

Human Factors

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Overview

① Perception

- Biases
- Structure
- Limitations
- Visual search
- HCI and vision
- Design implications

② Memory

- Design implications

③ Cognition

- Attention
- Learning
- Reasoning
- Design implications

④ What's next

Sources

- Jeff, **Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines**, 2nd ed. (2014).
- Mackenzie, Chapter 2, **Human Factors**, Human Computer Interaction: An Empirical Research Perspective, 1st ed. (2013)

HCI challenge

- **Human variability** is the biggest challenge of HCI
- Obviously, understanding humans increase our success
- Here, we discuss human **perception, memory and cognition**

Perception

- **First stage of processing** in the brain, occurs when sensory signals are received as input. It is at this stage human makes meanings
- Perception has been studied in a area of experimental psychology known as **psychophysics** - examines the relationship between perception and physical phenomena

Facts about Perception

- ① Our perception is biased by
 - our goals
 - our belief
 - our experience
 - the context
- ② Our vision is optimized to see structure
- ③ Our color vision is limited
- ④ Our peripheral vision is poor
- ⑤ Visual search is linear unless target "pops"
- ⑥ Reading is unnatural

Our perception is biased...



Our perception is biased...

Page 3

Back

Next

Page 4

Next

Back

Our perception is biased...

Exactly same character



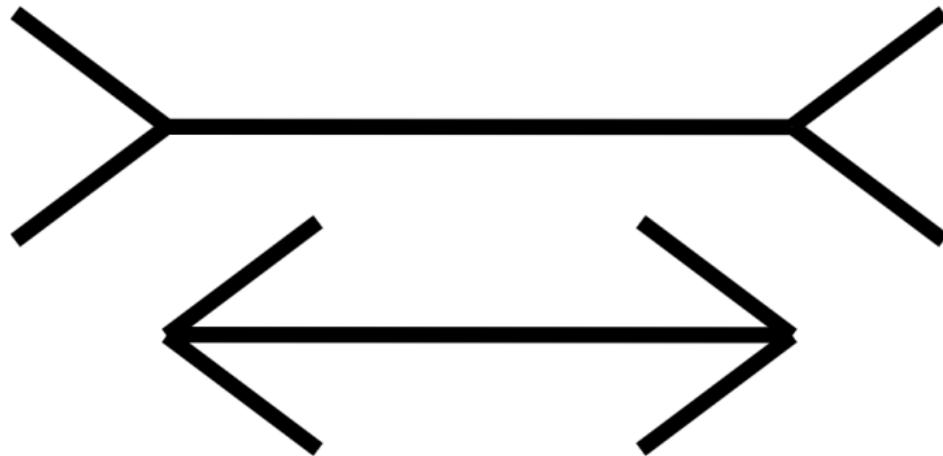
Our perception is biased...

But our perception can be changed based on the **context**

THE CHT

Our perception is biased...

Muller-Lyer illusion



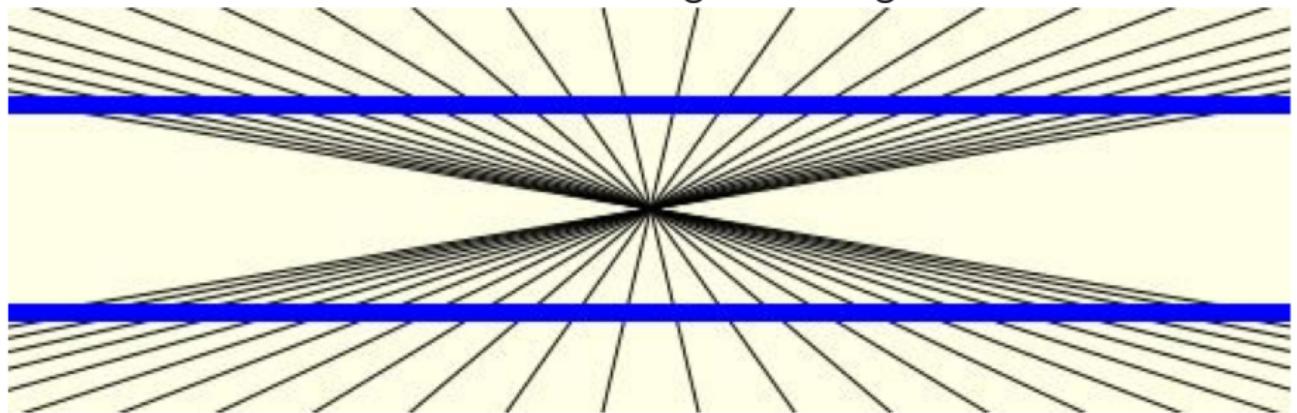
Our perception is biased...

Muller-Lyer illusion



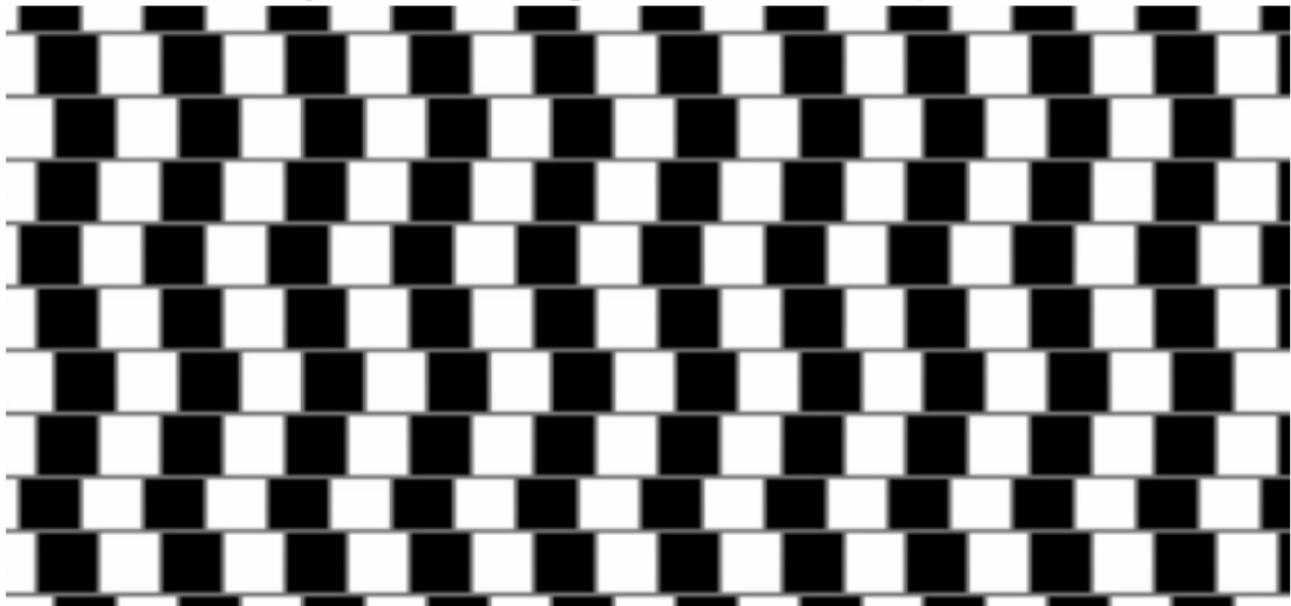
Our perception is biased...

All lines in this image are straight!



Our perception is biased...

Gray lines are straight, horizontal, and parallel!



Our perception is biased by goals

- Our perception is biased toward our **goals**
- Tend not to notice things unrelated to goals

Our perception is biased by goals

The homepage of the University of Canterbury's website features a navigation bar with links to Study, Courses, Departments, Students, Research, Teaching, Contact, a Search bar, and a magnifying glass icon. The main content area is divided into several sections: 'Courses' (with a video thumbnail of a student), 'International' (with a video thumbnail of a landscape), 'Liaison' (with a video thumbnail of two people), 'More Engineering' (with a video thumbnail of two people), 'Scholarships' (with a 'more' button), 'Postgraduate' (with a video thumbnail of a computer screen displaying 'ONE UNIVERSITY OF CANTERBURY'), and 'Nau mai, haere mai ki te Whare Wānanga o Waitaha' (with a video thumbnail of a landscape). Below this, there are sections for 'NEWS' (with a thumbnail of a person riding a bison) and 'WHAT'S HAPPENING' (with a thumbnail of a truck with a sign that says 'NEW CAREER AHEAD!'). A sidebar on the left lists 'Information for' categories: Prospective Students, International Students, Postgraduate Students, Current Students, Visitors and Community, Business and Industry, Alumni and Friends, and Prospective Staff.

