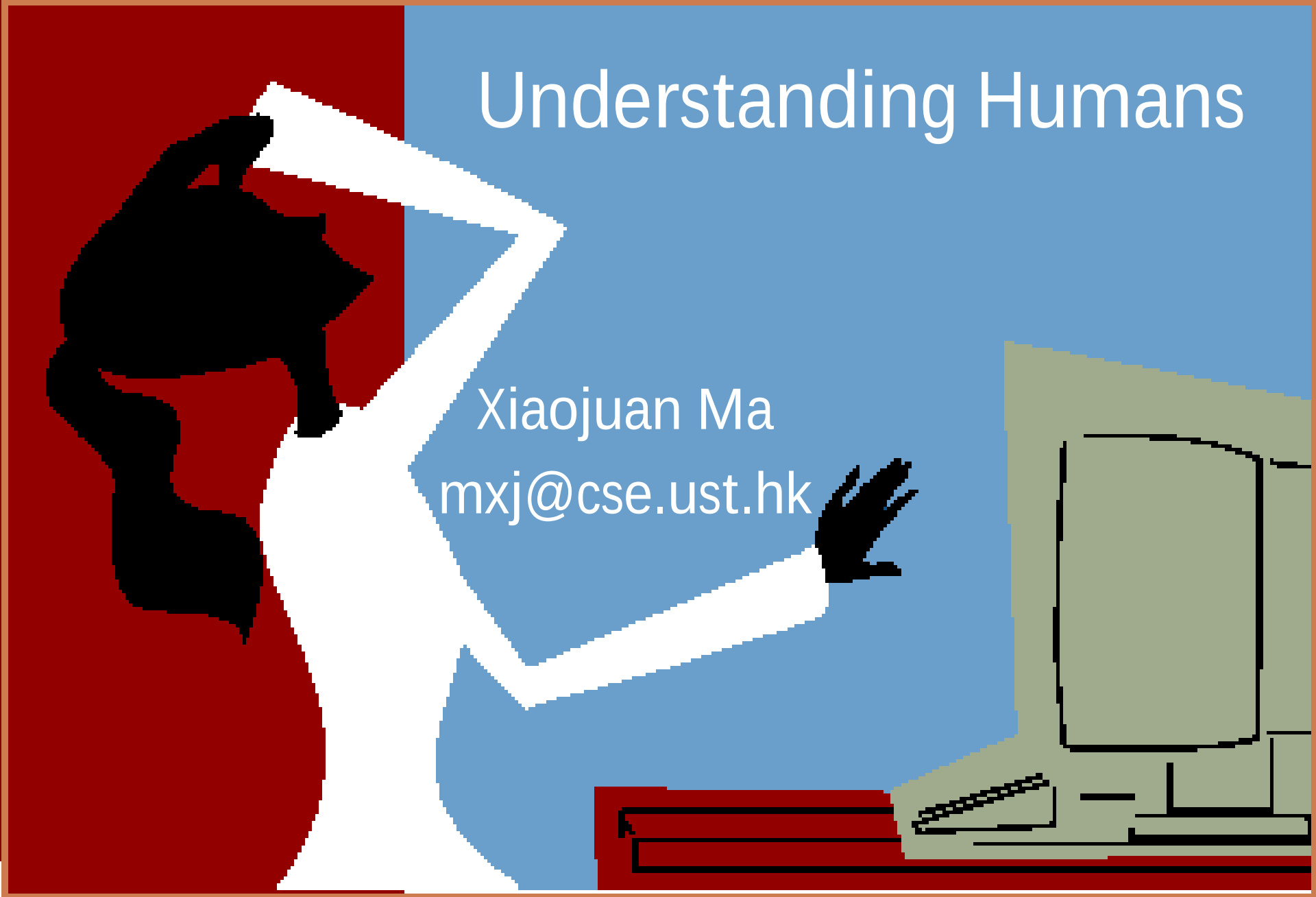
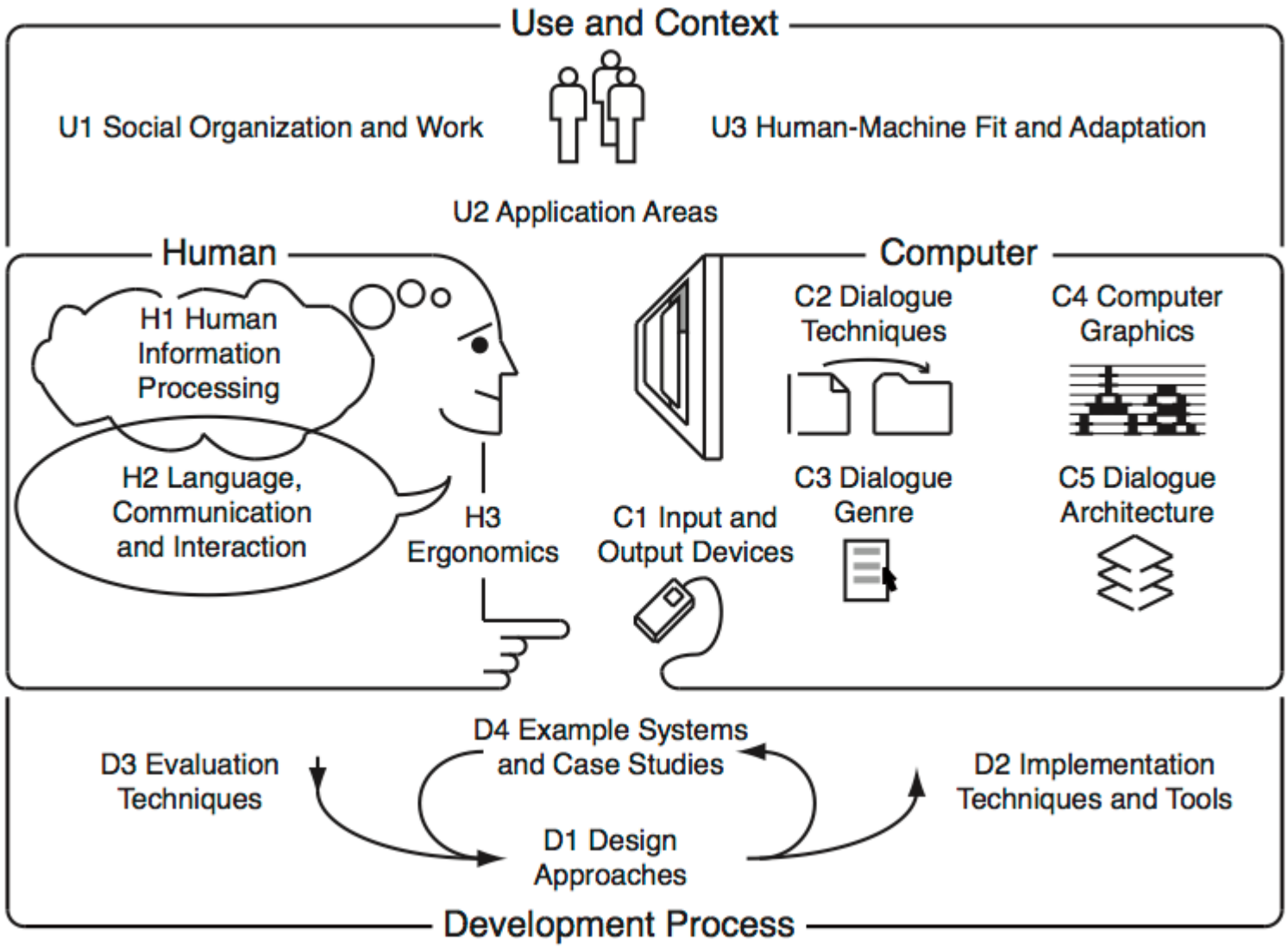
Understanding Humans

Xiaojuan Ma
mxj@cse.ust.hk



The Human, the Computer, the Interaction



https://foundationsofhci.files.wordpress.com/2012/10/figure_1.png

Three Waves of HCI

	Classical	Modern	Contemporary
Man	Information processor	Interpreter / predictor	Situated actor
Machine	Tool	Medium	Actor
Interact	with	through	alongside
Consider	Sensory limits	Cognitive knowledge	Ecological context
Method	Lab	Lab & field	Lab & field & wild

Caution: Don’t Make Wrong Assumptions

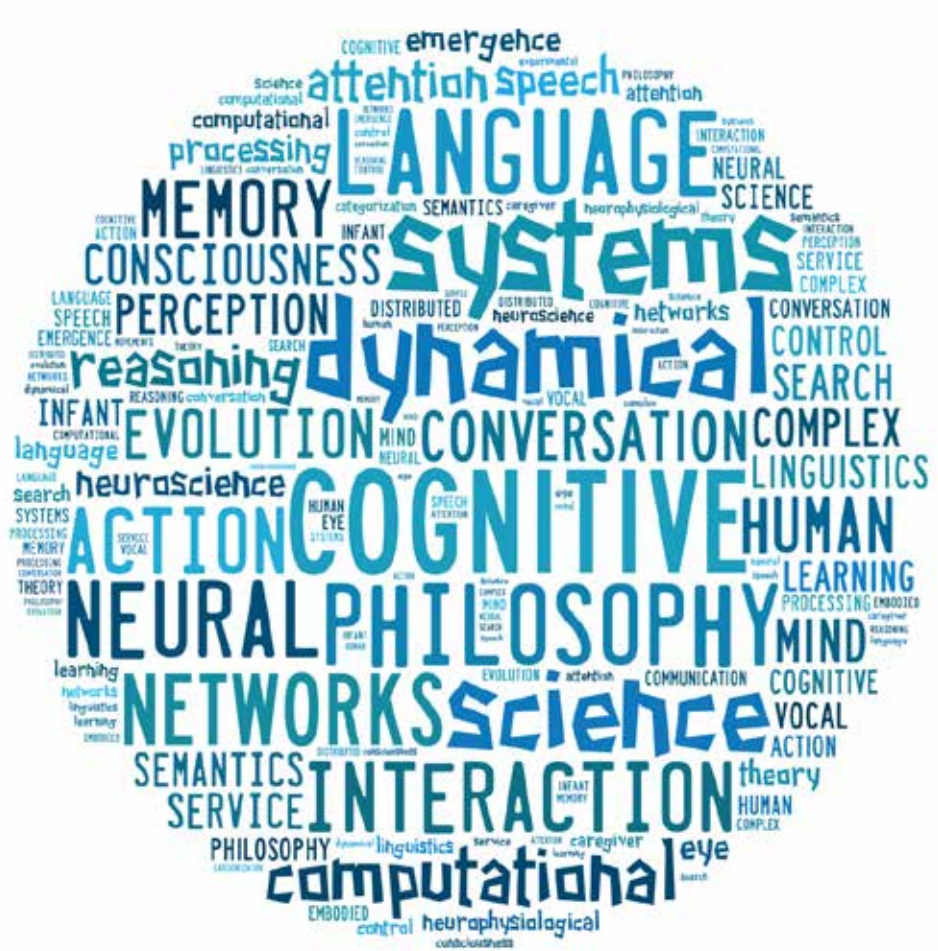
- All humans are alike
- All humans are like me
- All humans are like me who design the system

