. Or not.
- # System 2 can calculate correct answer;
System 1 cannot.

Example: System 1 vs System 2

⌘ System 1's perception of the dogs' size is biased by the lines; System 2's is not.



Test: System 1 vs System 2

Red		Blue
Blue		Red
Yellow		Green
Green		Orange
Orange		Yellow
Purple		Red
Red		Green
Green		Purple
Yellow		Green
Blue		Yellow
Green		Blue

Easy: Performing Learned Routines

⌘ Examples:

- Riding a bicycle after months of practice
- Driving to same workplace after many years
- Using a touchpad after a few days of practice
- Reading & deleting message from your phone

⌘ *Automatic*: doesn't use up STM / attention

- System 1: “zombie” or “robotic” processes
- Compiled mode, parallel processing
- Many processors: Can multi-task

Hard: Performing Novel Actions



⌘ Examples:

- Following a new cooking recipe
- Driving somewhere you've never been
- Writing with your non-dominant hand
- Switching from Mac to Windows PC (or vice-versa)

⌘ Controlled: consumes STM / attention

- System 2: Runs mainly in cerebral cortex
- Interpreted mode, serial processing
- Only one processor: Cannot multi-task

Test: Exercising Systems 1 vs. 2; Learned vs. Novel Actions



- # Recite alphabet, A – M
- # Recite alphabet *backwards*, M – A
- # Countdown from 10 to 1
- # Countdown from 21 to 1 *by 3s*
- # Hum first measure of “Twinkle, twinkle, little star”
- # Hum it *backwards*

Hard: Problem Solving & Calculation

- Only small problems don't tax memory & attention
 - | $9 \times 10 = ?$
- Most exceed STM or require retrieval from LTM
 - | $93.3 \times 102.1 = ?$
 - | Diagnosing computer problems
 - | Requires systematic testing of possibilities
- We invented *writing, numbers, arithmetic, calculators & computers* to overcome our brain's limitations

Easy: Generalizing & Learned Actions

Hard: Problem Solving & Calculation

Implications for UI design:

- Don't make people *deduce* things
 - "It wants my 'member ID'. Is that the same as my 'username'? It must be."
 - Explain *explicitly* & *exactly* what to do, or *explicitly* & *exactly* what happened
- Don't make people reason by elimination
 - Debug complex computer malfunctions, e.g., faulty Internet connection
 - Optimize combinations of many settings
- Don't make people calculate what *software* can calculate

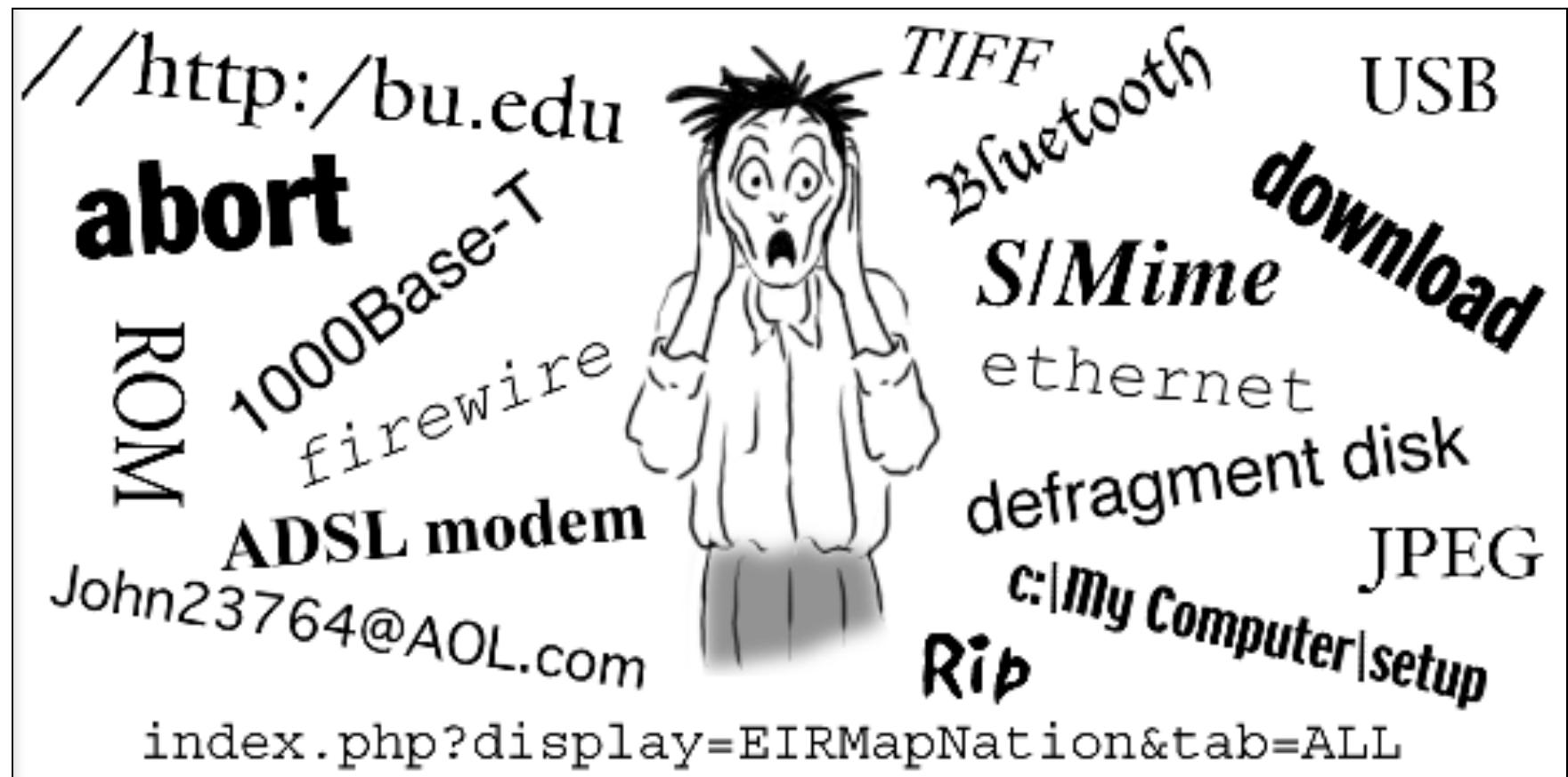
Many Factors Affect Learning

We Learn Faster When

- ***Vocabulary is familiar & task-focused***
- Vocabulary is consistent
- Risk is low