Information for	Quick Links
Prospective Students	›
International Students	›
Postgraduate Students	›
Current Students	›
Visitors and Community	›
Business and Industry	›
Alumni and Friends	›
Prospective Staff	›

NEWS



Expert to talk about captive elephants

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

WHAT'S HAPPENING



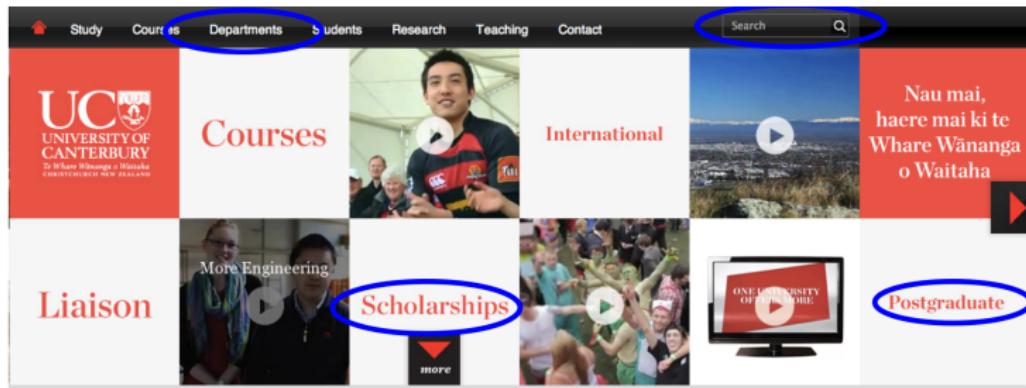
What can I do with a degree from UC?

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 perception is biased by goals



Information for

Quick Links

- Prospective Students
- International Students
- Postgraduate Students** (circled in blue)
- Current Students
- Visitors and Community
- Business and Industry
- Alumni and Friends
- Prospective Staff

NEWS

News Feature



Expert to talk about captive elephants
6 May 2013 | Erin Ivory, one of the world's leading

WHAT'S HAPPENING

Events



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 structures

Gestalt Principles of Visual Perception

- Proximity
- Similarity
- Continuity
- Closure
- Symmetry
- Figure/ground
- Common fate

Proximity

Items that are closer appear grouped

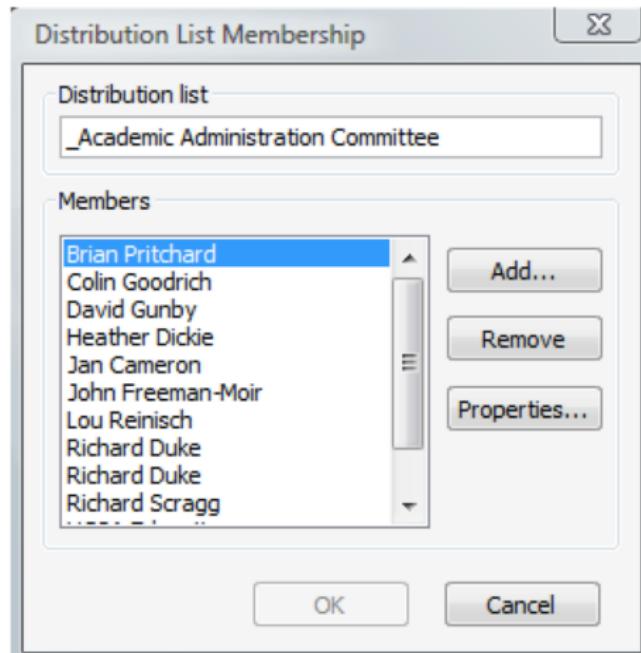


Left: rows



Right: columns

Proximity



Proximity

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 ▾

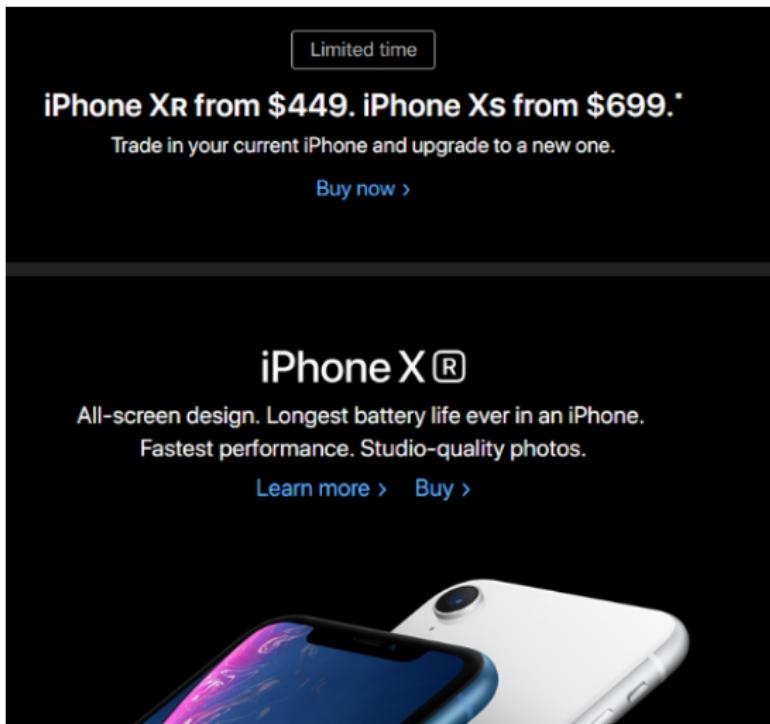
The San Francisco **Orchid** Society would like to express its thanks to the Taiwan Tourist Bureau CBS and KCBS for their continued support in production and ...

Orchids in the Park - San Francisco Orchid Society

www.orchidsanfrancisco.org/orchidsinthepark.html ▾

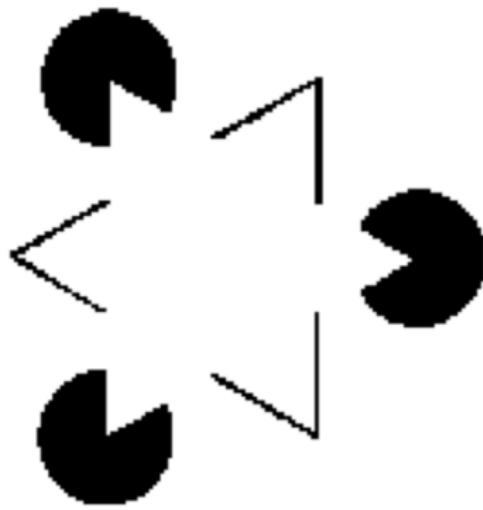
Thanks to all volunteers and attendees for a successful "Orchids In The Park" event. --
Images by Jeff Harris. --Images by Jeff Harris. <back to top> ...