- Lab = real world
- Lab can control all variables
- Lab can sufficiently simulate tasks and contexts

http://chandlermacleod.com/media/chandler-macleod-2013/Images/candidate-article.png

http://frontiersmag.wustl.edu/

Understanding Humans

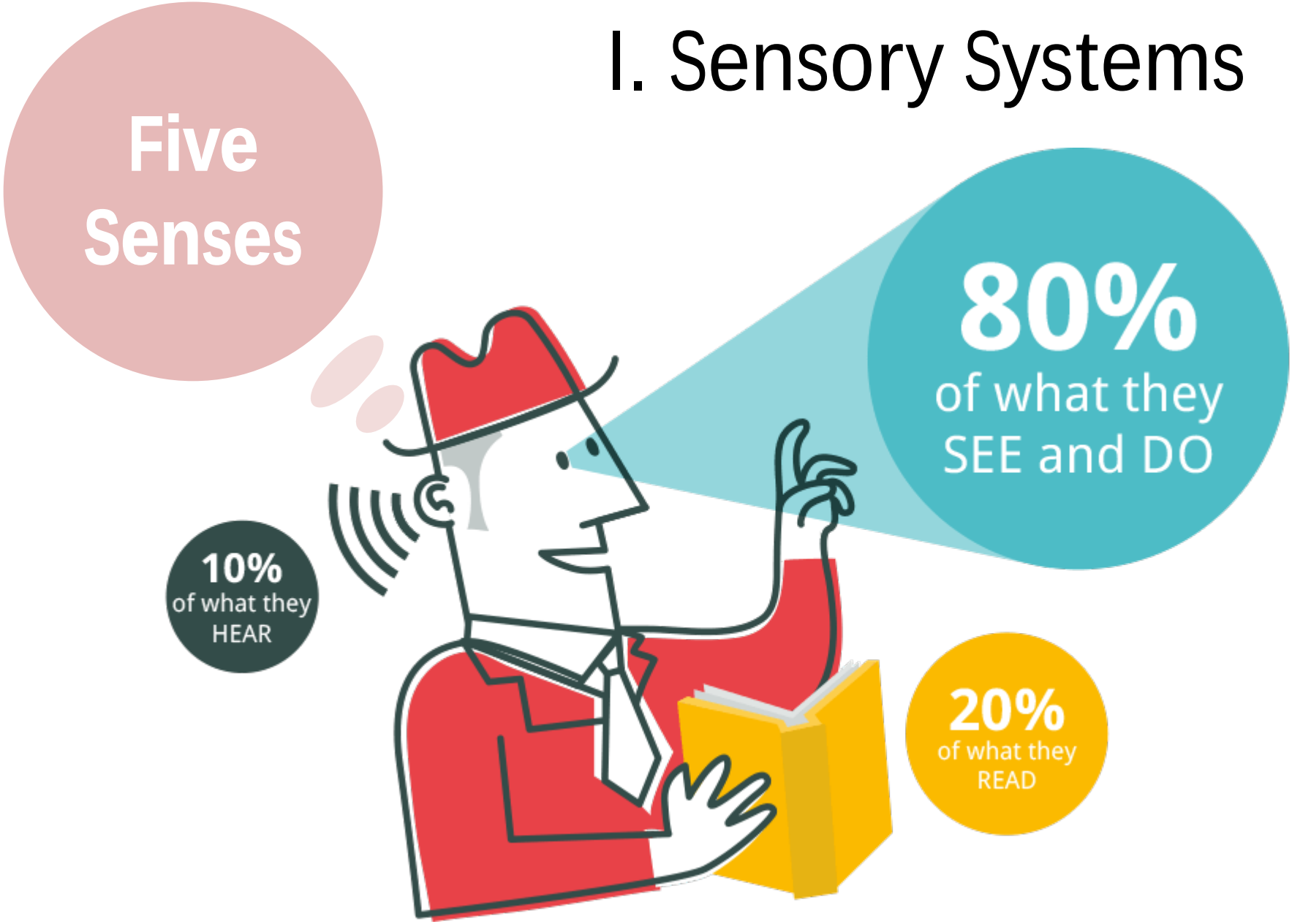


http://cogsci.ucmerced.edu/wp-content/uploads/2013/05/wordcloud2013.png

Human Capabilities

- Information received and responded via **senses**
  - Vision, hearing, touch, smell, taste
  - Motion and movement
- Information stored in **memory**
  - Short-term (working) memory
  - Long-term memory
- Information processed and applied in **Cognition**
  - Attention, learning, problem solving, language, etc.
- Capabilities influenced by **emotion**

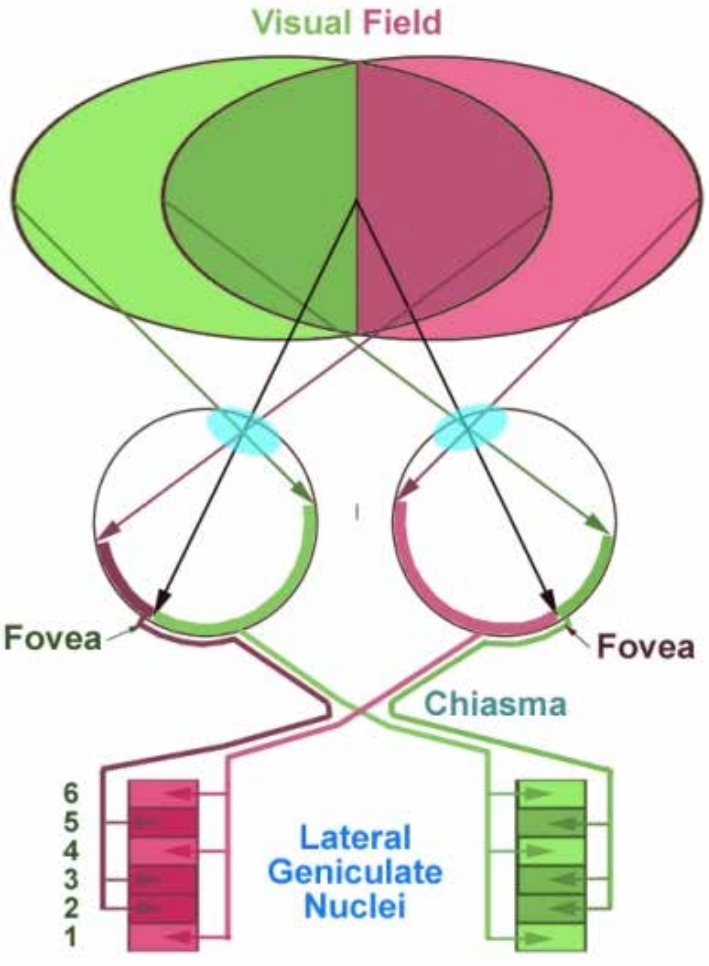
I. Sensory Systems



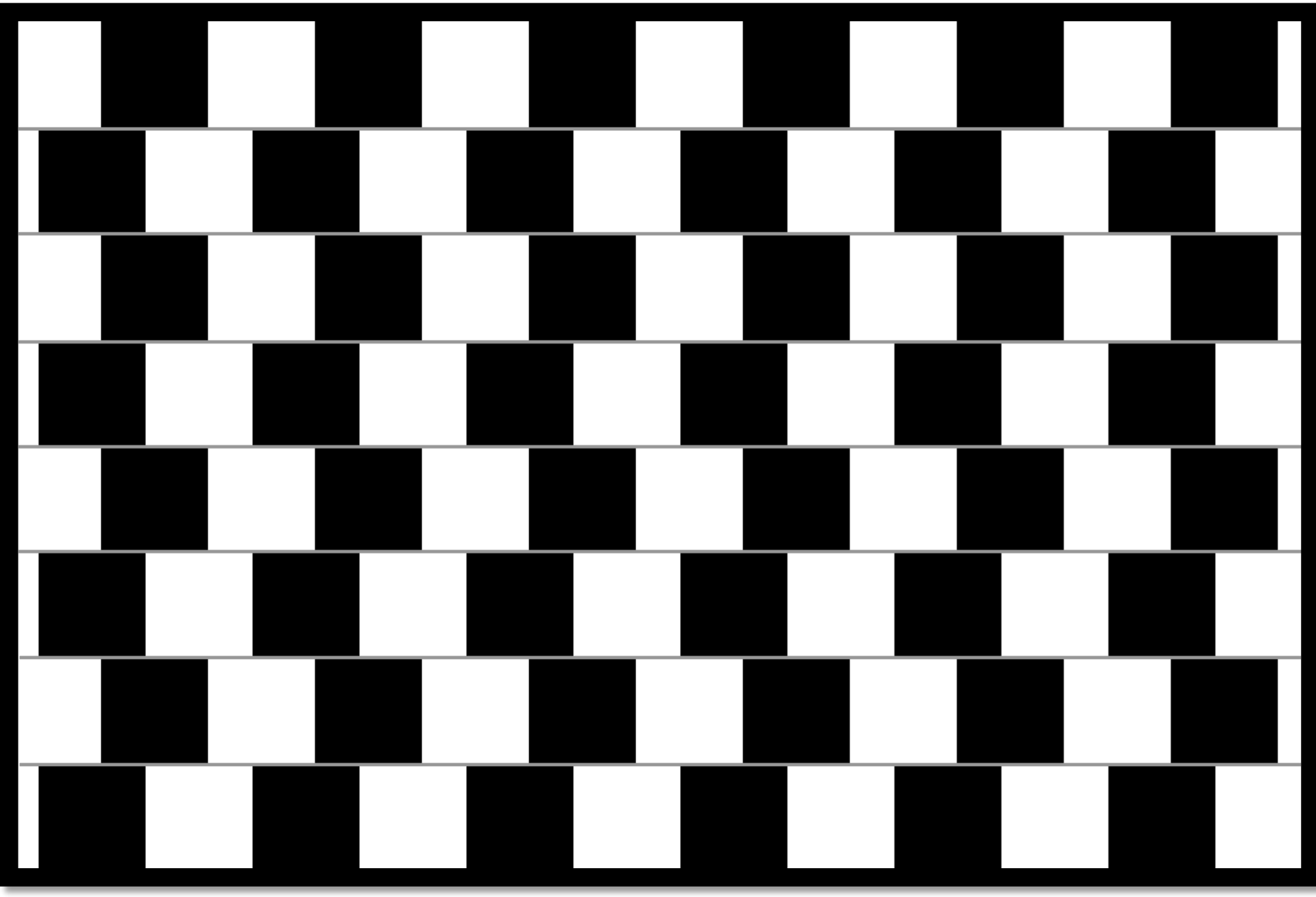
http://neomam.com/interactive/13reasons/img/see_hear.png http://fivesenses.com.my/wp-content/uploads/2014/06/five_senses_icons.png

I.I Vision System

- Sensitivity
  - Luminance $10^{-6} \sim 10^{7}$ mL
- Acuity
  - Angle & focus: detect, align
  - Movement tracking
- Adaptation
  - Distance, lighting à fatigue
- Deficiency
  - Age-related degeneration
  - Short/far sight
  - Color blind (8% male, 0.5% female)



http://photos1.blogger.com/blogger/226/1946/1600/17_opticPathL.jpg



Quirkology Channel

ASSUMPTIONS

www.RichardWiseman.com

I.I Heuristics: Mental Shortcuts (1)

- Gestalt Theory
  - Figure and Ground
  - Closure
  - Similarity
  - Continuity
  - Proximity

http://graphicdesign.spokanefalls.edu/tutorials/process/gestaltprinciples/gestaltprinc.htm