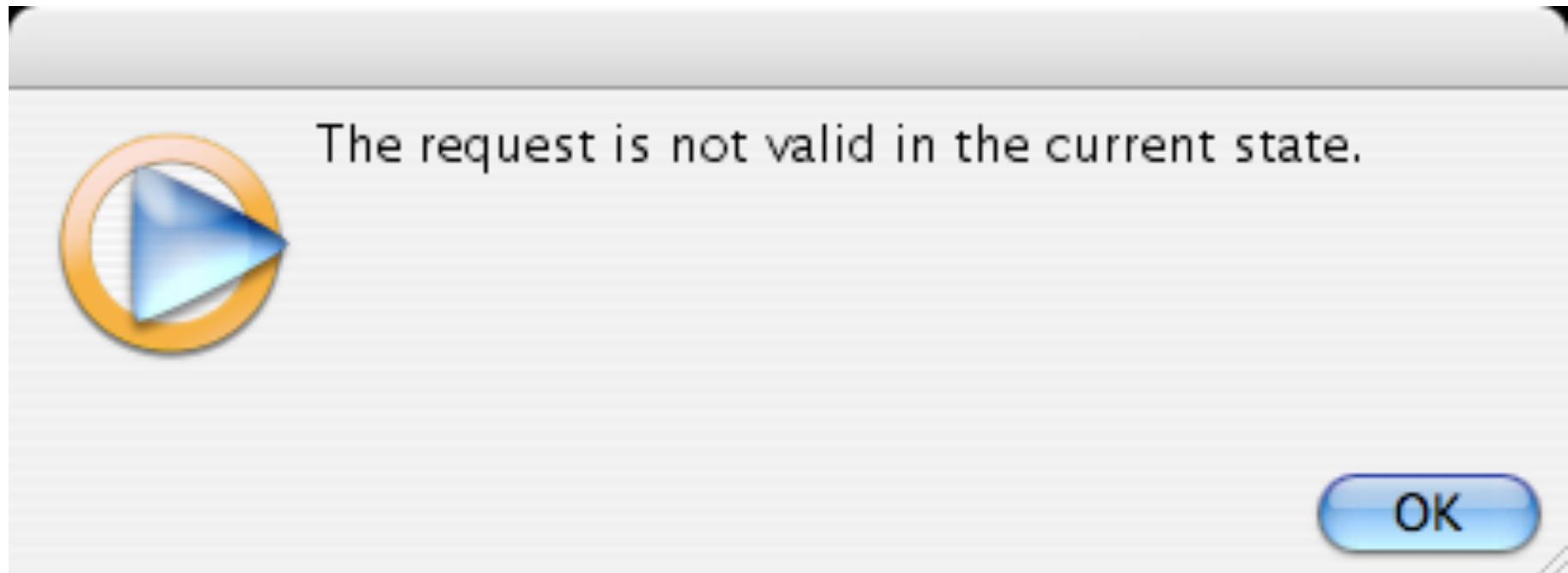
Familiar Terms Speed Learning

■ Geek-speak hurts learning



Familiar Terms Speed Learning

- Geek-speak hurts learning



Familiar Terms Speed Learning

■ Geek-speak hurts learning



Familiar Terms Speed Learning



What happened?

The departure date for the return flight is prior to the departure date for the outbound flight.

What you need to do:

Go back to the previous page and modify your selection.

Reference Number: 100041-8951

Occurred: 07/08/09 20:23:24

Human Decisionmaking is Rarely Rational

12

⌘ System 1 usually controls decisions, but is biased (Kahneman & Tversky):

- └ Losses mean more than gains
- └ Recent history & strong memories affect us more than distant history & weak memories
- └ Experiences of family & close friends more influential than mountains of statistics
- └ How choice is worded (framed) affects decision
- └ People avoid risk for potential gains; take risks for potential losses

Human Decisionmaking is Rarely Rational

Kahneman & Tversky: Fourfold Pattern

	Gain	Loss
High Probability	<p>Gamble: 95% chance to win \$10000 (5% chance to win \$0)</p> <p>Alternative: definite gain of \$8000 (less than expected value of gamble)</p> <ul style="list-style-type: none">• Fear to lose gain• People are risk-averse• Most accept “safe” definite gain	<p>Gamble: 95% chance to lose \$10000 (5% chance to lose \$0)</p> <p>Alternative: definite loss of \$8000 (less than expected loss of gamble)</p> <ul style="list-style-type: none">• Hope to avoid loss• People are risk-seeking• Most prefer to gamble
Low Probability	<p>Gamble: 5% chance to win \$10000 (95% chance to win \$0)</p> <p>Alternative: definite gain of \$2000 (more than expected value of gamble)</p> <ul style="list-style-type: none">• Hope for large gain• People are risk-seeking• Most prefer to gamble	<p>Gamble: 5% chance to lose \$10000 (95% chance to lose \$0)</p> <p>Alternative: definite loss of \$2000 (more than expected loss of gamble)</p> <ul style="list-style-type: none">• Fear of large loss• People are risk-averse• Most accept “safe” definite loss

Human Decisionmaking is Rarely Rational



Implications for Design:

- ⌘ *Decision-support*: helping System 2 override System 1
- ⌘ *Data visualization*: harness System 1 (perception) to support System 2
- ⌘ *Persuasion*: seducing System 1 and bypassing System 2

Decision-support: helping System 2 override System 1

Mortgage one	Mortgage two	Mortgage three	Total
\$ 600,000	\$ 600,000	\$ 600,000	\$ 1,800,000

Mortgage three Reset

Loan amount i \$ 600000 Type i fixed Interest rate i 6 % You can find current interest rates from lenders eg. banks [learn more](#)

Repayment frequency i monthly Mortgage length (years) i 20

Like to know how old you'll be when your debt is paid off?
Select the month and enter the year you were born.