Proximity



Closure

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



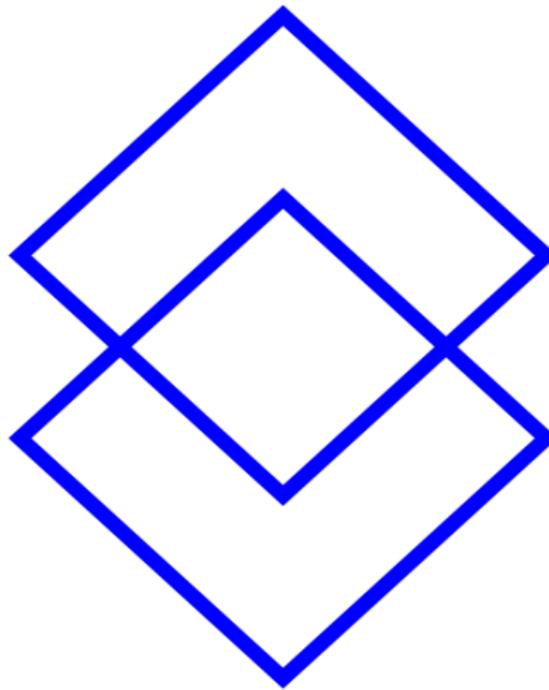
Closure

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



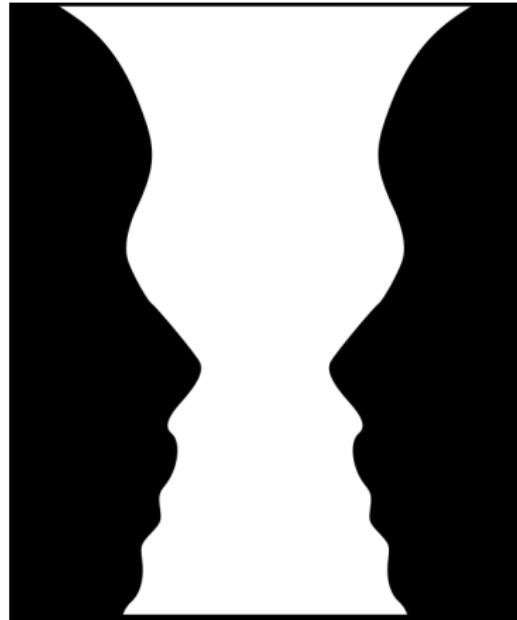
Simplicity

We tend to see simple figures rather than complex ones



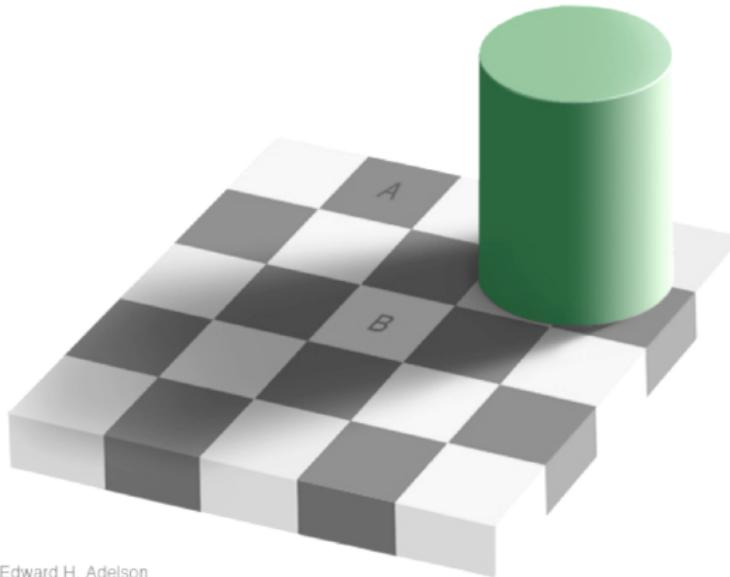
Figure/Ground

The tendency to simplify based on the figures and the grounds



Our color vision is limited...

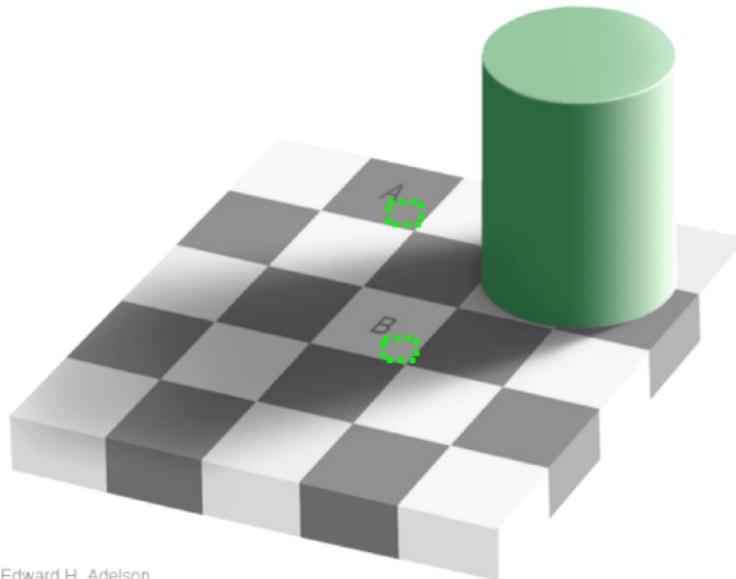
Optimized to see contrasts, edges, and changes, not absolute levels



Edward H. Adelson

Our color vision is limited...

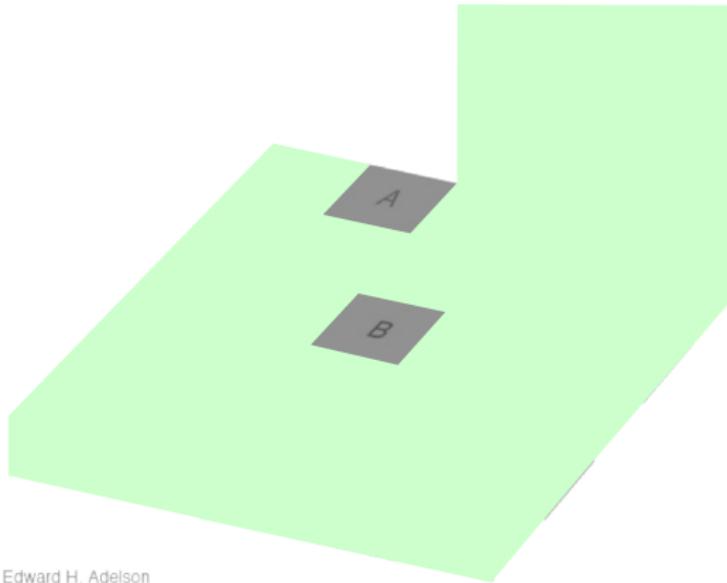
Optimized to see contrasts, edges, and changes, not absolute levels



Edward H. Adelson

Our color vision is limited...

Optimized to see contrasts, edges, and 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...

We have trouble discriminating - pale colors, small color patches, separated patches...



Our color vision is limited...

We have trouble discriminating - pale colors, small color patches, separated patches...

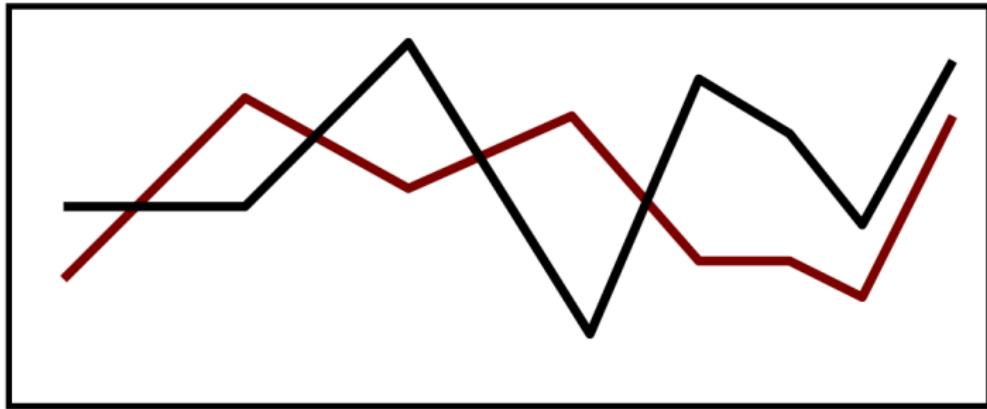


Our color vision is limited...

Some people have color blindness

- 8% of males
- 0.5% of females

colors that would be hard for red-green colorblind people to distinguish



Our color vision is limited...

Most common forms of color blindness - red-green called deutanopia

Google: normal



Google: deutanopia



Our color vision is limited...