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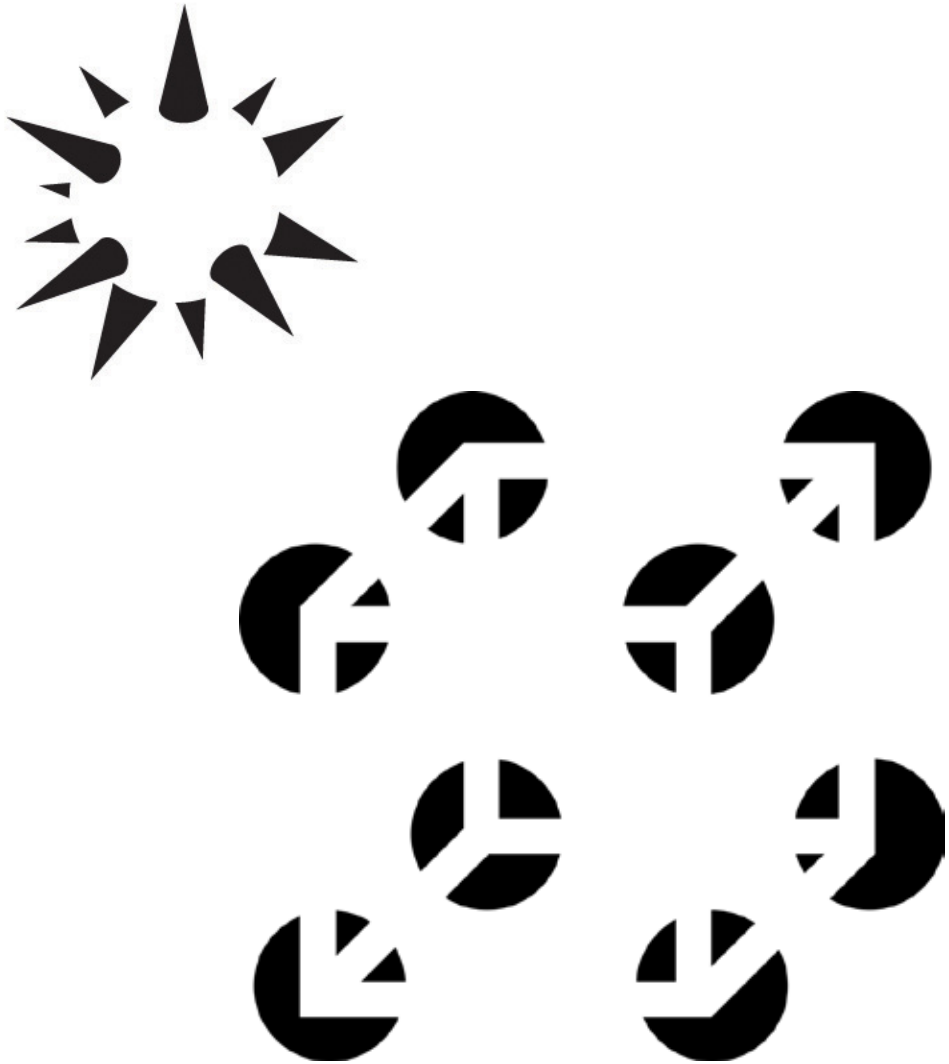

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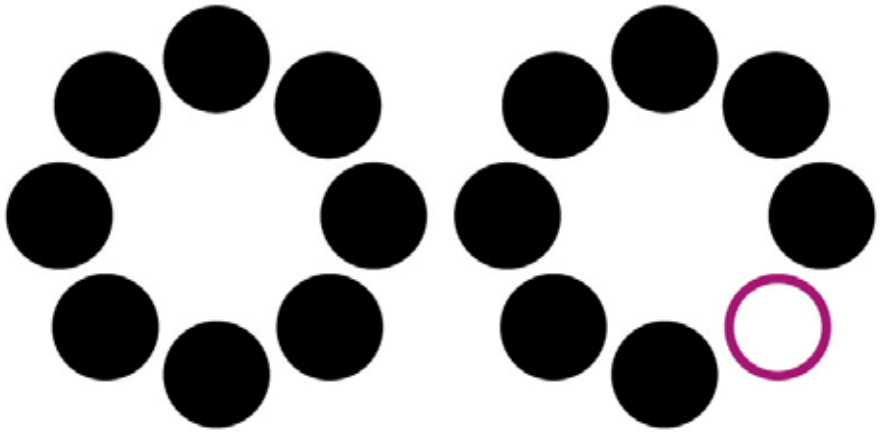

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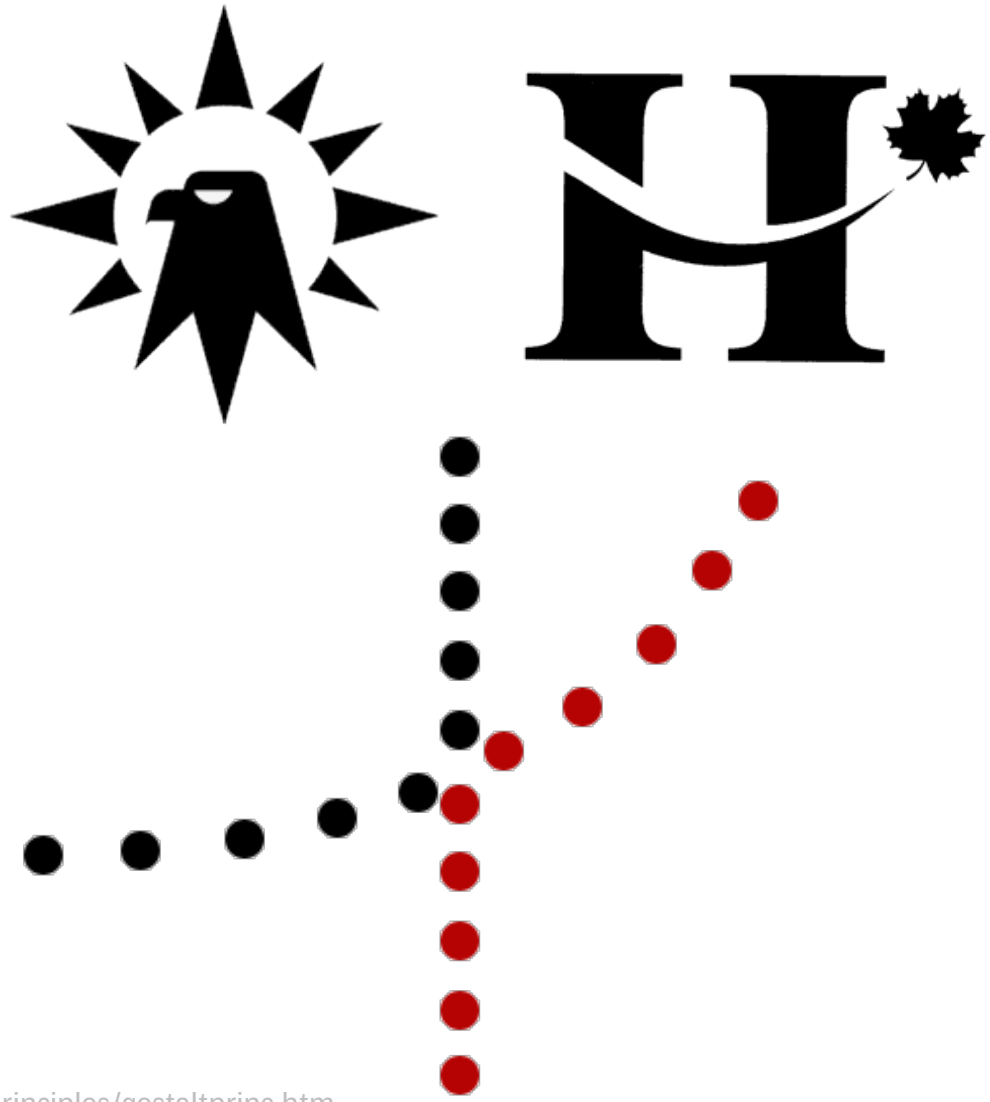

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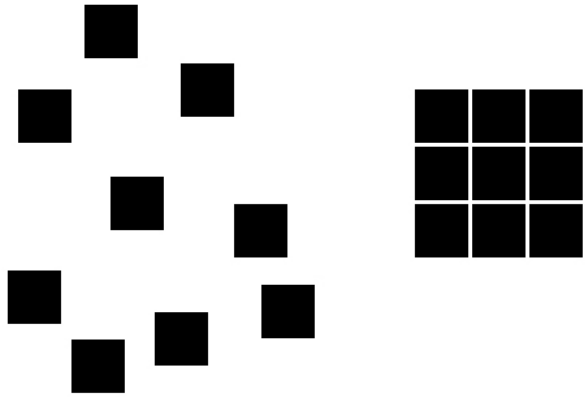
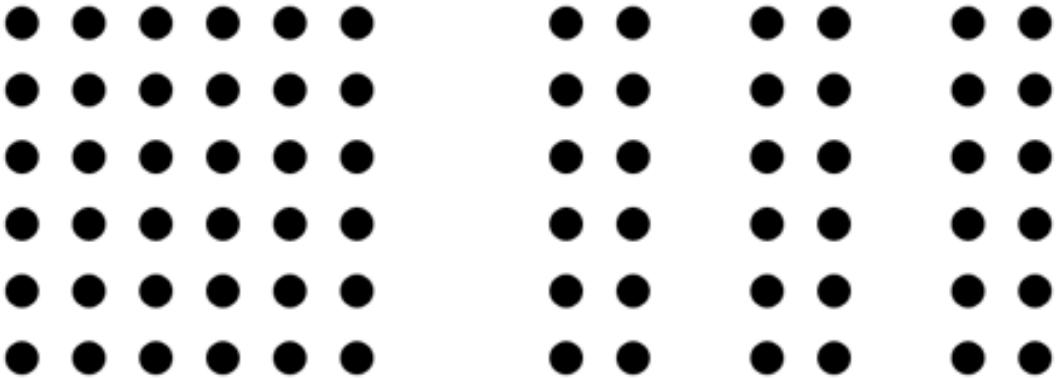
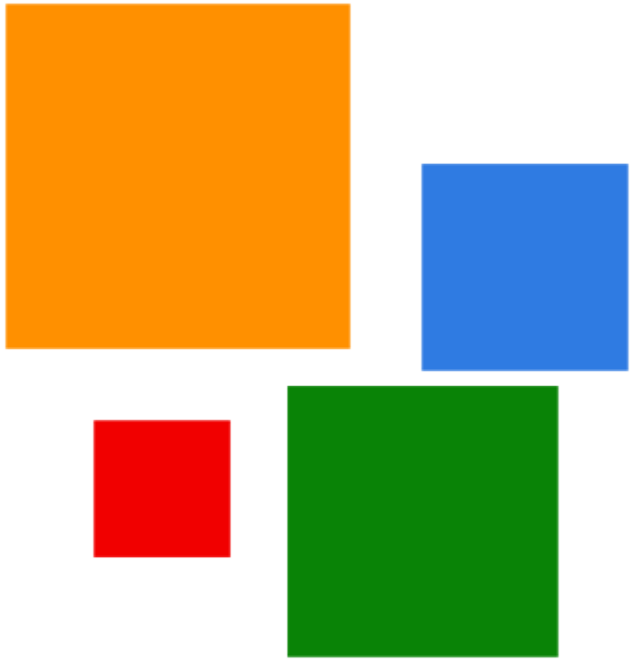