Month YYYY

Minimum repayment amount i \$ **80004.298** monthly

Total you will pay i \$ **1,031,660** Including interest of \$ **431,660** Time to repay **20 years** Age repaid by --

NC.
JLTING

Decision-support: helping System 2 override System 1

The price has been changed today  

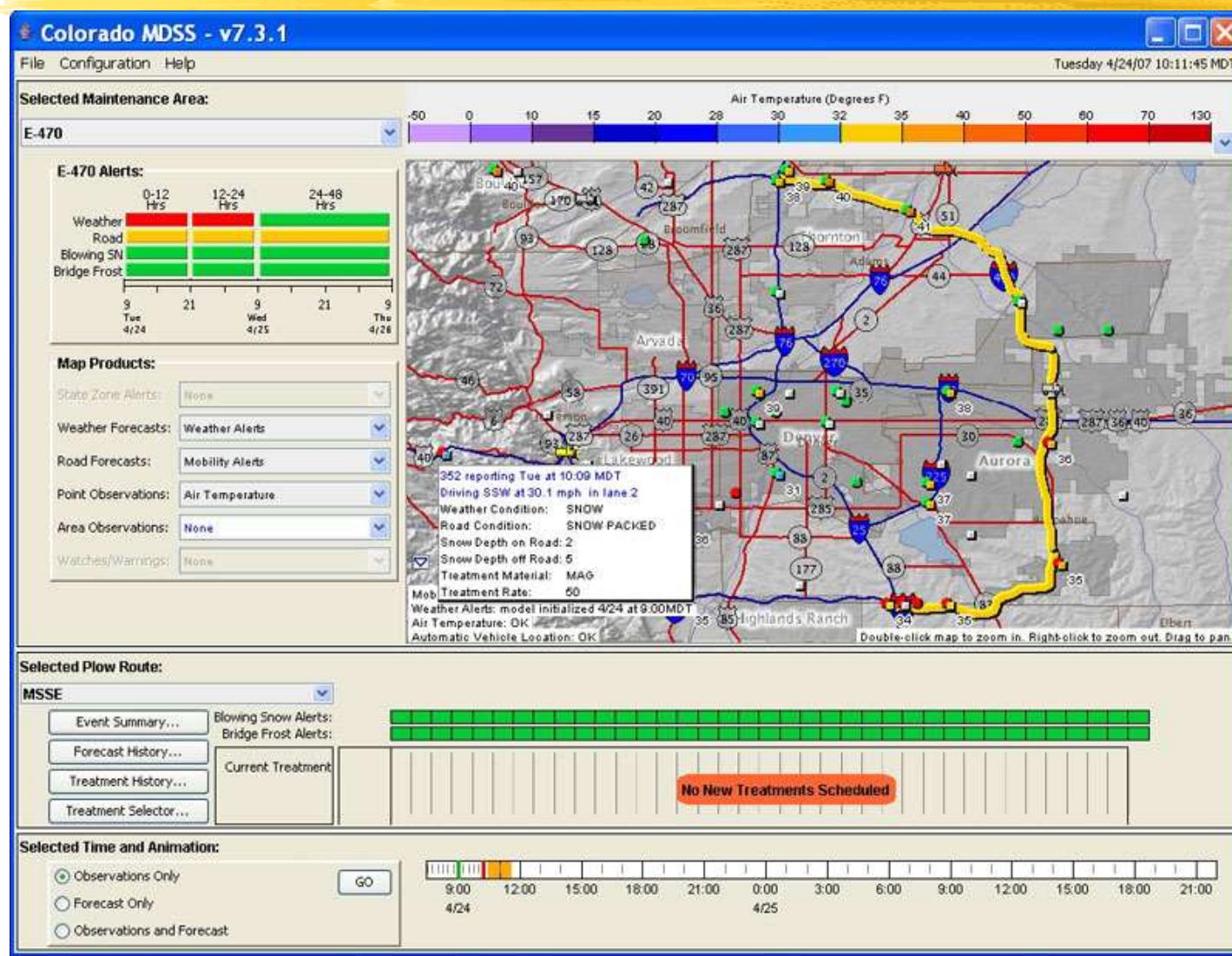
▼ More filters  Instant search results

View as:    Order by:  Rank (popularity)