Don't use colors only! Also rely on other things like shapes or cues

E.g., Let's improve ITN.net

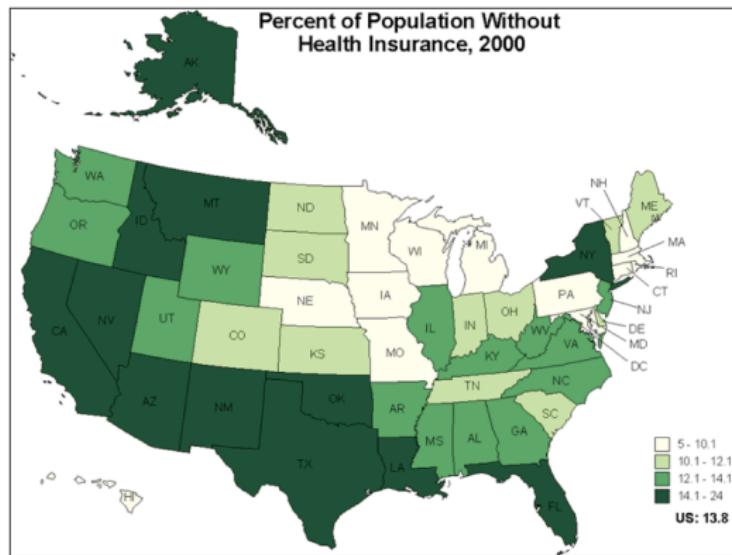


How *they* improved it:



Our color vision is limited...

Don't use subtle color differences. Should still look different in gray scales.
Bad examples below....



Our peripheral vision is poor...

Our view of vision is actually narrow...

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...

Bad design...

RETURNING CUSTOMER LOGIN

Login ID not found.

Login ID:

Password:

Remember my Login ID for faster logins.

LOGIN

Our peripheral vision is poor...

Simulating the fovea...



Our peripheral vision is poor...

Better design...

The screenshot shows a web browser displaying the **informaworld** homepage. The top navigation bar includes links for **eBooks**, **Journals**, **Reference Works**, and **Abstract Databases**. Below the navigation is a search bar with the placeholder "Search entire site" and a "GO" button. There is also an "Explore" dropdown menu with "informaworld" selected. To the right of the search bar are links for "Browse Publications A-Z", "Browse Subjects A-Z", and "Advanced Search". The main content area features a logo for **Taylor & Francis** and a "Taylor & Francis Group" banner. Below this is a "My Account" section with tabs for **My Account**, **Register**, **Subscriptions**, **Purchases**, **Shopping Cart**, **Alerts**, **Marked Lists**, and **Saved Searches**. The **Register** tab is currently active. The page title is "Register". On the right side, there is a "Help" link. The main content area contains sections for "Personal Registration" and "Institutional Registration". It also includes a note about existing accounts and a "Sign in" link. A red warning message is displayed: "Username/password combination was not recognised." Below the "Sign in" form, there are links for "[forgotten password?]" and "[Athens users click here to sign in]".

Our peripheral vision is poor...

Better design...

Create a Free Email Address

[Already a Member? Click here](#)

* First Name: 

* Last Name: 

* Desired Email Address: @aol.com
3-16 letters or numbers. It must start with a letter.

* Password: Password Strength 
Please enter a Password that is 6-16 characters using only letters and numbers.
6-16 letters or numbers.
[Help for creating a secure password.](#)

Visual search is linear...unless the target "pops"



Where's Waldo?



Visual search is linear...unless the 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 8

Visual search is linear...unless the target "pops"

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.

Visual search is linear...unless the target "pops"

Icons help....arranging by alphabet also helps



Visual search is linear...unless the target "pops"

Visual search slows down by age...

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

- Top Navigation:** Your Amazon.com, Today's Deals, Gift Cards, Sell, Help.
- Search Bar:** Search All | Go
- User Account:** Hello, Sign in Your Account, Try Prime, Cart, Wish List.
- Year-End Deals:** Sponsored by SanDisk
- Kindle Fire HDX:** Introducing kindle fire HDX And the revolutionary "Mayday" button. From \$229. Shop now.
- Mayday Button:** A circular orange button labeled "MAYDAY".
- Cloud Player:** Instant Video, MP3 Store, Cloud Player, Kindle, Cloud Drive, Appstore for Android, Digital Games & Software, Audible Audiobooks.
- Return or replace a gift:** Extended holiday returns until January 31. Go to the Returns Center.
- New Year's Eve Deals:** Shop now.
- Clothing:** UP TO 70% OFF CLOTHING. Select styles. Prices as marked. See more.
- LifeProof Cases:** for iPhone 4 & 5. Learn more.
- Holiday Favorites:** from Marketplace Sellers. Shop now.
- Amazon Credit Card Offer:** = \$30 Off Instantly.
- Bottom Navigation:** The Perfect Clip, Year-End Deals, Top Movies and TV.
- Prime Membership Offer:** Included with Prime Membership at No Additional Cost.
- Movie Posters:** General Mills, The Hunger Games, Skyfall, 007, Schindler's List.

Talking about reading a bit

- We're pre-wired for **language**
- We are pre-wired for **pictures**
- We are NOT pre-wired for **reading** - reading requires practice!
- We **scan**, not look nor think → common mistakes on icon design

HCI and vision

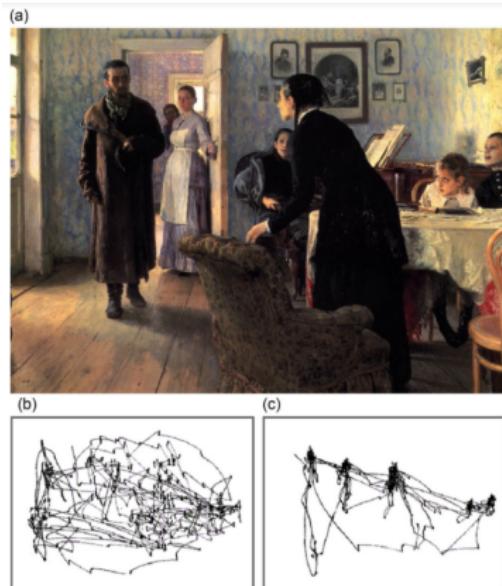


FIGURE 2.6

Yarbus' research on eye movements and vision (Tatler et al., 2010). (a) Scene. (b) Task: Remember the position of the people and objects in the room. (c) Task: Estimate the ages of the people.

Figure: Source: Fg 2.6 (Mackenzie)

HCI and vision

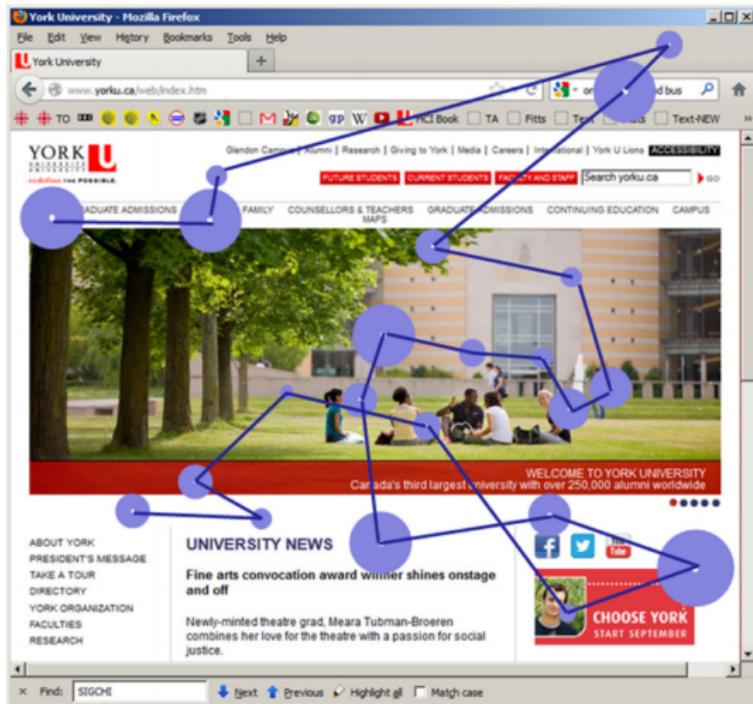
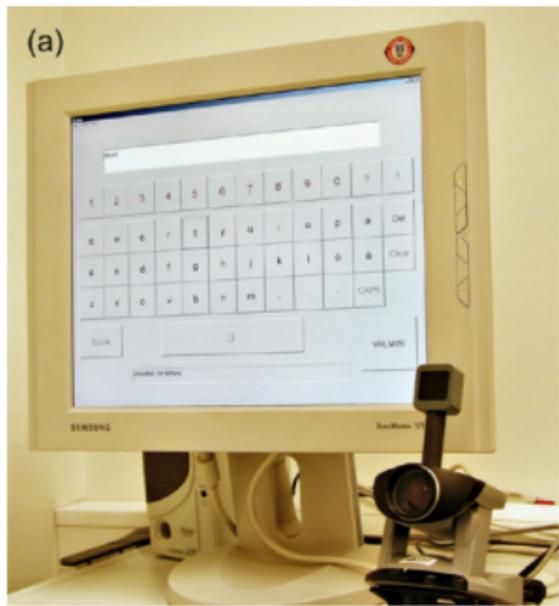


FIGURE 2.7

Scanpath for a user locating content on a web page.