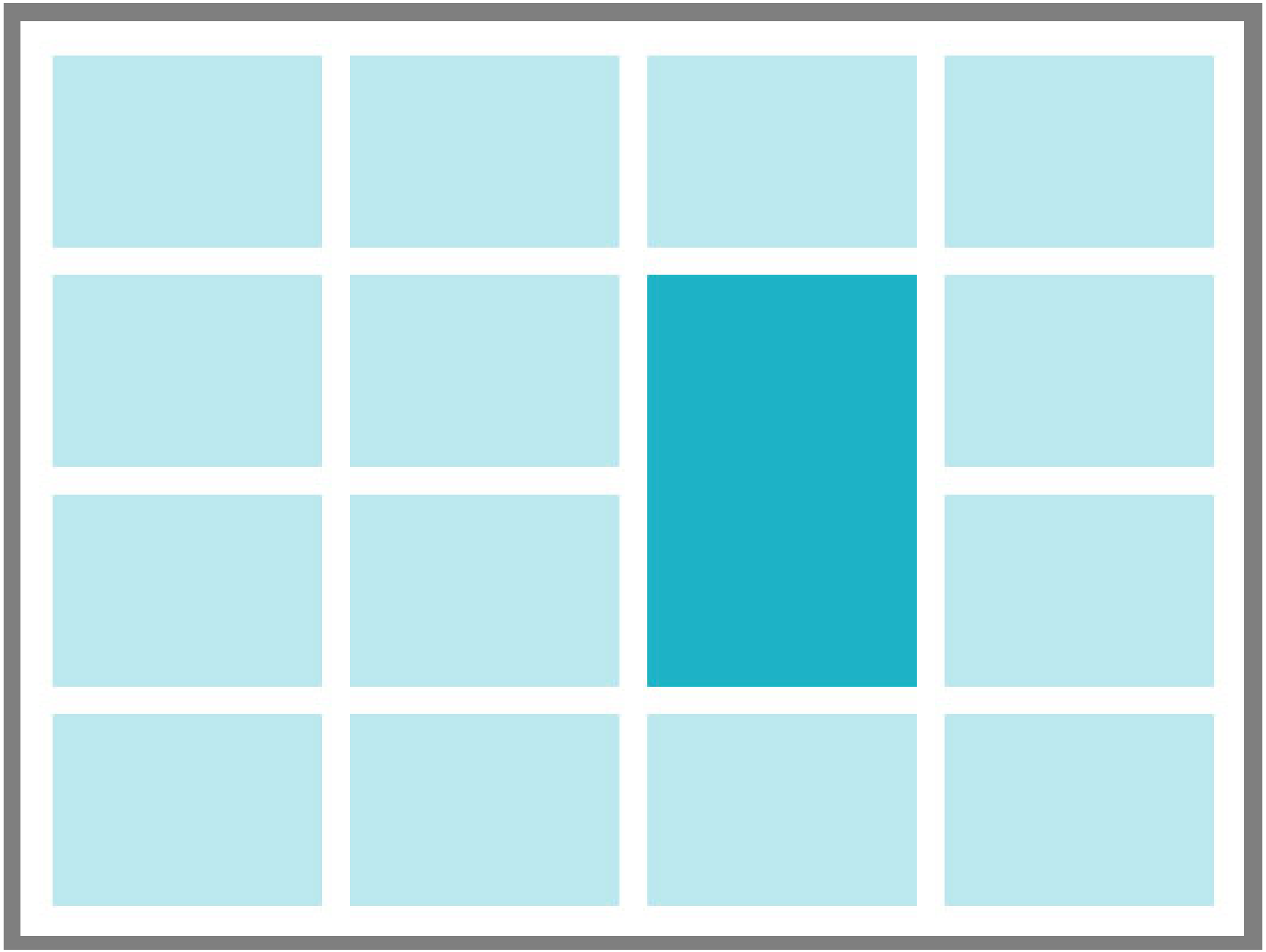
http://graphicdesign.spokanefalls.edu/tutorials/process/gestaltprinciples/gestaltprinc.htm

I.I Heuristics: Hierarchy



Visual Hierarchy

http://www.hexadesigns.in/blog/the-principles-of-good-website-design/

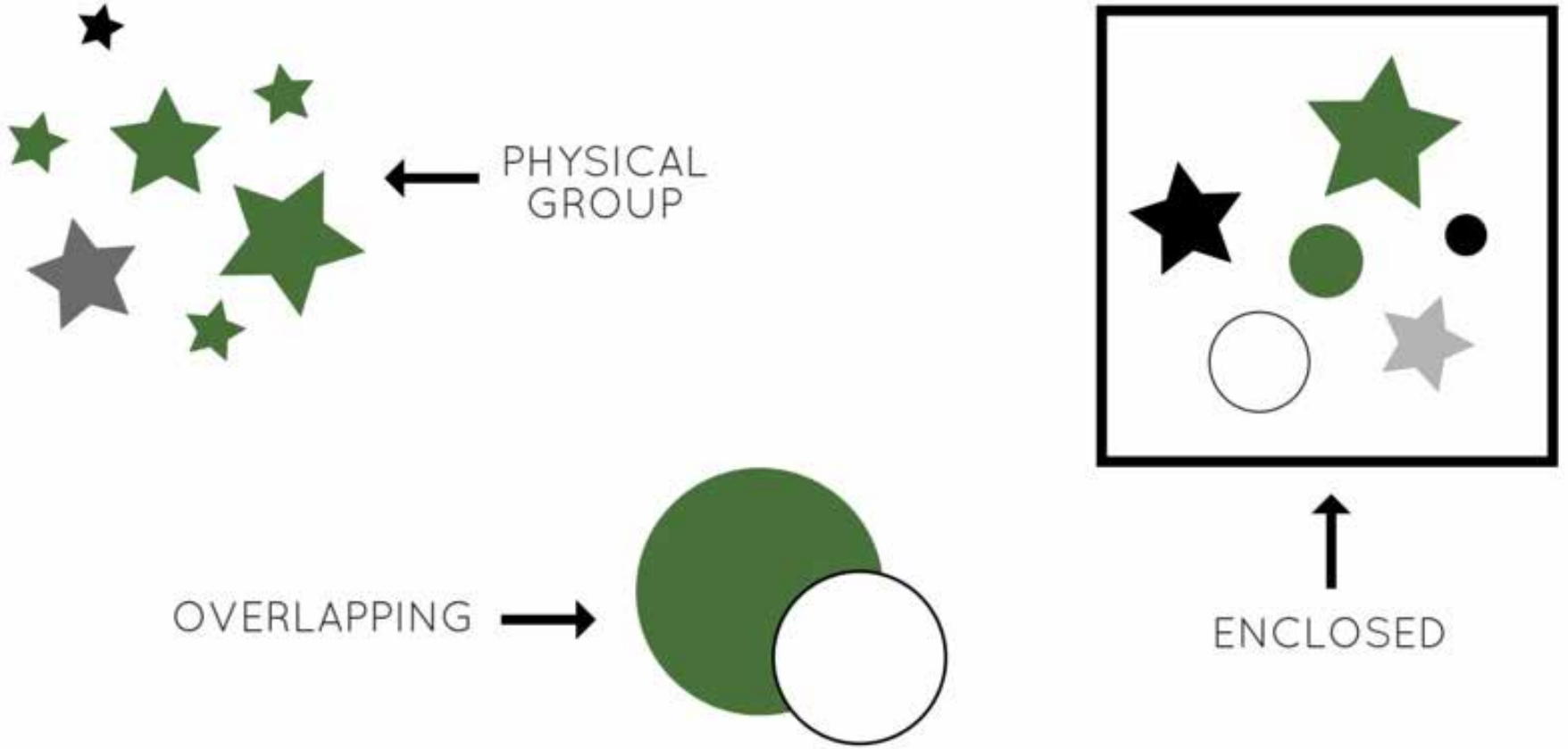


I.I Heuristics: Grouping

Grouping

http://www.hexadesigns.in/blog/the-principles-of-good-website-design/

Common Grouping Techniques



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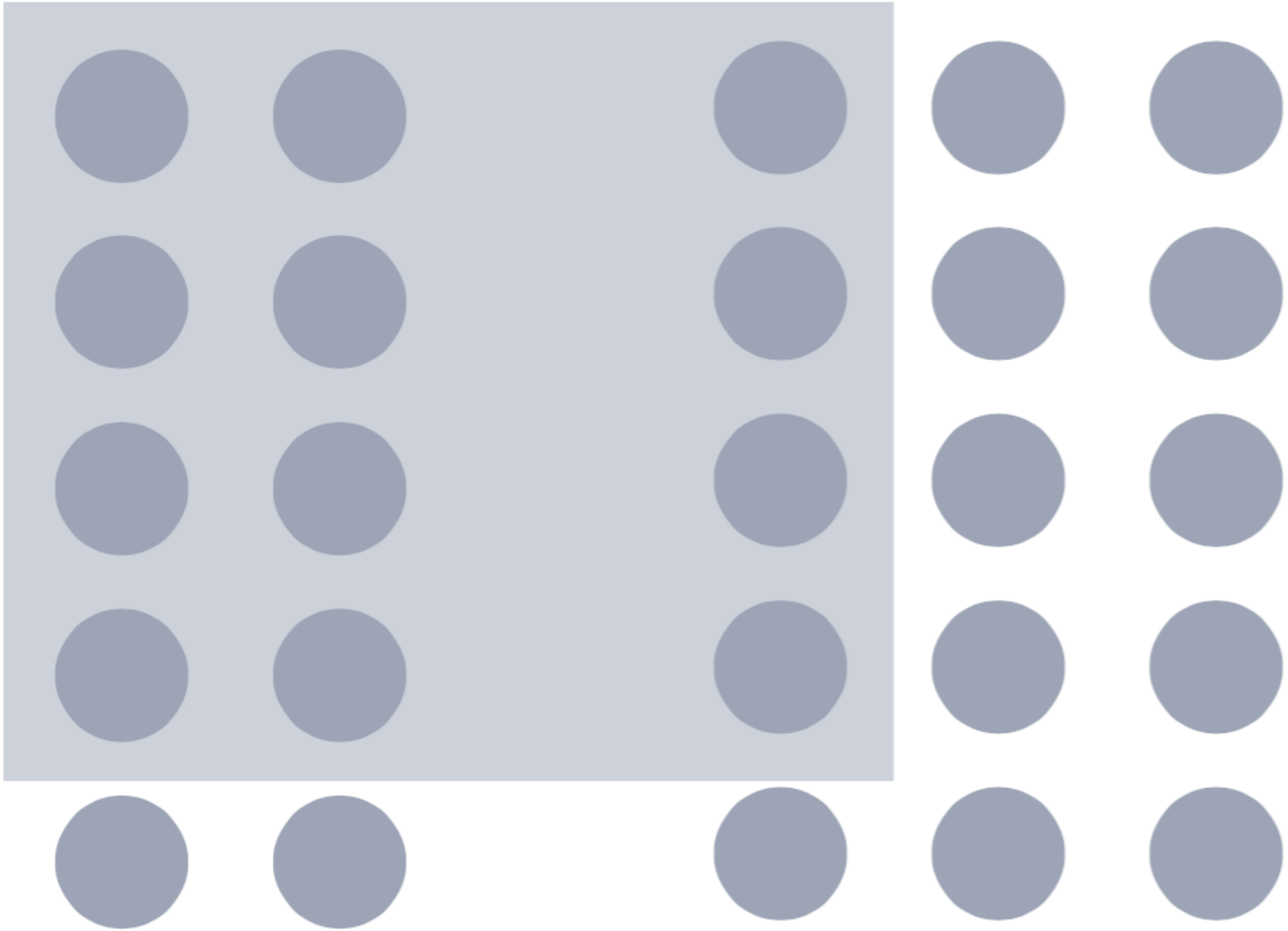


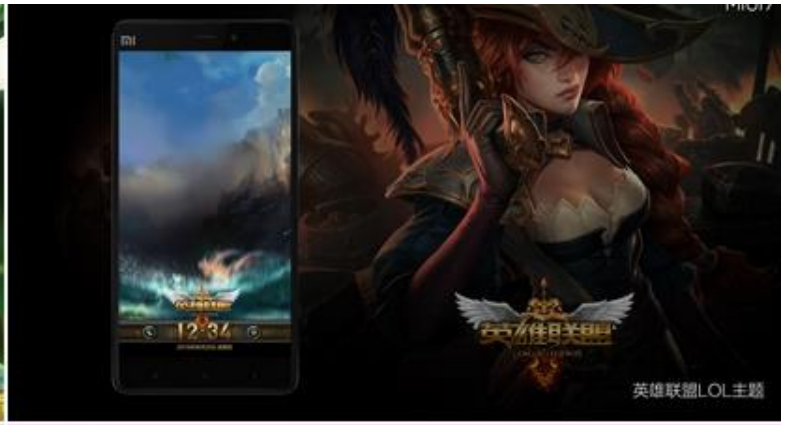
http://www.hexadesigns.in/blog/the-principles-of-good-website-design/

I.I Color Vision

- Wavelengths 0.4 - 0.7 micrometers
- Varying sensitivity to different colors
- Perception affected by surroundings
- Color psychology

http://i1-news.softpedia-static.com/images/news2/Top-10-Coolest-Science-News-of-the-Week-December-1-7-2014-466722-9.jpg


寻梦消消乐主题


英雄联盟LOL主题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遇事冷静
脸小三分
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MIUI7
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Hello Kitty主题