Product	Lowest price	User rating	Sensor reso...	Optical zoom	Design	?
Canon PowerShot SX50 HS	\$527.00	45 	12.1 Mp	50 times	SLR format	8★ 7
Sony CyberShot DSC-RX100	\$735.00	14 	20.2 Mp	3.6 times	Compact	9★ 11
Panasonic Lumix DMC-TZ40	\$558.99	9 	18.1 Mp	20 times	Compact	9★ 7
Sony CyberShot DSC-RX100 II	\$1,068.00	7 	20.2 Mp	3.6 times	Compact	9★ 4
Fujifilm FinePix X20	\$743.00	12 	12 Mp	4 times	Compact	9★ 11
Canon PowerShot G15	\$549.00	42 	12.1 Mp	5 times	Compact	8★ 7
Samsung Galaxy Camera EK-GC100	\$519.00	18 	16 Mp	21 times	Compact	7★ 10
Ricoh GR	\$620.00	4 	16.2 Mp		Compact	8★ 6
Panasonic Lumix DMC-TZ30	\$379.00	9 	14.1 Mp	20 times	Compact	8★ 11
Canon PowerShot SX280 HS	\$396.00	31 	12 Mp	20 times	Compact	8★ 8
Canon PowerShot S110	\$425.00	18 	12.1 Mp	5 times	Compact	8★ 7
Canon PowerShot SX260 HS	\$367.00	26 	12.1 Mp	20 times	Compact	8★ 13
Nikon Coolpix P520	\$515.00	14 	18.1 Mp	42 times	SLR format	7★ 5
Olympus Tough TG-2	\$529.00	16 	12 Mp	4 times	Compact	8★ 8
Sony CyberShot DSC-HX300	\$601.00	19 	20.4 Mp	50 times	SLR format	7★ 4

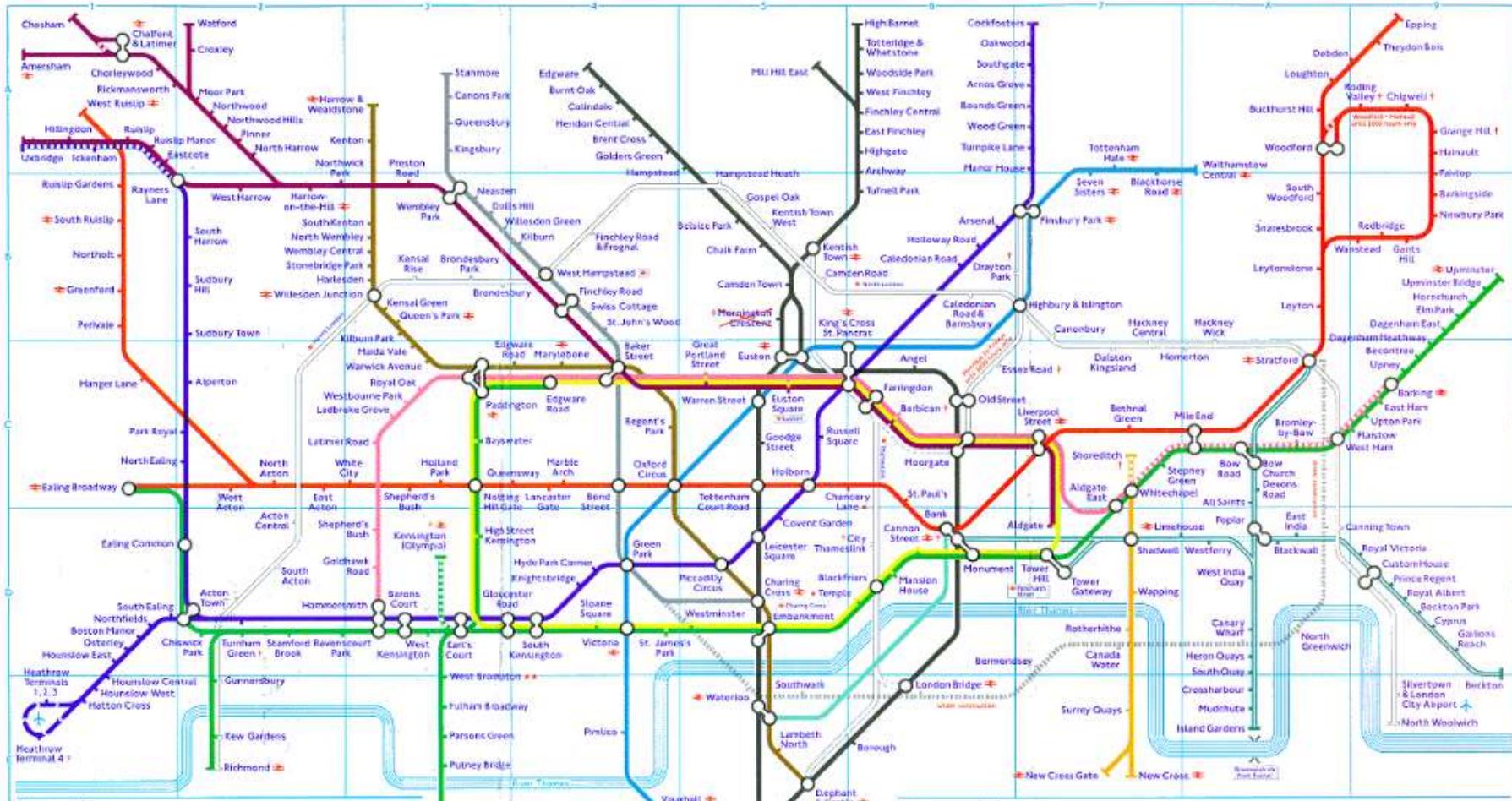
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Decision-support: helping System 2 override System 1