HCI and vision



(b)

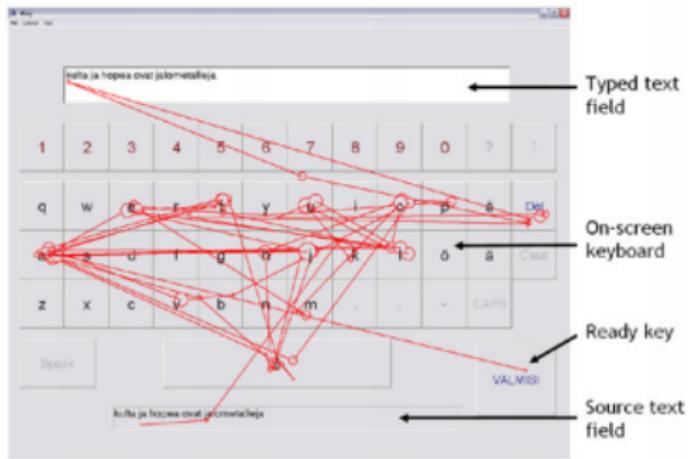


Figure: Source: Fg 2.13 (Mackenzie)

Design implications

- **Don't believe what users say;** instead understand their goals and knowledge (and what they don't know)
- Always exploit **structure** rules
- Use **color** very carefully
- Humans can focus only at **very tiny spot**. Thus put where users are **looking**
- Use **affordance, convention, constraints, mapping** can increase visual search speed

Activities

Classwork

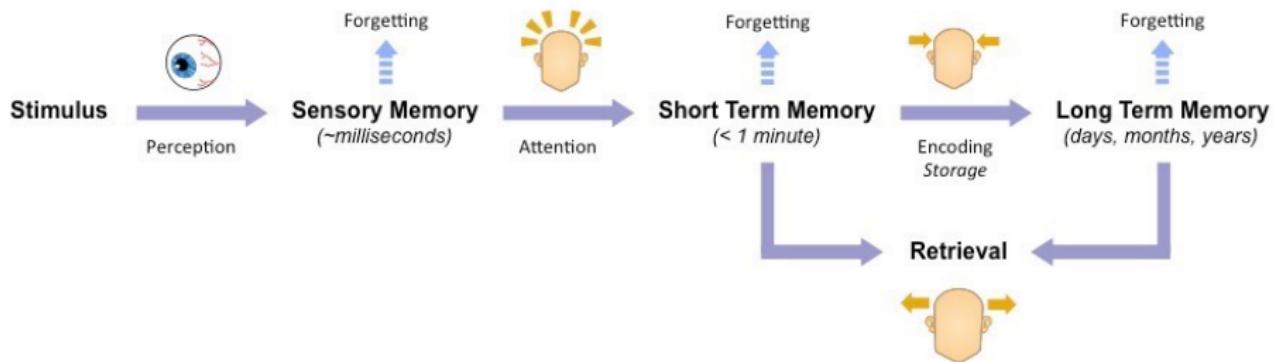
- Download latest PEBL from <http://pebl.sourceforge.net/download.html>
- Perform the Muller-Lyer experiment 2 times. Combine the two csv files into one and perform analysis using any tool, e.g., Excel.
- Attempt to think of **three** research questions, **three** corresponding hypotheses, and perform **analysis**. Finally make a **50** words conclusion for **each** question.

The challenge is to think what are good scientific questions, and do proper analysis. Make sure all graphs have standard bar errors.

Questions

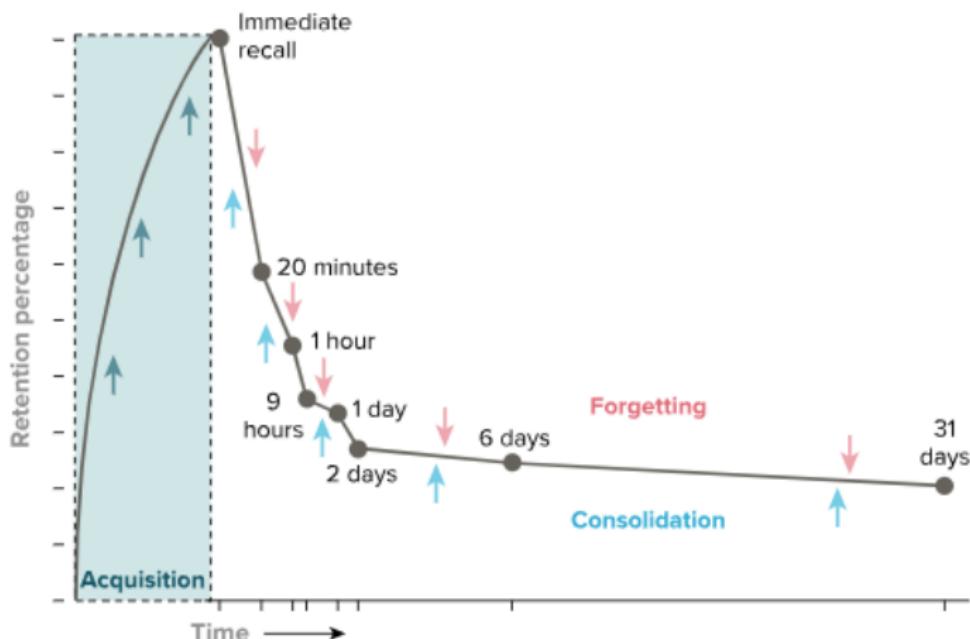
Our memory is imperfect

- Short Term Memory (STM or WM)
- Long Term Memory (LTM)



Our memory is imperfect

Memory strength over time



SOURCE: R.L. DAVIS & Y. ZHONG / NEURON 2017

KNOWABLE MAGAZINE

Short-term memory

- Also known as working memory
- Can remember around 7 (± 2) unrelated items (3-5 are better estimates, according to Jeff)
- Can stay for around <1 minute
- **Chunking** improves our short-term memory

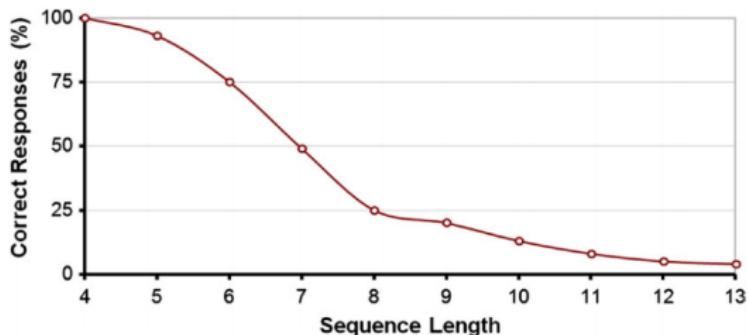


Figure: Source: Figure 2.18 (Mackenzie): Digital lengths and memory

Chunking

Deploy and scale seamlessly

Our optimized configuration process saves your team time when running and scaling distributed applications, AI & machine learning workloads, hosted services, client websites, or CI/CD environments.

Deploy

Manage

Secure

Scale

Monitor



Cluster deployments

Provision multiple Droplets (virtual machines) in seconds with our control panel, CLI, or directly against our API.



Optimized compute types

Get the compute resources you need with Standard or Optimized Droplets.



One-click apps

Skip the install and configuration process with pre-built open source images supporting Rails, Cassandra, Docker, and more.



Global availability

Deploy to any of our data center regions around the world.

Long-term memory

- Stores life time experience but prone to error and biases
- Similar experience trigger same patterns > **recognition**
- Internal neural activity triggers pattern > **recall**
- Why we forget?
 - **Decay theory:** proposes that memory fades due to mere passage of time - active rehearsing information is believed to counter this temporal decline
 - **Interference theory:** proposes that similar information can make memories less accessible

Provide external memory aids

$$5+6*7/3 =$$

19

Provide external memory aids

The use of flagging helps...