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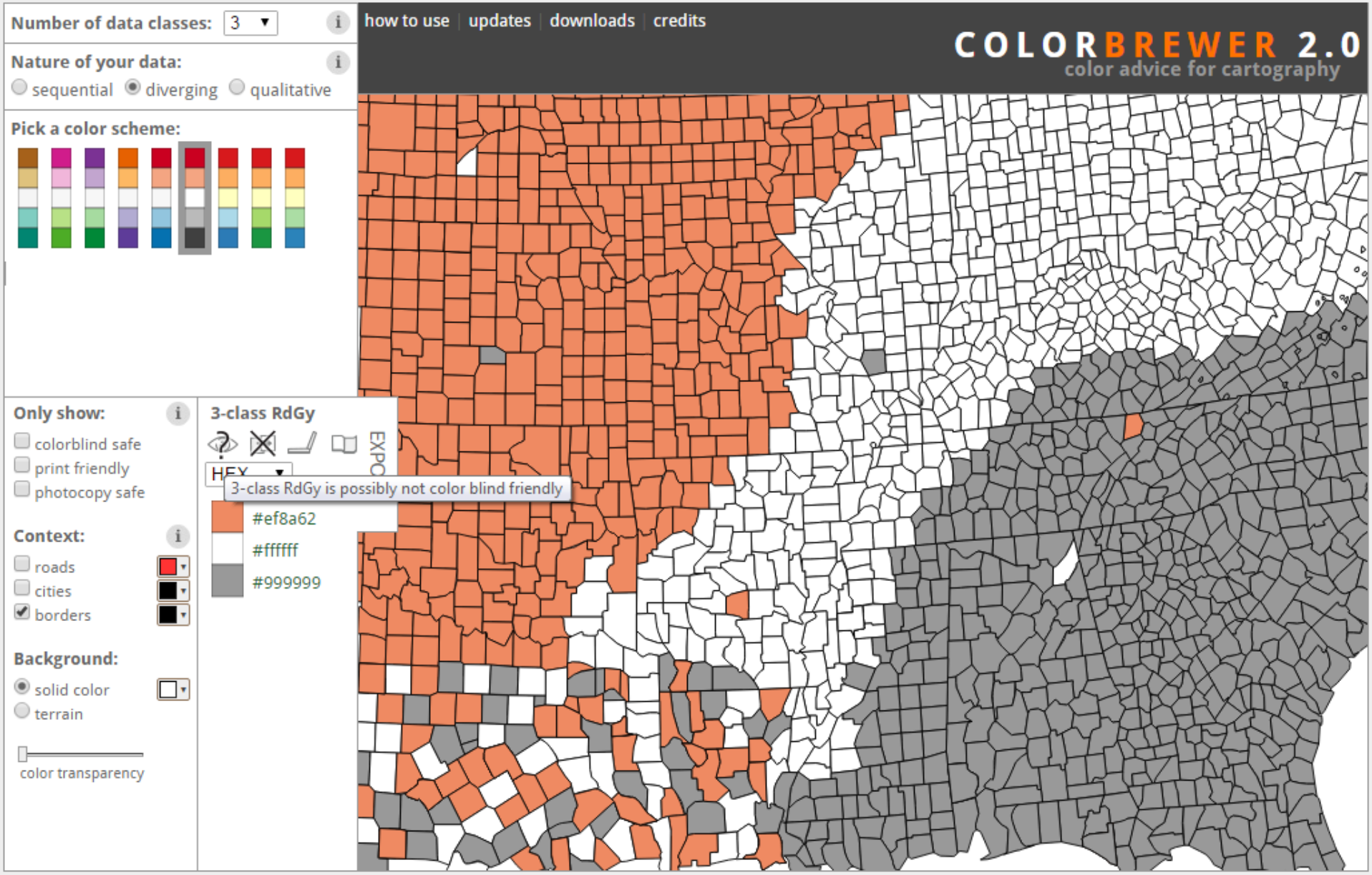
Number of data classes: 3
Nature of your data:
sequential
diverging
qualitative
Pick a color scheme:
Only show:
colorblind safe
print friendly
photocopy safe
Context:
roads
cities
borders
Background:
solid color
terrain
color transparency
3-class RdGy
HEX
3-class RdGy is possibly not color blind friendly
#ef8a62
#ffffff
#999999
how to use
updates
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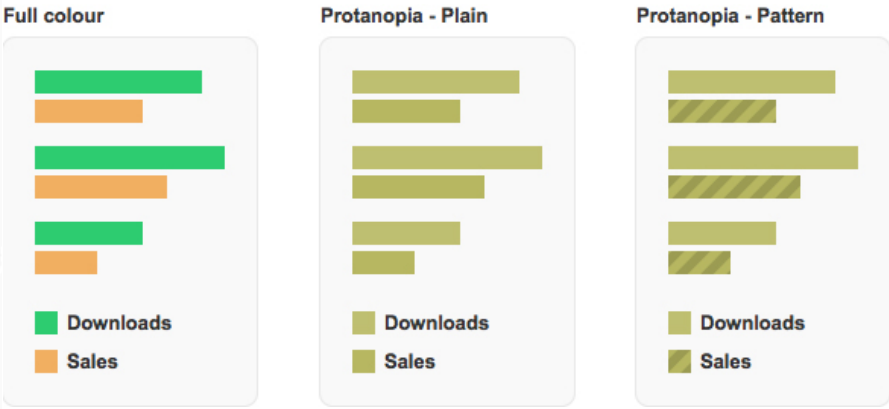
credits
COLORBREWER 2.0
color advice for cartography



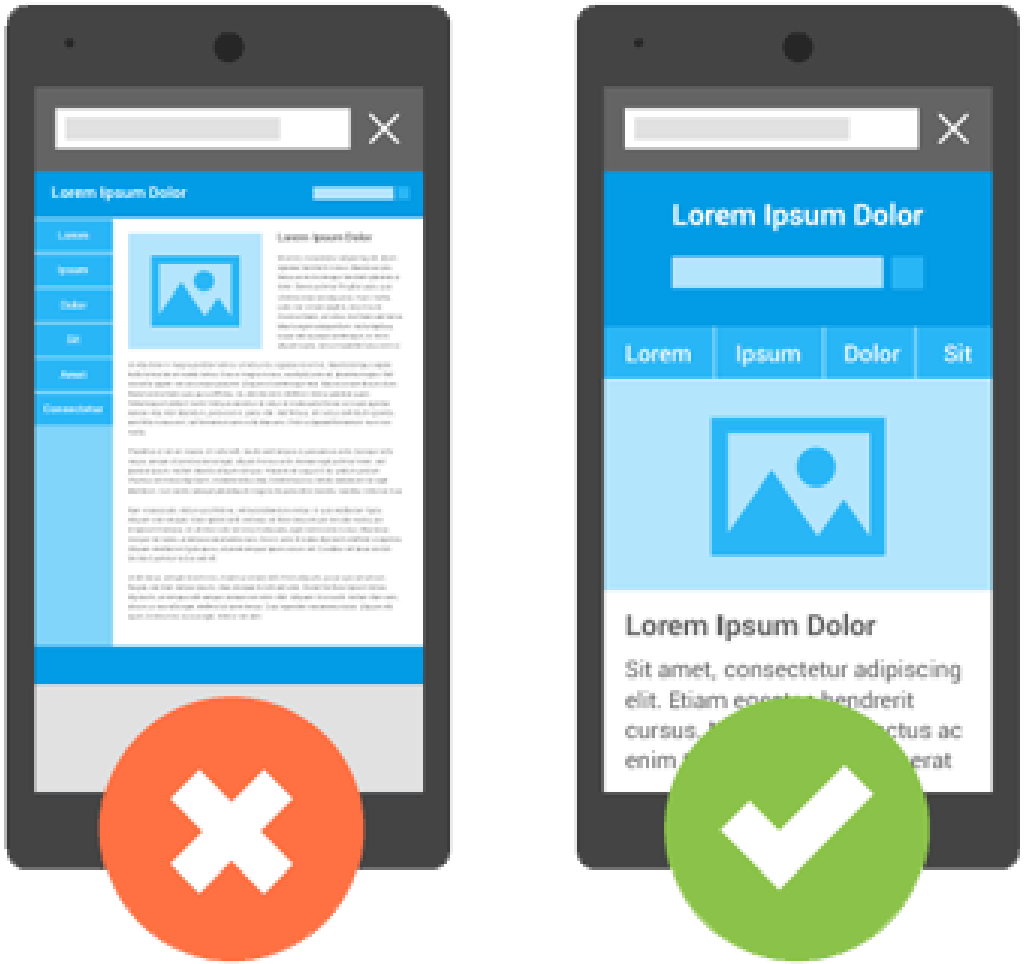
http://blog.eyequant.com/blog/2013/07/02/108-million-web-users-are-color-blind-how-do-they-see-your-website

I.I Vision: Implications for HCI

- Aware that people may see the world differently
- Ensure legibility and accessibility
- Consider characteristics and limitations
- Consider contextual and psychological factors

http://www.confectious.net/wordpress/wp-content/uploads/2013/09/features-jump-out.jpg

Processing Fluency à Mental Distance



(Harrison & Hudson, 2011)

I.II Hearing

- Capabilities (best-case scenario)
  - pitch - frequency (20 - 20,000 Hz)
  - loudness - amplitude (30 - 100dB)
  - location (5° source & stream separation)
  - timbre - type of sound (lots of instruments)
- Cocktail Party Effect
  - Selection
  - Detection

http://curatti.com/wp-content/uploads/2014/11/CocktailParty.jpg

I.II Hearing: Implications for HCI

- Apply different types of sounds properly
  - Speech
  - Music
  - Environmental sound
  - Synthesis sound
- Leverage features of sound
- Balance sensitivity and comfort

http://sid.bek.no/media/works/additional/photos/original/12_12_AuditoryAugmentation_.jpg?1304848371

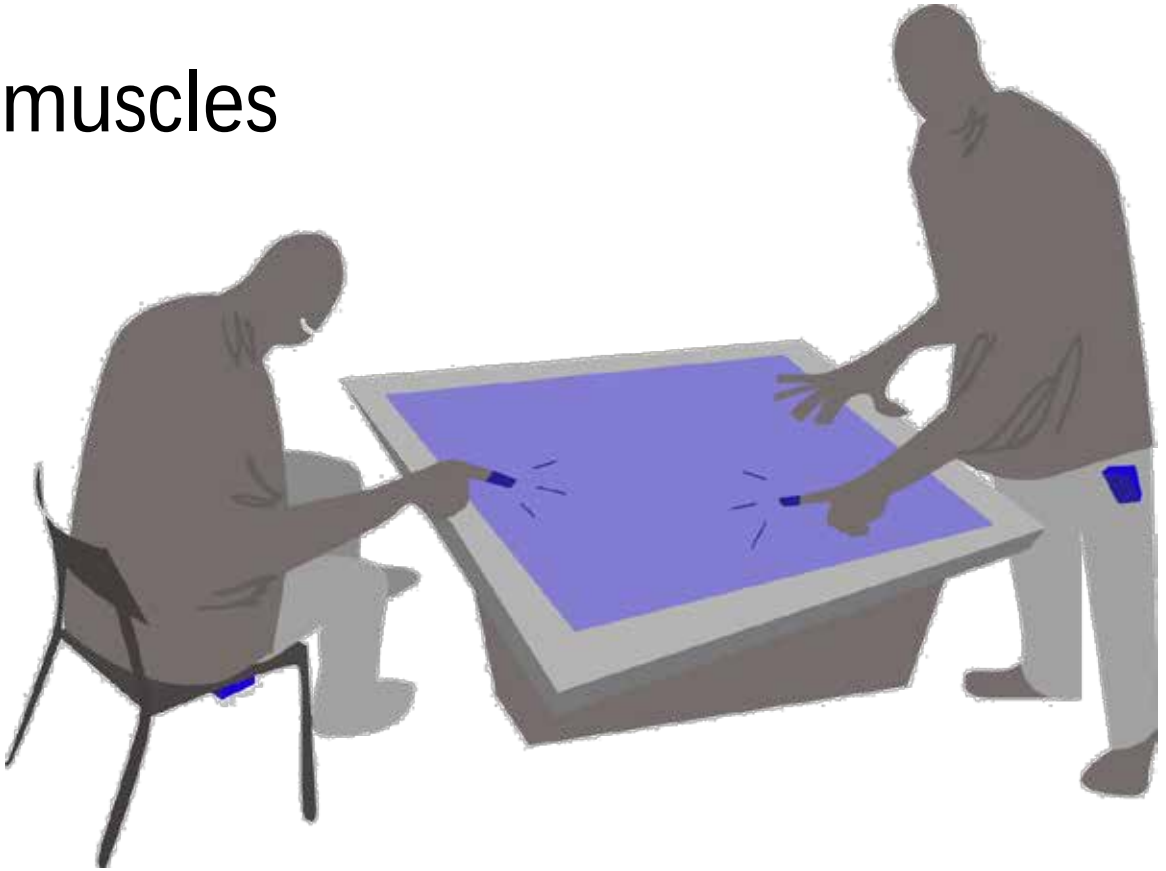
Avatar (2015)