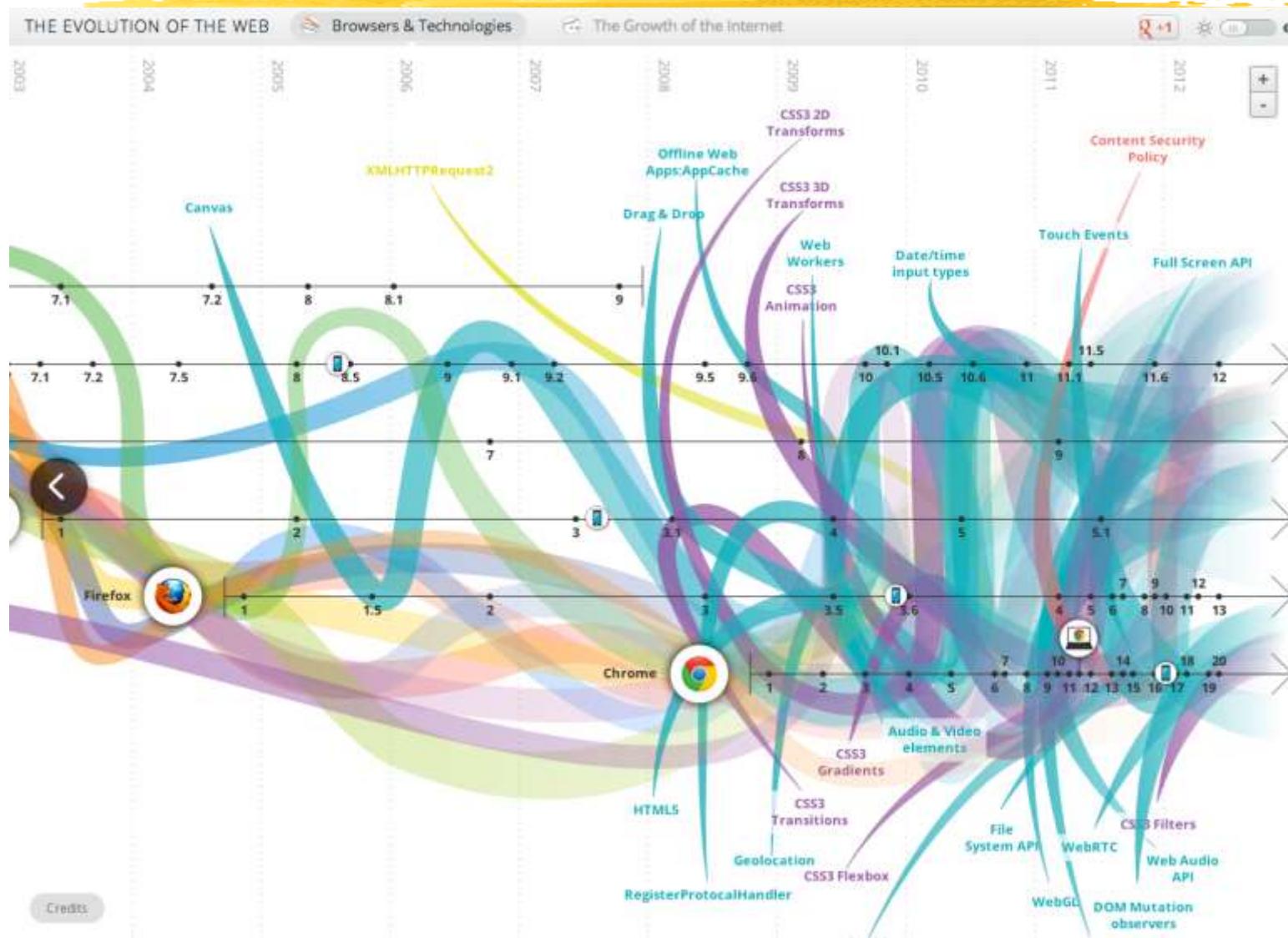


Data visualization: harness System 1 to support System 2

London Metro



Data visualization: harness System 1 to support System 2



Persuasion: seducing System 1 and bypassing System 2



Persuasion: seducing System 1 and bypassing System 2



Our Hand-Eye Coordination Follows Laws

13

⌘ Fitts' Law

⌘ Steering Law

Fitts's Law [Fitts, 1954]: Time to hit a target w/pointer

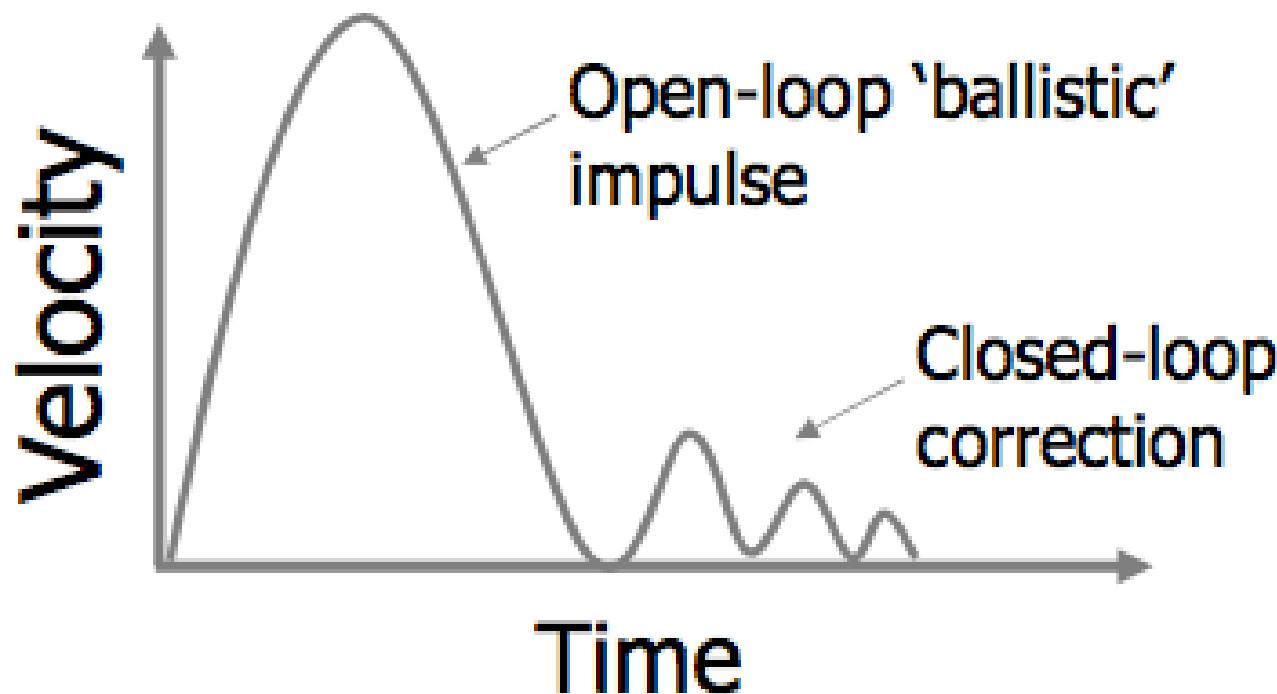
- ⌘ T = time (duration) to move to target
- ⌘ D = distance from pointer to target
- ⌘ W = width of target (on axis of movement)
- ⌘ a = start/stop time of pointer/user
- ⌘ b = maximum speed of device/user