Mailboxes

	Inbox	7
	Flagged	185
	Red	7
	Yellow	92
	Drafts	
	Sent	
	Junk	692
	Trash	
	All Mail	408

Smart Mailboxes

	Recovered Me...	
--	-----------------	--

Google

	Important	13
	Boomerang-O...	
	CHI-list	2
	CSCW	
	Interaction De...	

Sort by Unread

- **Slideshare** 11:25
More content like "[ID] Week 02. Un...
SlideShare is now on Android. Get the app We found something with that mi...
- **Kyoko Hatakenaka** 11:10
[renlab 02543] Fwd: [kut 06647] (...
Dear all, University will do power outage work from 8:30 to 16:30 on A...
- **Patiphan Pholmat** 11:03
✉ Accepted: Open House Meeting
Attachment: Mail Attachment.ics
- **CHI-JOBS automatic digest...** 11:02
CHI-JOBS Digest - 3 Aug 2017 to 7...
There are 2 messages totaling 83 lines in this issue. Topics of the day: 1...
- **CHI-ANNOUNCEMENTS auto...** 11:01
CHI-ANNOUNCEMENTS Digest - 6...
There are 11 messages totaling 1538 lines in this issue. Topics of the day: 1...
- **Apiporn Simapornchai** 11:00
✉ Accepted: Open House Meeting
Attachment: Mail Attachment.ics
- **Quora Digest** 07:34
What laptop do I buy for deep learni...

Apiporn Simapornchai

Declined: Open House Meeting

To: Chaklam Silpasuwanchai



Mail Attachment

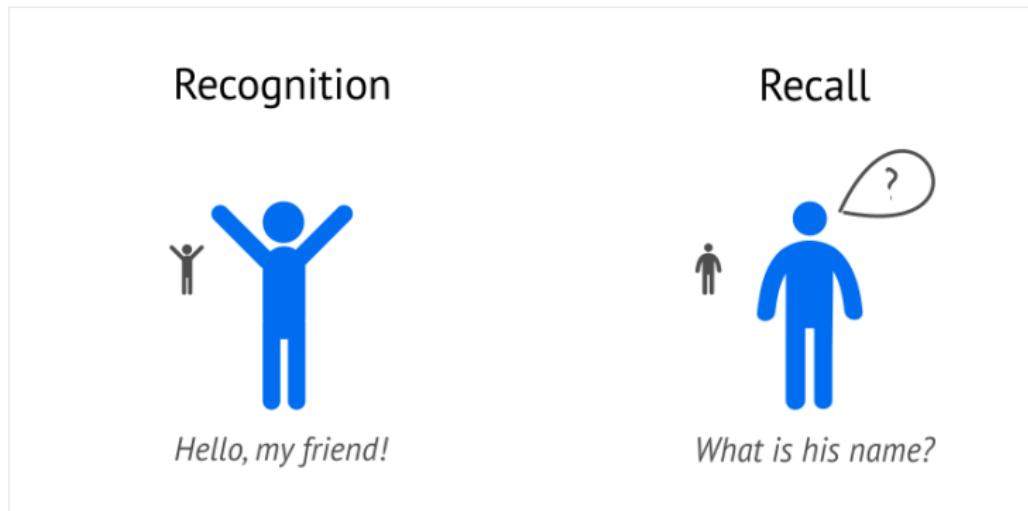
Provide external memory aids

```
STIU-M-00101:~ csilpasuwanchai$ history
1 ipconfig
2 ifconfig
3 ping 10.10.101.62
4 ping Server returned error: "334
5 Server returned error: "334
6 ping smtp.office365.com
7 java -version
8 cd /System/Library/Java/
9 ls
10 ls
11 cd ..
12 ls
13 cd ..
14 ls
15 cd /Library/
16 ls
```

History of commands helps...

Recognition much faster than recall

- Use menus and metaphors
- Use auto-completion if recall is really needed



Design Implications

- Use **convention** and **consistency**
- Use **recognition** instead of recall when possible (but do not forget ways for novice to transition to experts)
- Use **chunking** when possible; 3-5 rule
- **Put the knowledge in of the world** (Norman, 1988), e.g., bookmarks, history of commands, tagging, time stamping, reminders, marked emails, pwd etc.

Attention

- Our attention is limited
- Goldfish has an attention span of 9s, guess how much is of humans? 8s! (In 2000, our attention span is 12s)
- Do you remember what I discuss in the previous slide? What did you eat yesterday morning?



Our attention is on the goal, not the tools/person

<https://www.youtube.com/watch?v=FWSxSQsspiQ>



Consider "viewport" - bad example

engadget

Login

Gear Gaming Entertainment Tomorrow The Buyer's Guide Video Reviews US Edition 

Featured



Switch Online code hints at potential SNES game additions

3h ago



Epic's updated game store refund policy matches Steam

17h ago



Business

Unity, Improbable and Epic Games are squabbling in public

N. Summers, 01.10.19 | #

Consider "viewport" - good example

The screenshot shows the homepage of the New Chapter website. At the top, there is a purple header bar with the text "Use our store locator to find products at a shop near you." Below the header is a navigation bar with links for "Home", "Products", "Health Needs", "Ingredients", "Our Difference", "Shop", "My Account", and icons for search, cart, and account.

A red banner across the top of the main content area says "Save when you subscribe today! Get 15% off your monthly subscription." Below this, there is a large background image of a person walking away from the camera on a path through a forest.

The main headline reads "INTRODUCING New Chapter® Rewards" followed by the subtext "The next step in your self-care journey...". A "Learn More" button is located below this text.

At the bottom of the main content area, another red banner offers "Special Offer free shipping*. Save 15% when you subscribe." Below this banner, there are three product recommendations:

- TOP PICK** Vitamins
Every Woman™'s One Daily Multivitamin

[BUY NOW](#) \$19.44
- TOP PICK** Inflammation
Zyflamend™ Whole Body

[BUY NOW](#) \$21.60
- TOP PICK** Bone Strength
Bone Strength Take Care™ Slim Tablets

[BUY NOW](#) \$16.34

Consider "hierarchy" - bad example

ADIDAS CORPORATE WEBSITE Reebok ⚪ myPerformance ⚪ SOCIAL SPACE ⚪ GAMEPLAN A

adidas

BLOG ON-THE-JOB RECORDS CAREER TALK BUSINESS OPERATIONS SUSTAINABILITY ASPECTS HEADQUARTER NEWS STRATEGY UPDATES MORE ▾

SEARCH ARCHIVE

ALL POSTS NOW ON **GAMEPLAN A** by adidas

Alisen Smith May 6, 2016

On-the-Job Records How being a Mom helps me stay fit

NOW ON **GAMEPLAN A** by adidas

Sophia Schör April 28, 2016

Career Talk Get out of bed! Challenge yourself to be the early bird.

MOST RECENT MOST POPULAR

NOW ON **GAMEPLAN A** by adidas

Joanne McDonald April 27, 2016

On-the-Job Records Turn on the lights – harnessing positive energy in London

WE ARE MOVING. MOVE WITH US.

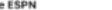
It's finally here: the new digital magazine we've been dying to share with you. Join the huddle to make work life better, more inspiring and fun.

Consider "hierarchy" - good example

TOP FOOTBALL  La Liga F1 ATM 1 BIL 0 SEV 0 F1 BAR 2 EBB 0 F1 BET 3 MAD 0 COPPA ITALIA F1 TOR 1 FIO 2 F1 INT 0 NAP 6 SAS 2 > Full Scoreboard

ESPN Football NBA NFL Cricket Rugby Golf ... Fantasy  

 Football Home Scores Fixtures Transfers Teams Tables Leagues & Cups Fantasy Football 

Customise ESPN  

Topics

- Premier League
- Champions League
- La Liga
- Liga MX
- Football Asia
- Fantasy Football
- Transfer Talk



Solskjaer's tactical acumen overcomes Pochettino

Man United had won games before under their caretaker manager, but their victory at Spurs showed why Ole Gunnar Solskjaer's reputation is growing.