I.III Touch

- Three main sensations handled by different types of receptors:
  - Pressure (normal)
  - Intense pressure (pain)
  - Temperature (heat)
- Different part of body varies in
  - Sensitivity, dexterity, flexibility, speed

I.III Touch: Implications for HCI

- Use as input
- Use as output
- Fool the skin and muscles

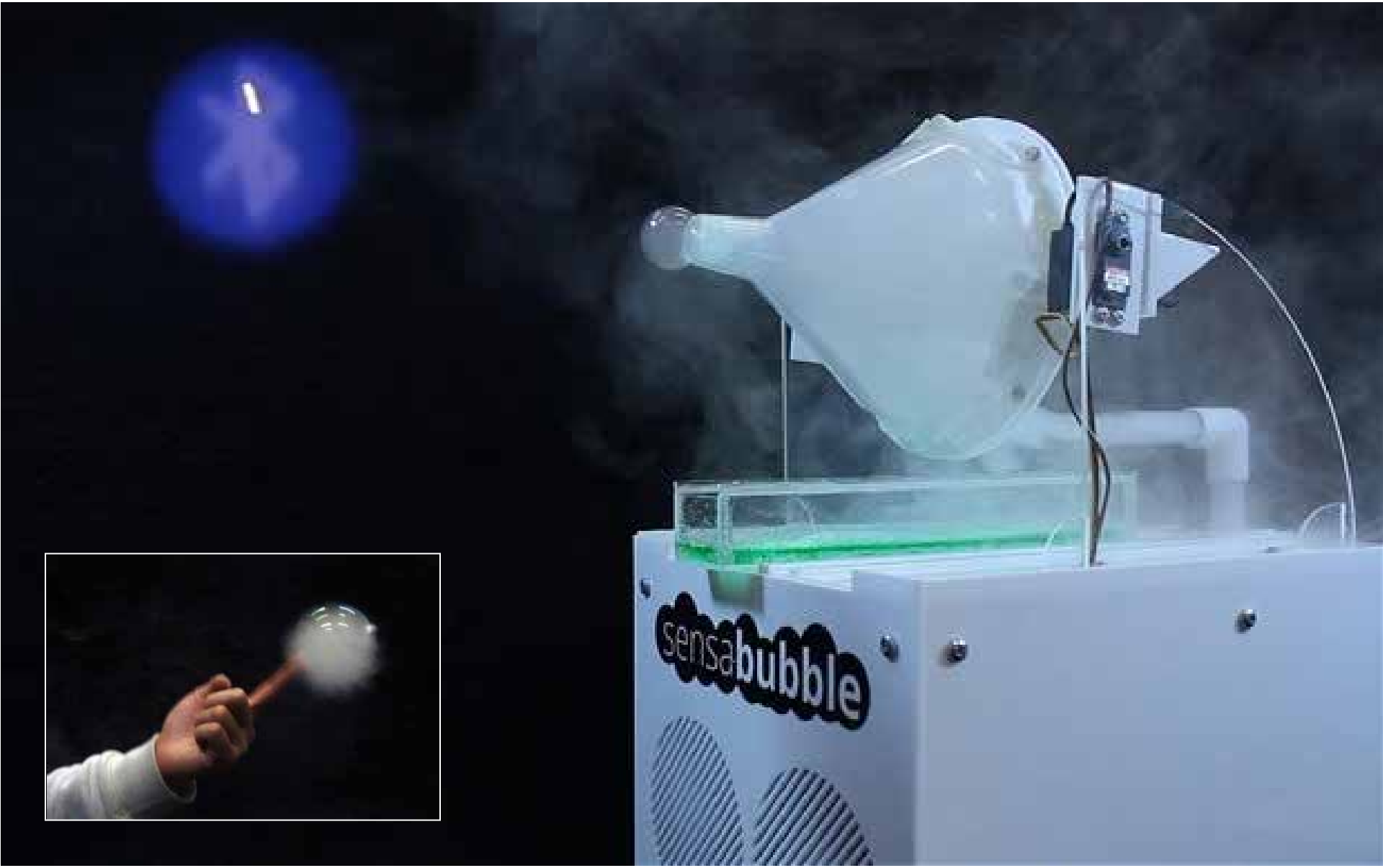


http://www.olivierbau.com/files/revel/speculative_applications-techno-2.jpg

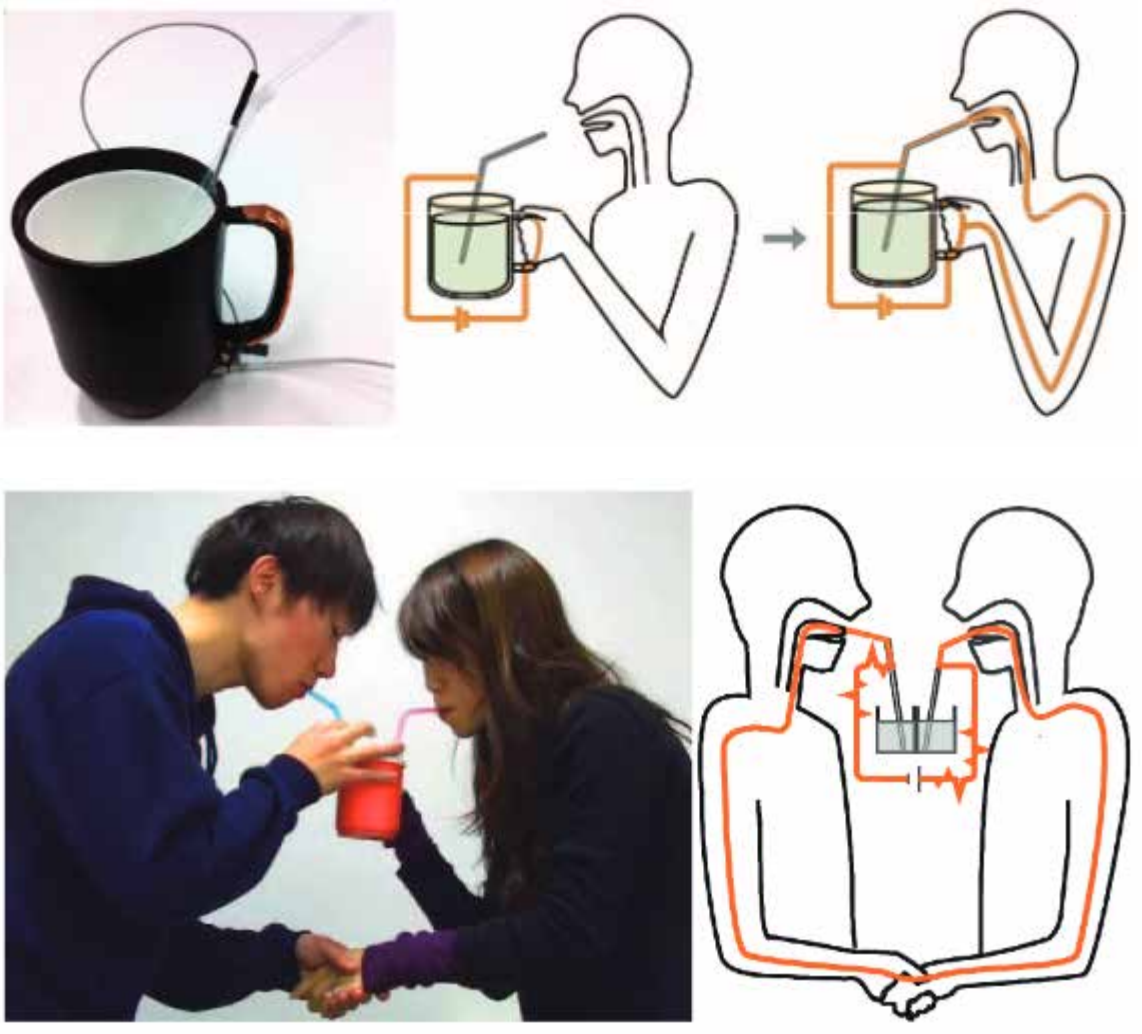
http://www.cnet.com/news/a-keyboard-that-rises-up-from-flat-touch-screens/

I.IV Smell and Taste: Implications for HCI

- Define applicable scenarios
  - System feasibility
  - Social appropriateness
- Serve as augmentative or alternative channels
- Utilize natural and synthesized stimuli
- Ensure safety



(Seah et al., 2014)



(Nakamura et al., 2012)

I.V Motor: Implications for HCI

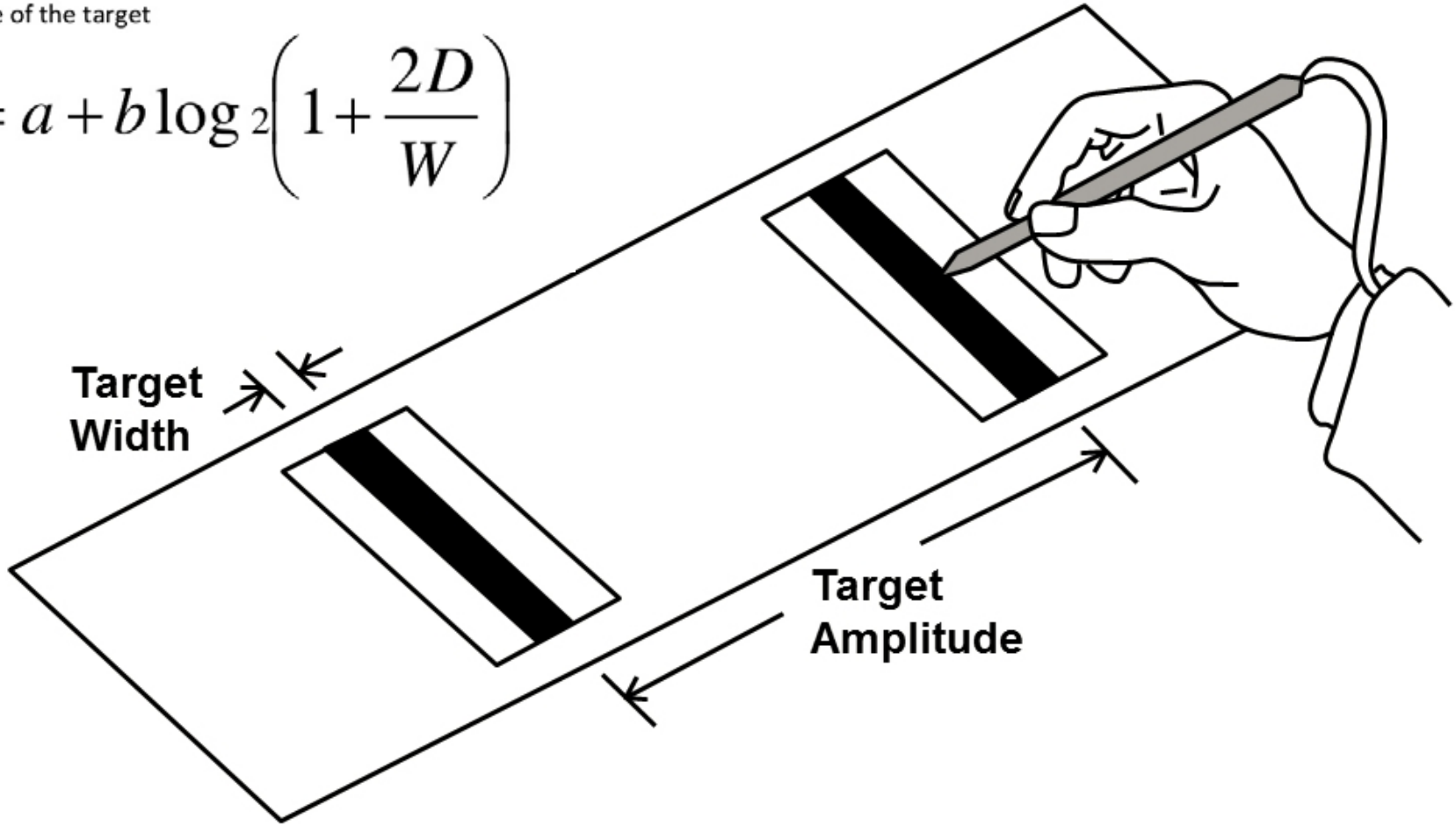
- Capabilities
  - Range of movement, reach, speed,
  - strength, dexterity, accuracy
- Principles
  - Feedback is important
  - Minimize eye movement – eye-hand coordination
- Often cause of errors
  - Resolution of motion registration: wrong button
  - Similarity of motion: double-click vs. single click