- ⌘ Formula:
$$T = a + b \log_2 \left(1 + \frac{2D}{W} \right)$$

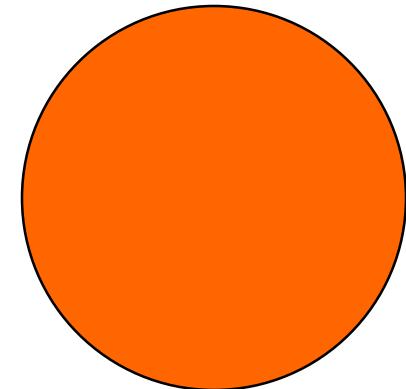
- ⌘ Simpler:
$$T = a + bI$$

Fitts's Law: Time to hit a target w/pointer

- ⌘ Movement starts fast; slows near target
- ⌘ Slows *more* at target if target is *small*



Fitts's Law: Time to hit a target w/pointer



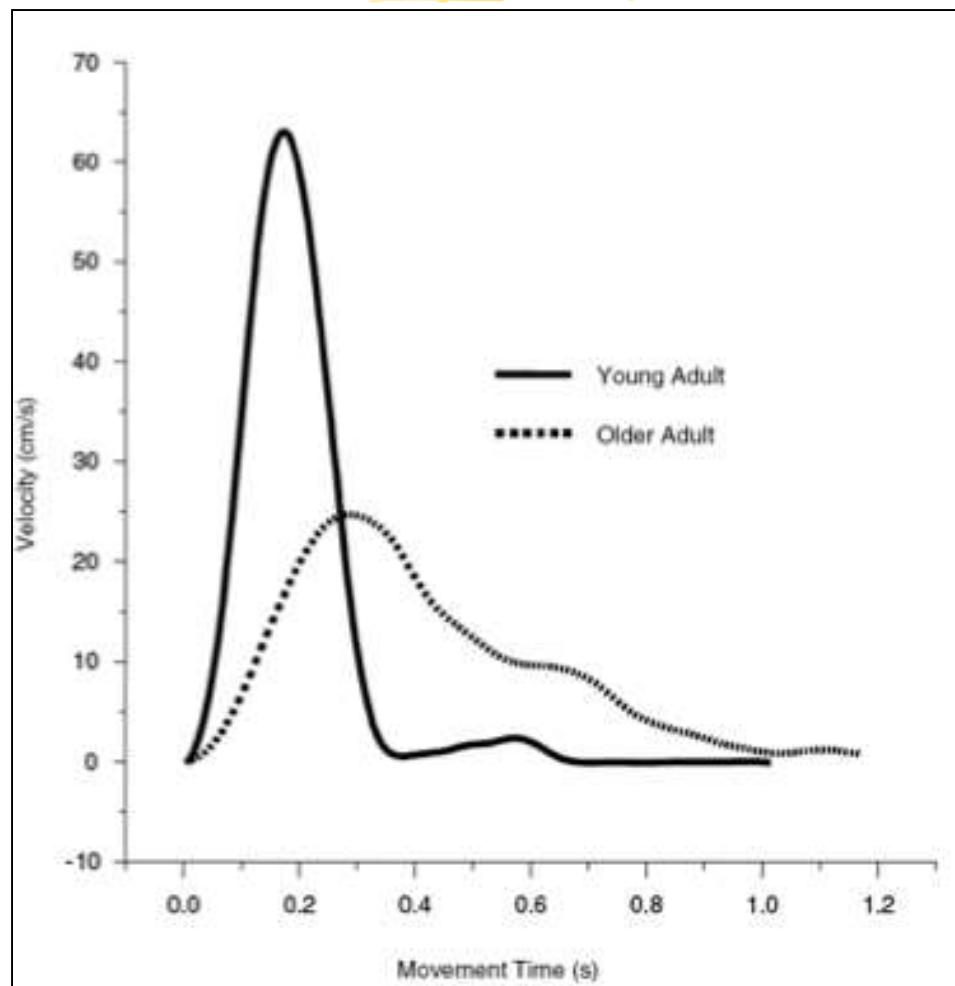
Fitts's Law: Applies to almost all pointing