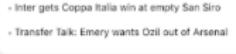


Suarez stars, Messi makes more history

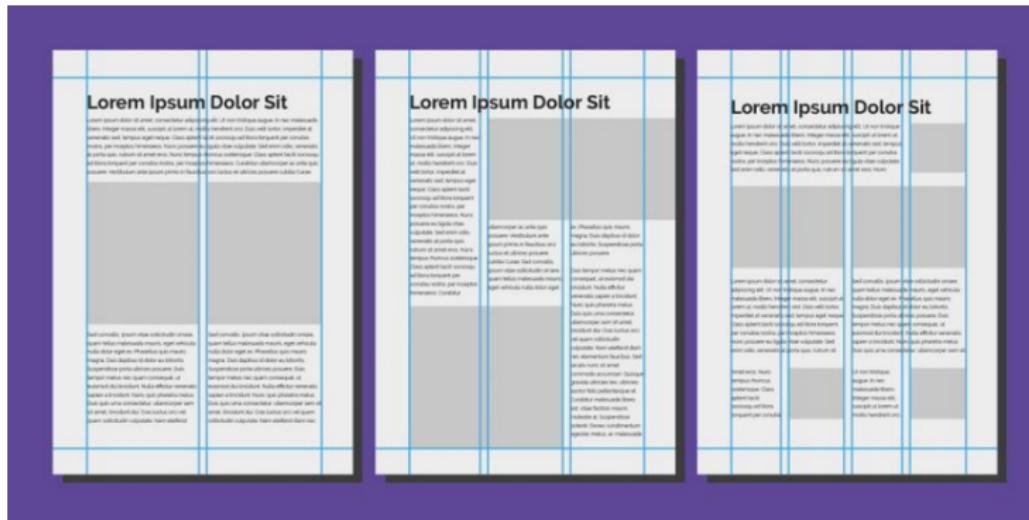
The Liga leaders restored their five-point advantage with a routine win vs. Elbar that was highlighted by Luis Suarez's impressive form.

Top Headlines

- Solskjaer surpasses Busby, sets United record
- Poch: Spurs' Kane injury would be 'massive' blow
- Pogba lauds 'freedom' to play under Solskjaer
- Chesterfield's Hudson-Odoi nearing top level - Sarri
- Guardiola: City battling Barca, Real for signings
- Messi becomes first to score 400 La Liga goals
- Solari: Not 'personal' for starting Real youngsters
- Inter gets Coppa Italia win at empty San Siro
- Transfer Talk: Emery wants Ozil out of Arsenal



Use grid



Just enough for decisions - bad example

Top 100 Products	
	Entertainment System Controllers
	PlayStation Classic
	Fossil Sport
	Surface Headphones
	Nintendo Entertainment System Controllers
	Sony PlayStation Classic
	Fossil Smartwatch
	Microsoft Surface Headphones
	Apple iPhone
	Samsung Galaxy S9
	Google Pixel 2
	LG G6
	HTC U11
	OnePlus 5T
	Google Pixel 3
	Samsung Galaxy Note 8
	Apple iPad
	Microsoft Surface Pro 6
	Google Pixel 3 XL
	Samsung Galaxy Tab S4
	Apple Watch Series 3
	Fitbit Versa
	Garmin Venu
	Pebble Time
	Sony WH-1000XM3
	Beats Solo3 Wireless
	JBL Live 400BT
	Bowers & Wilkins PX7
	Philips Fidelio L3
	Sony MDR-100ABN
	Sony WH-1000XM2
	Sony WH-1000XM3
	Sony WH-1000XM4
	Sony WH-1000XM5
	Sony WH-1000XM6
	Sony WH-1000XM7
	Sony WH-1000XM8
	Sony WH-1000XM9
	Sony WH-1000XM10
	Sony WH-1000XM11
	Sony WH-1000XM12
	Sony WH-1000XM13
	Sony WH-1000XM14
	Sony WH-1000XM15
	Sony WH-1000XM16
	Sony WH-1000XM17
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	Sony WH-1000XM46
	Sony WH-1000XM47
	Sony WH-1000XM48
	Sony WH-1000XM49
	Sony WH-1000XM50
	Sony WH-1000XM51
	Sony WH-1000XM52
	Sony WH-1000XM53
	Sony WH-1000XM54
	Sony WH-1000XM55

Just enough for decisions - good example

EXTRA 40% OFF SALE

End of season sale extended. Get an extra 40% off already marked down items. Use code NEWYOU. Ends 1/14/19.

Shoe Model	Color Options	Price	Rating	Reviews
Reebok CrossFit Nano 8 Flex...	> 16 colors	\$ 99.97 - \$130	★★★★★	1,121
Reebok CrossFit Nano 8 Flex...	> 15 colors	\$ 99.97 - \$130	★★★★★	759
Speed TR Flexweave®	> 3 colors	\$ 69.97 - \$100	★★★★★	37
Reebok Yourflex Train 10	> 5 colors	\$ 39.97 - \$40	★★★★★	282

One click theory

Fewer scrolls, fewer hovers, fewer mouse moving, faster decision makings

The screenshot shows the top navigation bar with links for Mac, iPad, iPhone, Watch, TV, Music, and Support, along with a search icon and a shopping bag icon. Below the navigation, a "Limited time" offer is displayed: "Save 6% on holiday gifts at Apple." It includes a subtext: "Get 6% Daily Cash back when you pay with Apple Card from now until December 31.*" Two buttons are present: "Learn more >" and "Apply now >". The main content area features the Apple logo with a red bow and the text "Wrap up your gift list." A blue link "Shop last-minute favorites >" is located below the text. At the bottom, there are three decorative illustrations: a row of colorful smartwatches, a cluster of white earbuds, and a group of colorful smartphones.

Loose ends

- When we finish our goal, we often forget the "loose ends" of tasks
 - Turning headlights of car off
 - Forgetting to take your ATM card after withdrawing money



End with action

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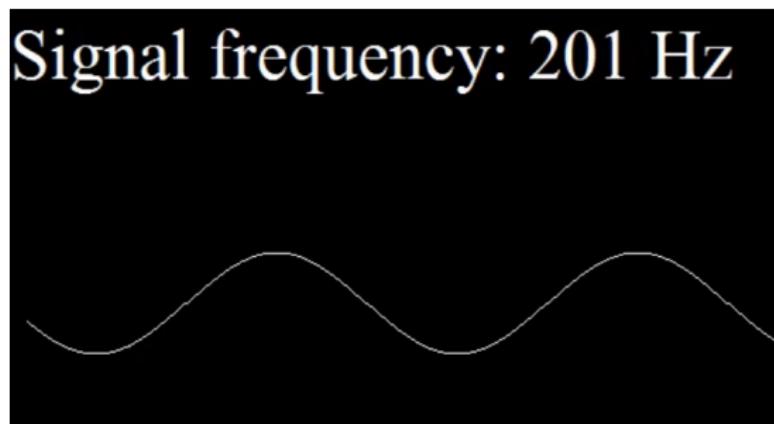
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Hearing capabilities

- Human hearing begins with sounds of 0-10dB. Conversational speech is about 50-70 dB. Painful sound is about 120-140 dB
- Pitch is the frequency and human can perceive sounds in the range of 20Hz to 20,000Hz (mine was 200Hz! How about yours?)

<https://www.youtube.com/watch?v=qNf9nzvnd1k>



Multitasking

- Humans cannot really multi-task, we can only quickly switch between multiple tasks in ms

<https://www.youtube.com/watch?v=vJG698U2Mvo>



Colors

Color is **subjective**. For example, do you believe in the following **color-emotion** mapping?

Colors

Red - confidence, ambition.