Fitts's Law

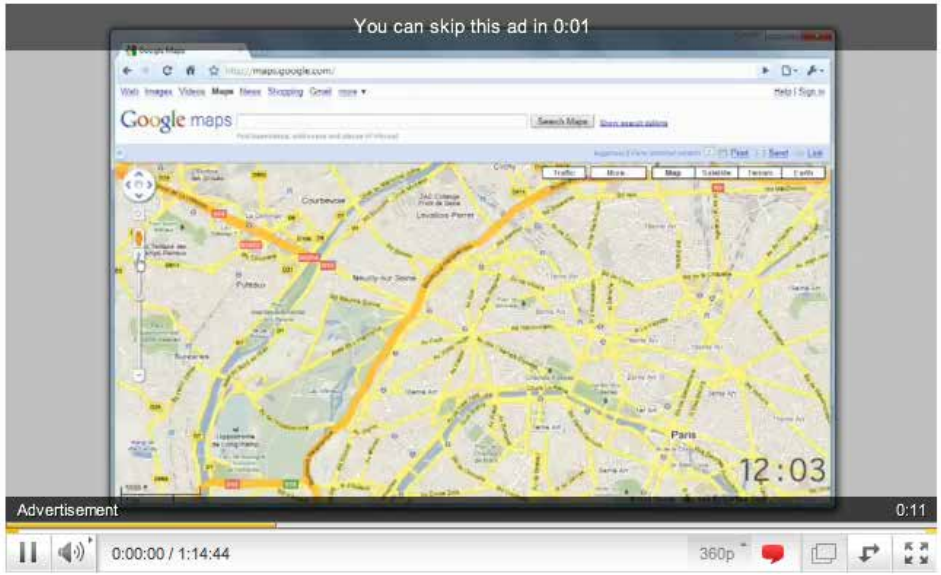
Fitts' Law

The time needed to reach a target depends on the distance to and size of the target

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



(Fitts, 1954)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Google maps
Paris
12:03
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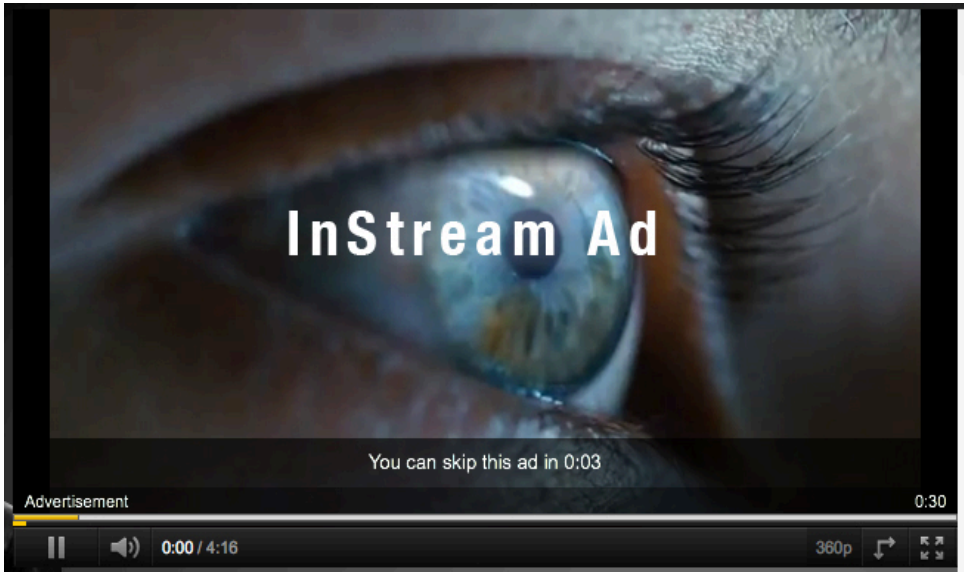
InStream Ad
You can skip this ad in 0:03
Advertisement
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360p


You can skip to video in 3
Skip Ad »
Advertisement (0:22)
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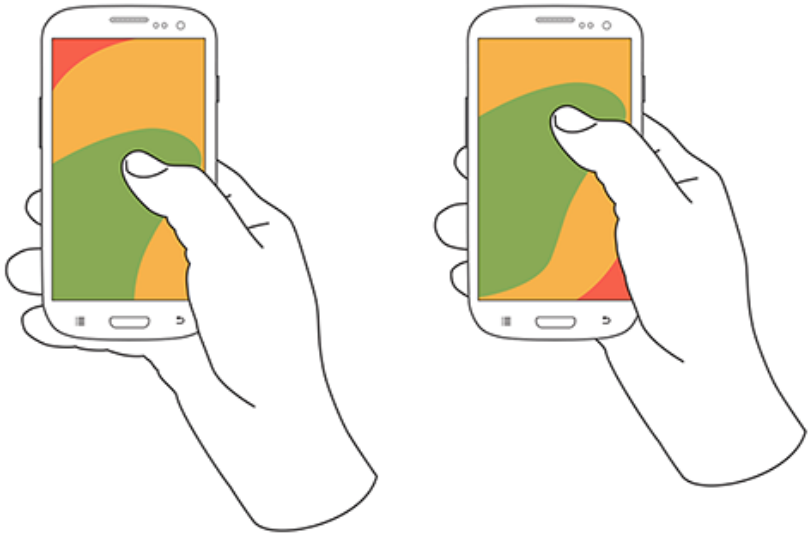
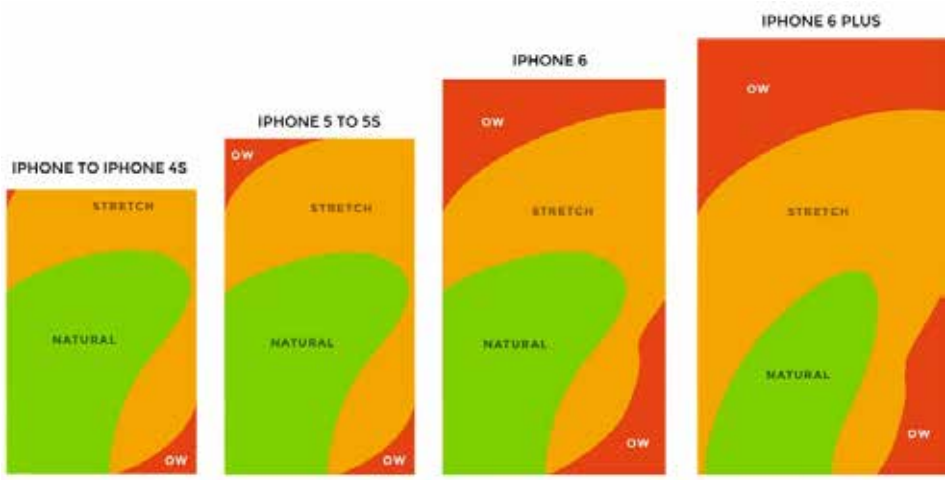
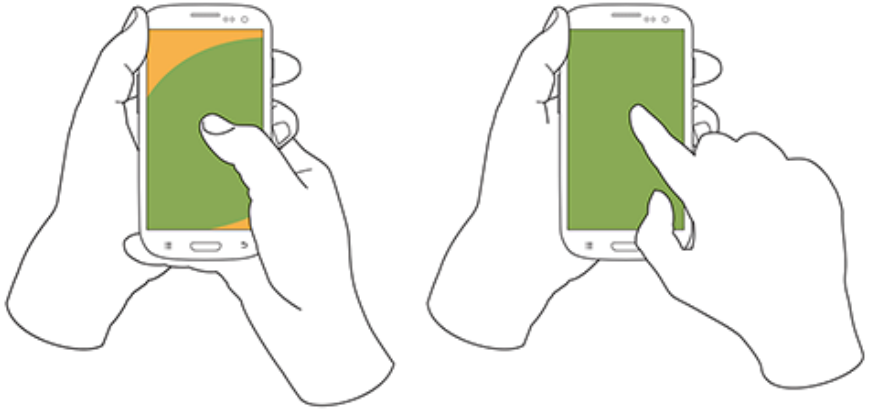
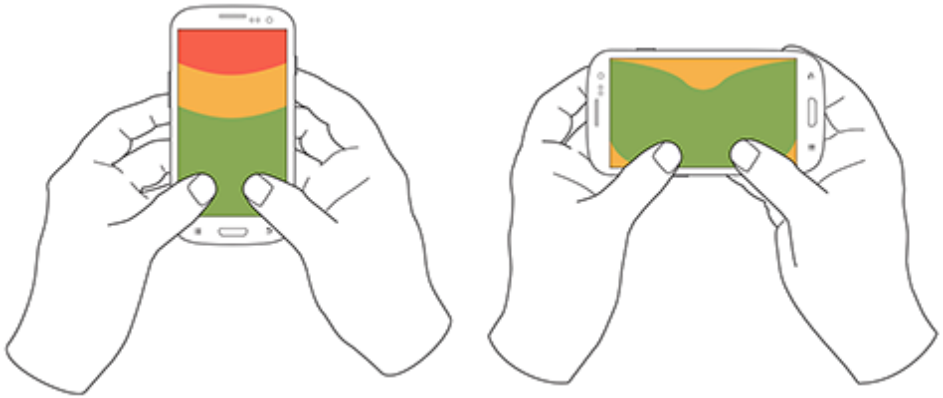
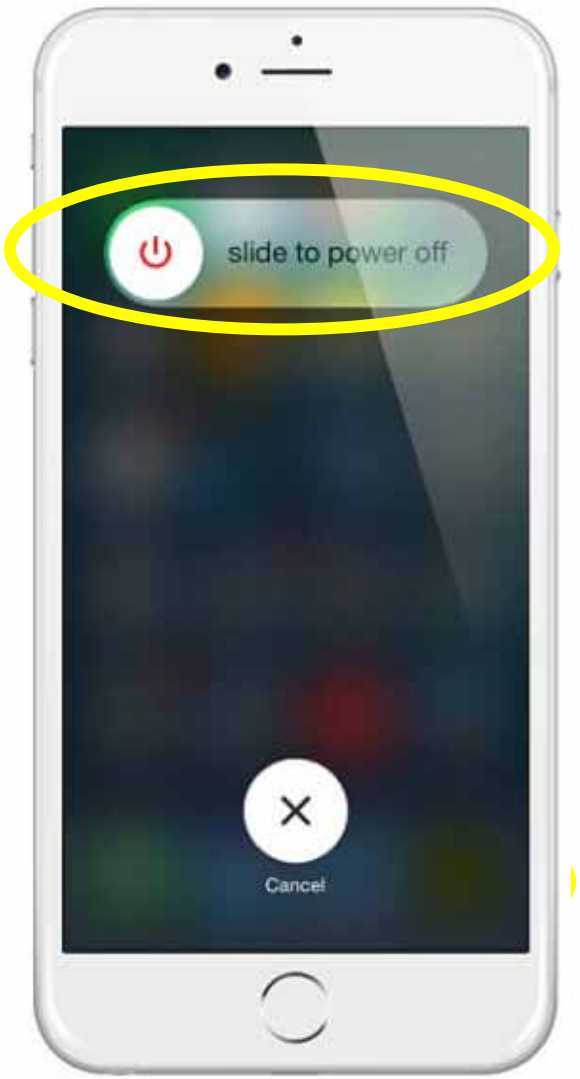








http://www.uxmatters.com/mt/archives/2013/02/how-do-users-really-hold-mobile-devices.php


slide to power off
Cancel


SAMSUNG
12:45


09:41
Timeline
Search Timeline
@ismh
Shawn is the King of Dad Jokes
twitter.com/shawnblanc/sta...
@shawnblanc
@ismh What do you call a pig that knows karate?
(A Pork Chop!)
@shawnblanc
@ismh What do you call a pig that knows karate?
(A Pork Chop!)
@shawnblanc
@ismh What do you call an alligator in a vest?
(An Investigator.)
@chartier
Seems like there's a disconnect
Tap to share with AirDrop
Stephen
MacBook Pro
Message
Mail
Instapaper
Pinner
Reminders
Run Workflow
Copy Link
Copy Tweet
Open in Safari
Open in Chrome
Cancel
View Details
View Retweets
View in Favstar
Translate
Cancel