- ⌘ All pointing devices
- ⌘ Human hands, feet, even head movement!
- ⌘ *All people*: all ages, abilities, even if drugged
- ⌘ Just change parameters: a & b

$$T = a + bI$$

Pointing Slows with Age



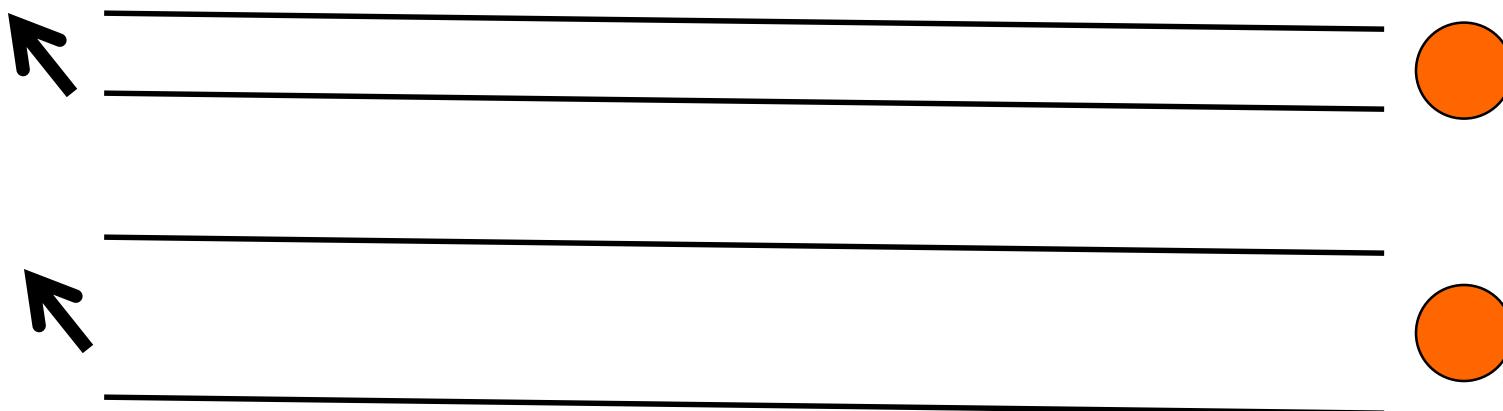
Fitts's Law: Implications for Design



- ⌘ Make click-targets (e.g., buttons, links) *big*
- ⌘ Targets at *top & edge* of screen fast to hit
 - ↗ Essentially have infinite size
- ⌘ Menus: *pop-up & pie* menus faster than *pull-down*
 - ↗ Less movement required
 - ↗ All faster than *pull-right* menus

Steering Law [Accot & Zhai, 1997]

- ⌘ Derived from Fitts's Law: $T = a + b(L/W)$
- ⌘ Wider paths allow faster movement



- ⌘ Implications: allow wide paths for scrollbars & pull-right menus

Steering Law

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Road Scholar Blogs

Steering Law

☒ Road Scholar Menus: 2012 vs. 2013

Africa & Middle East	Asia	Australia & South America
Africa	Botswana	
Middle East	Egypt	
	Ghana	
	Kenya	
	Libya	
	Madagascar	
	Malawi	
	Mali	
	Morocco	
	Namibia	
	Seychelles	
	South Africa	
	Tanzania	
	Tunisia	
	Uganda	
	Zambia	
	Zimbabwe	

2012 Menu: A woman with blonde hair wearing a blue jacket. Text on the left says "S AND IST SEE IONS". Text at the bottom says "Elaine Murrell Support the Why She Loves".

Africa & Middle East	Asia	Australia & South America
Africa	Botswana	
Middle East	Egypt	
	Ghana	
	Kenya	
	Libya	
	Madagascar	
	Malawi	
	Mali	
	Morocco	
	Namibia	
	Seychelles	

2013 Menu: A woman with dark hair wearing a white shirt. Text on the left says "our tter & book: experiences world". Text at the bottom says "ograms go ► x 2:45 / 5:2: ograms".

Human Real-Time Characteristics

- # Shortest audible silent gap in sound: 0.001 sec
- # Briefest visual stimulus that affects us: 0.005 sec
- # Threshold for *auditory* fusion of clicks: 0.02 sec
- # Threshold for *visual* fusion of images: 0.05 sec
- # Speed of (involuntary) flinch reflex: 0.08 sec
- # Lag in full awareness of visual event: 0.1 sec
- # Limit on perception of cause/effect: 0.14 sec

Human Real-Time Characteristics



- ⌘ Time for skilled reader to comprehend a word: 0.15 sec
- ⌘ Time to *subitize* 1-5 items: 0.2 sec
 - ◆ ◆ ◆
- ⌘ Time to identify (name) visual object: 0.25 sec
- ⌘ Time to *count* items in visual field: 0.5 sec/item
 - ■ ■ ■ ■ ■ ■ ■ ■ ■
- ⌘ Minimum visual-motor reaction time: 0.7 sec
- ⌘ Average conversational gap: 1 sec
- ⌘ Length of unbroken attention to task: 5-30 sec