Colors

Yellow - youthfulness, creativity



Colors

Green - nature, friendly



Colors

Blue - trustworthiness, security, stability



Colors

Purple - luxury



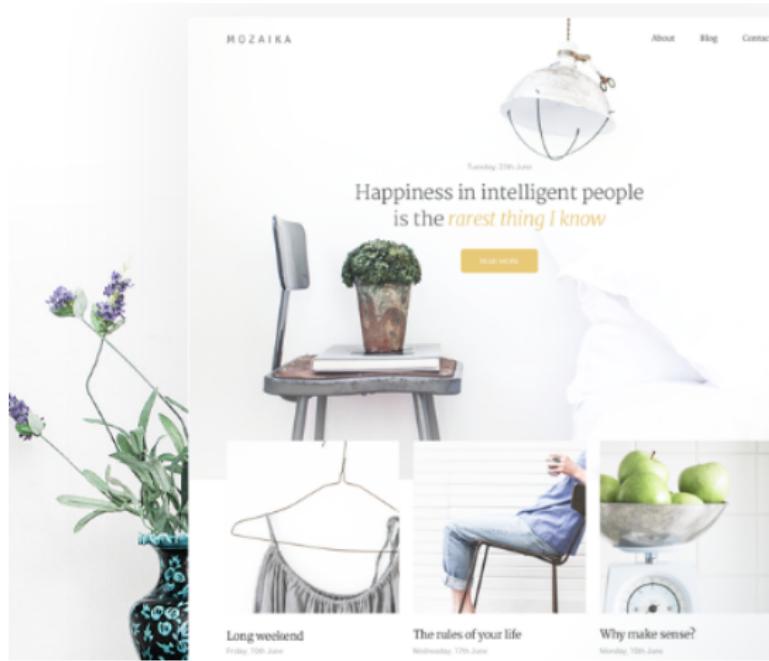
Colors

Black - neutral



Colors

White - clean, simplicity, modern



Learning

- **Convention** helps learning
- **Feedback** helps learning
- **Risk** is low
- **Reward** is high

Convention helps learning

Always preach...follows convention!

Products	About	Legal	Resources
Vitamins	Our Science	Terms & Conditions	My Account
Herbals	Our Tradition	Retailer Policy	Blog: Unlocking Wellness
Fish Oil	Ingredients	Privacy Policy	Newsletter
Booster Powders	New Chapter Rewards	Our Guarantee	Recipes
Mushrooms	Contact Us	Accessibility Notice	Digital Resources
Probiotics	Careers		
Calcium	FAQ		

* These statements have not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease.

* Limited time introductory offer.

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Convention helps learning

Always preach...follows convention!

The screenshot shows the homepage of NewChapter.com. At the top, there is a purple header bar with the text "Use our store locator to find products at a shop near you." Below the header is a navigation bar with links for Home, Products, Health Needs, Ingredients, Our Difference, Shop, My Account, and a search icon. A red banner below the navigation bar encourages users to subscribe for a discount. The main content area features a large headline "Bring wellness home." followed by a subtext about the company's commitment to quality ingredients.

Use our store locator to find products at a shop near you.

NEWCHAPTER. Home Products Health Needs Ingredients Our Difference Shop My Account

Save when you subscribe today! Get 15% off your monthly subscription.

Bring wellness home.

Our products are made with your well-being in mind.

You'll feel good about choosing New Chapter[®] – our multivitamins are all Non-GMO Project Verified and we strive to create products made with certified organic vegetables and herbs. We use only the highest quality ingredients, just for you.

Convention helps learning

Convention is about "stealing" but make it better

The screenshot shows a product search results page for 'convention' on the Nike website. At the top, there are filters for 'BRAND' (Nike, Converse, Hurley), 'COLLECTIONS' (Aerobill, Aerocore, Dri-FIT), 'FIT' (Slim, Tight, Loose, Standard), and 'COLOR'. On the left, there are additional filters for 'WEATHER' (Cold Weather, Mild Weather, Warm Weather, Water-resistant, Rainy Weather) and 'SIZE'.

The main content area displays a grid of five items per row:

- Row 1:**
 - Nike Men's 2-in-1 Running Shorts (\$100)
 - Nike Therma Sphere Men's Running Pants (\$120)
 - Nike Sportswear Men's Hoodie Jacket (\$100)
 - Nike Sportswear Windrunner Men's Hooded Jacket (\$110)
- Row 2:**
 - Nike Sportswear Club Fleece Men's Hoodie (\$45)
 - Nike Sportswear Men's Slim Pants (\$100)
 - Nike Sportswear Tech Fleece Men's Jogger (\$100)
 - Nike Sportswear Tech Pack Men's Cargo Pants (\$40-\$110)
- Row 3:**
 - Nike Sportswear Tech Fleece Icon Men's Slouchy Joggers (\$120)
 - Nike Men's 2-in-1 Running Shorts (\$100)
 - Nike Therma Sphere Men's Running Pants (\$120)
 - Nike Sportswear Men's Hoodie Jacket (\$100)

Feedback helps learning

Feedback informs us how to become better



Risk is low

- **Cheap failures** - no ways to make errors; easy to recover



Rewards

- If you decide to break the cycle and reinvent something new
 - make sure its **reward exceeds learning effort**
 - make sure it's **learnable** and able to master over time!
 - even better, **expert can still learn** something, i.e., novice vs. expert mode
- **Games** are fun, because everytime we play, **we get better, to no limits.** (Self Determination Theory, 1985)



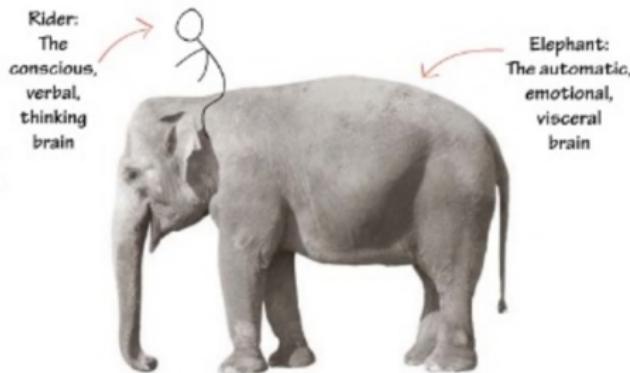
System 1 and System 2

- Our brain has two systems: system 1 and system 2
- **System 1** is the *irrational* brain - fast, automatic, unconscious, yet govern most of our behavior
- **System 2** is the *rational* brain - slow, precise, conscious, "believes" it governs our behaviors

System 1 and 2

One brain, two minds

- Elephant = impulsive mind
- Rider = Rational mind
- Path = the environment



Willpower is the strength of the rider

System 1 and 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 instant answer: 10 (wrong)
- System 2 may reject that answer. Or not.
- System 2 can calculate correct answer; System 1 cannot.

Human decisions are rarely rational

System 1 usually controls decisions but is very biased.

- **Losses** mean more than **gains**
- **Recent** history and strong memories "feel" more
- **Experience** and **intuition** means more than mountains of statistics and data
- People **avoid risks** for potential gains, but **take risks** for potential losses
- Influence by **word** (75% survival rate vs. 25% mortality rate)

Human decisions are rarely rational

Kahneman and Tversky: Fourfold Pattern

	Gains	Losses
High Probability Certainty effect	95% chance to win \$10k Fear of loss Risk Averse	95% chance to lose \$10k Hopeto avoid loss Risk Seeking
Low Probability Possibility effect	5% chance to win \$10k Hopeto gain Risk Seeking	5% chance to lose \$10k Fear of loss Risk Averse

- TL - eye surgery with 95% success but afraid of eye loss
- TR - desperate investment with 95% failure but still do it
- BL - only 5% chance to win **lottery** but still do it
- BR - only 5% chance to lose, but get **insurance**

Human decisions are rarely rational



Human decisions are rarely rational



Design Implications

- **Prioritize** your information. People only have around a window of **5-8s**.
- Remind **loose ends** - e.g., return to default mode, disconnect after inactivity, end with action, etc.
- **Convention** and **feedback** helps learning.
- If it is something **new**, make sure learning is fun with **low risk** and **high rewards**.
- Don't assume people **will think or read or learn**. We are irrational.
- Test regularly and quantitatively. Don't only take **average** performance but take note of the **special** cases.

Activities

Classwork

- In PEBL, select one task you are interested.
- Carry out the same analysis as previous classwork.
- Make sure you perform enough times to perform analysis.

What's next

In following week, read my slide on **Test** and these complimentary resources:

- Mackenzie, Chapter 6, **Hypothesis Testing**, Human Computer Interaction: An Empirical Research Perspective, 1st ed. (2013)
- Yatani, Advanced Topics in Human-Computer Interaction,
<http://yatani.jp/teaching/doku.php?id=2016hci:start>

Please also download **JASP** for our next next week workshop.

Questions