Clicks Need Immediate Feedback

- ⌘ Controls must react immediately (0.1 sec) to clicks or we assume we missed



Display “Whole” Quickly Fill in Detail Later

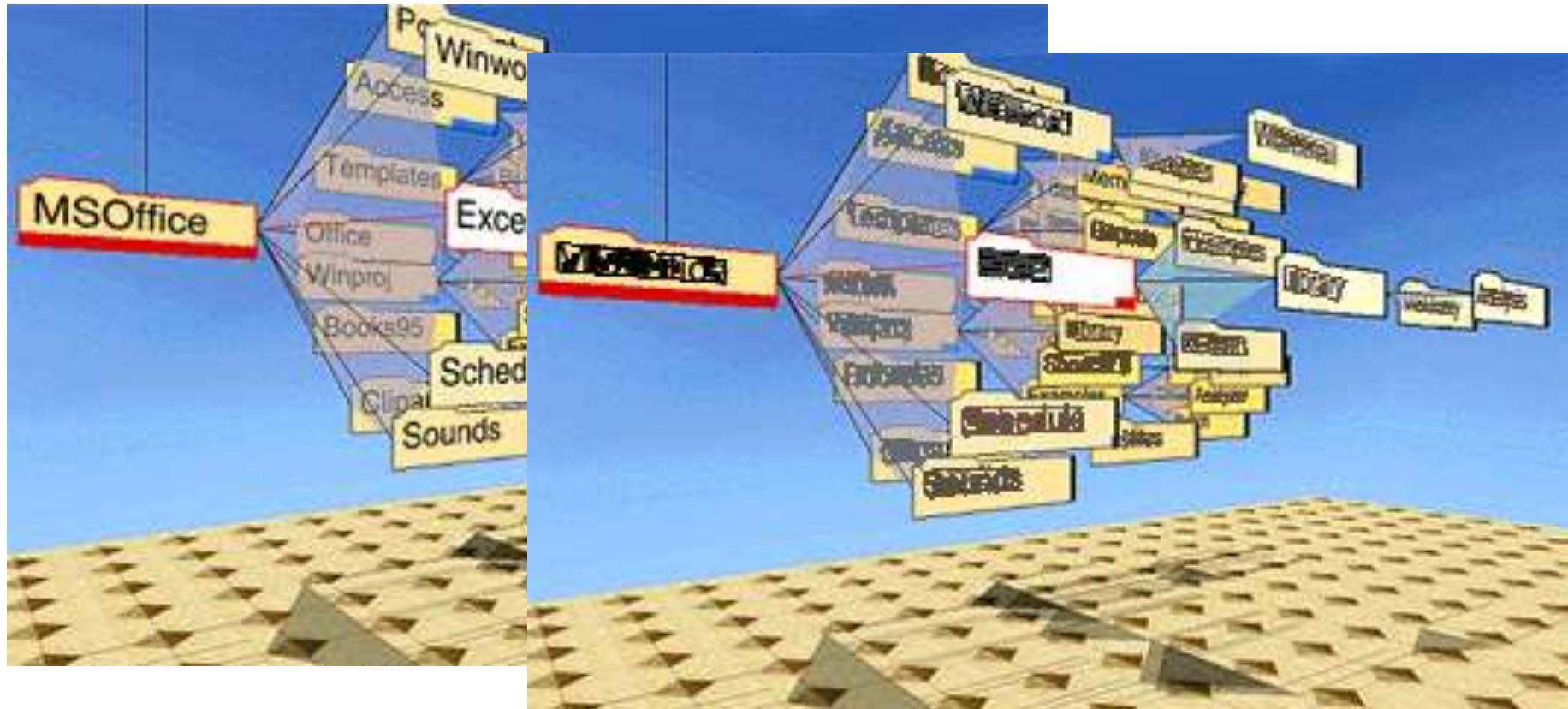


Display “Whole” Quickly Fill in Detail Later



Animation: Preserve 16 frames/sec

⌘ InXight Cone Tree



Questions?



Conclusion: Applying Design Rules in UI Designs is Not Simple & Mindless



- ⌘ UI design is a *skill*; not something anyone can do by following guidelines
- ⌘ Knowing cognitive basis helps us prioritize
 - 应用查看 which rules to follow in each design situation

Now, Maybe those UI Design Rules Make More Sense

- # Strive for consistency
- # Cater to universal usability
- # Offer informative feedback
- # Design task-flows to yield closure
- # Prevent errors
- # Permit easy reversal of actions
- # Make users feel *they* are in control
- # Minimize short-term memory load

UI Design Guidelines (Nielsen & Molich, 1993)



- ⌘ Visibility of system status
- ⌘ Match between system & real world
- ⌘ User control & freedom
- ⌘ Consistency & standards
- ⌘ Error prevention
- ⌘ Recognition rather than recall
- ⌘ Flexibility & efficiency of use
- ⌘ Aesthetic & minimalist design
- ⌘ Help users recognize, diagnose, & recover from errors
- ⌘ Provide online documentation & help

UI Design Guidelines (Stone *et al*, 2005)



- # **Visibility**: First step to goal should be clear
- # **Affordance**: Control suggests how to use it
- # **Feedback**: Should be clear what happened or is happening
- # **Simplicity**: as simple as possible & task-focused
- # **Structure**: content organized sensibly
- # **Consistency**: similarity for predictability
- # **Tolerance**: prevent errors, help recovery
- # **Accessibility**: usable by all intended users, despite handicap, access device, or environmental conditions

The End



⌘ Questions?

Human Real-Time Characteristics

- Shortest audible silent gap in sound: 0.001 sec
- Briefest visual stimulus that affects us: 0.005 sec
- Shortest noticeable lag in ePen ink: 0.01 sec
- Threshold for *auditory* fusion of clicks: 0.02 sec
- Threshold for *visual* fusion of images: 0.05 sec
- Speed of (involuntary) flinch reflex: 0.08 sec
- Lag in full awareness of visual event: 0.1 sec
- Limit on perception of cause/effect: 0.14 sec

Human Real-Time Characteristics

- Time for skilled reader to comprehend a word: 0.15 sec
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 - ◆ ◆ ◆
- Time to identify (name) visual object: 0.25 sec
- Time to *count* items in visual field: 0.5 sec/item
 - ■ ■ ■ ■ ■ ■ ■ ■ ■
- Minimum visual-motor reaction time: 0.7 sec
- Average conversational gap: 1 sec
- Length of unbroken attention to task: 6-30 sec

Human Real-Time Characteristics

Applicability to UI Design

- Controls must react within 0.14 sec to clicks, or perception of cause/effect is *broken*



Conclusion: Applying Design Rules in UI Designs is Not Simple & Mindless

- UI design is a *skill*; not something anyone can do by following guidelines
- Knowing cognitive basis helps us prioritize
 - Recognize which rules to follow in each design situation

Thank you!

- ***Designing With the Mind in Mind***
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- Questions?