II. Memory Systems

- Perceptual “buffers”
  - Brief impressions
- Short-term memory
  - Conscious thought, calculations
- Intermediate
  - Storing intermediate results, future plans
- Long-term
  - Permanent, remember everything ever happened

A G A M E

5 2 9 7 4 6 3 1 5 8 4 8 7 7 6 5 1 5 3 9 6 4 5 7 8 5 4 1 9

II.I Short-term vs. Long-term Memory

- Short-term memory
  - Use “chunks”: 4-5 units (not 7±2)
  - Affected by age-related degeneration
- Long-term memory
  - Episodic memory
    - Events & experiences in serial form
    - Helps us recall what occurred
  - Semantic memory
    - Structured record of facts, concepts & skills
    - Network model, feature model, associative model, etc.

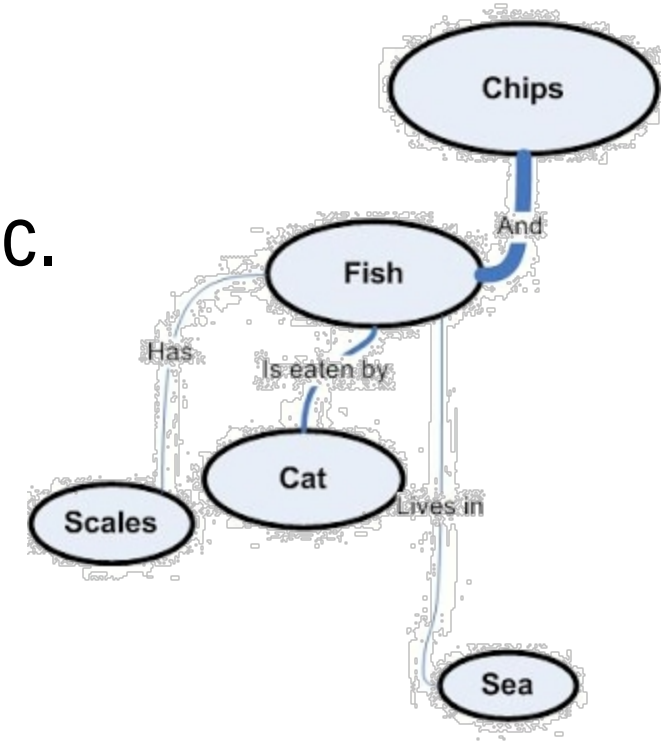
Hermann Ebbinghaus Law

- Serial Position Effect
  - Recall accuracy is a function of the position in the list
- Recency Effect
  - The latest item
- Primacy Effect
  - The first few items

1	Amul Butter
2	Pen Pencil
3	Diary Milk
4	Orange Juice
5	Key Board
6	Drum Sticks
7	Paper Cup

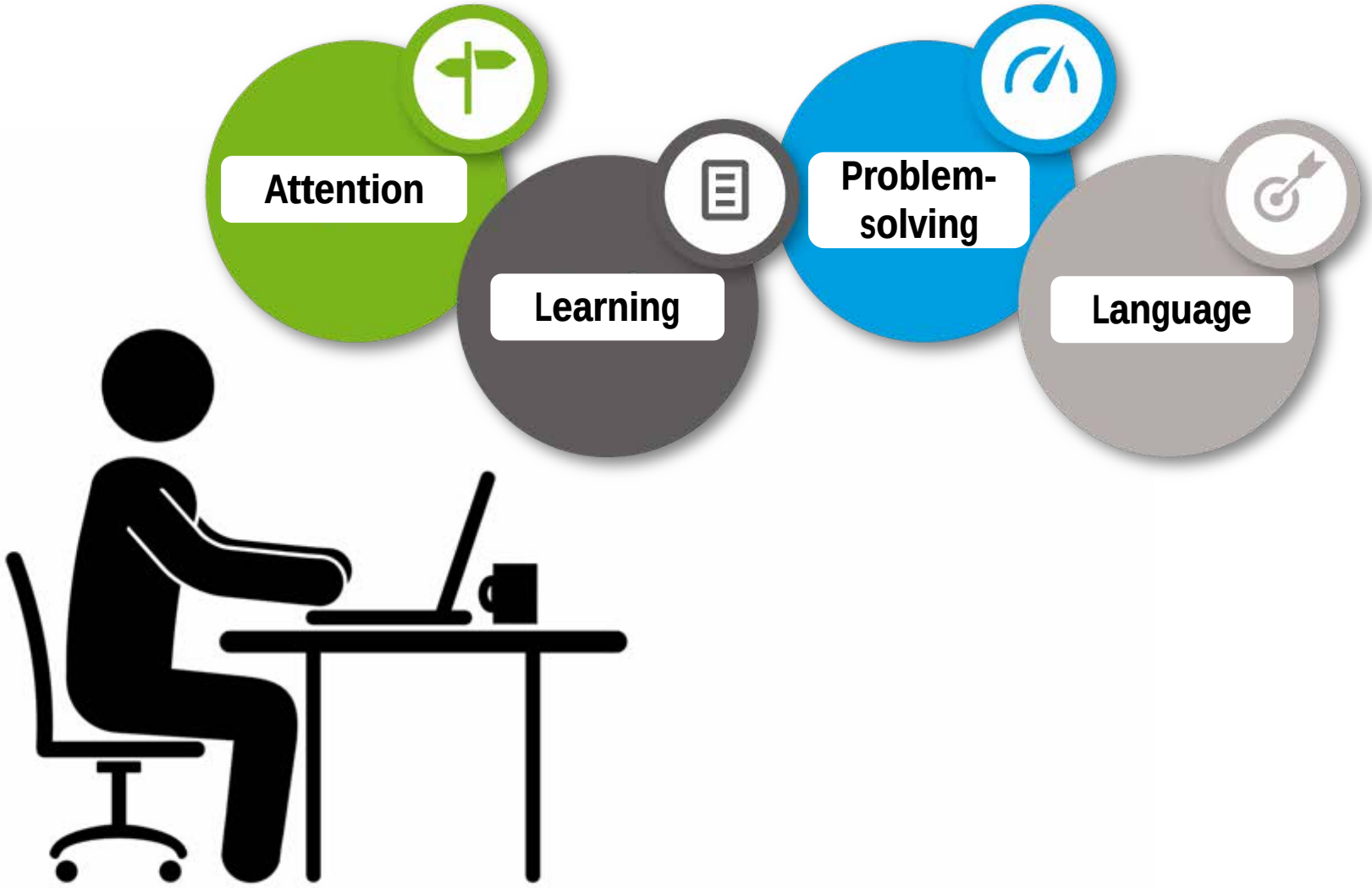
II.II Memory: Implications for HCI

- Practice and use in context help
  - Recall things “forgotten” due to decay & Interference
  - Priming: spread-activation
- Make use of familiarity, habit, etc.
  - Enhance learnability



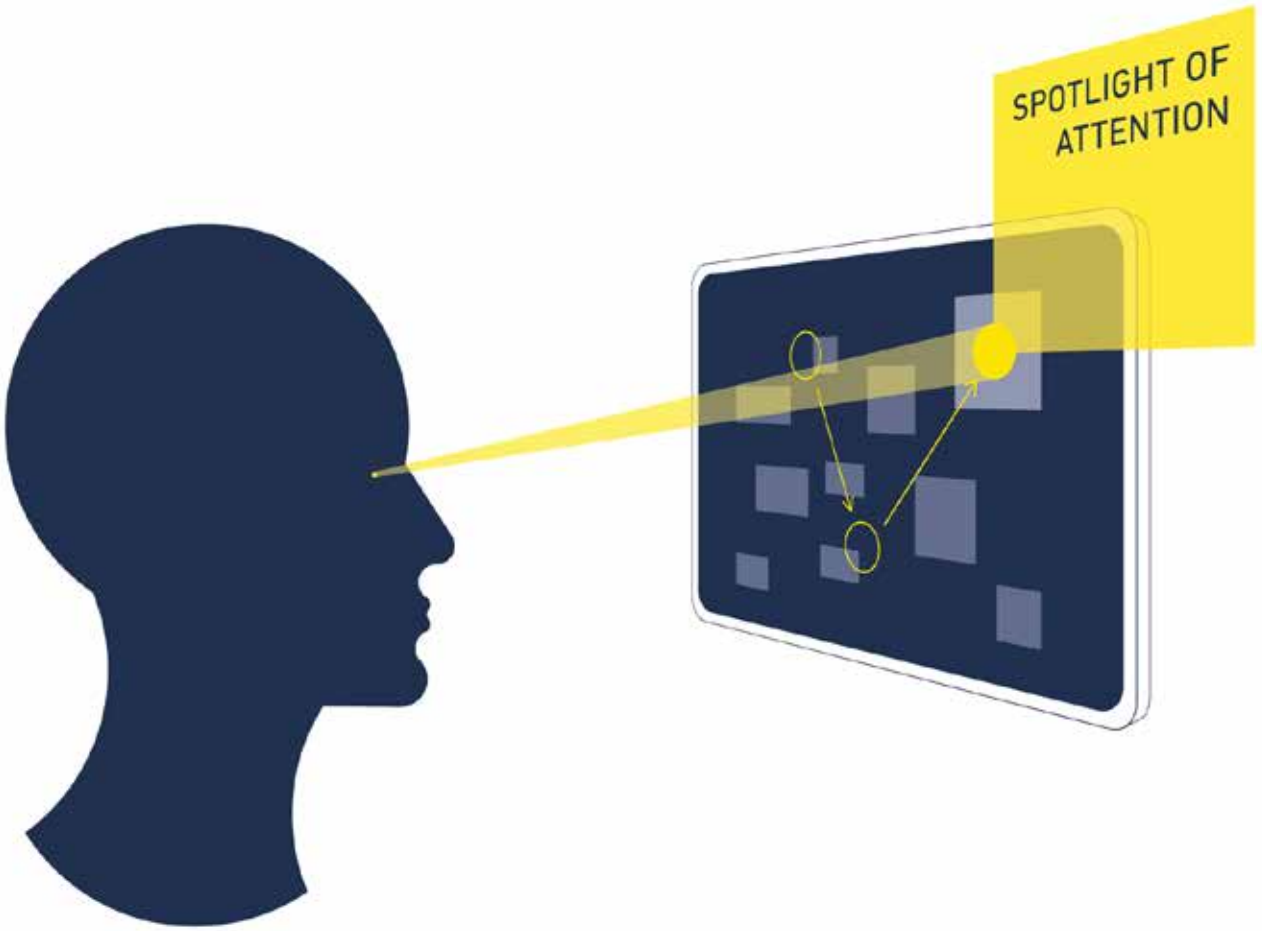
https://sites.google.com/a/students.colgate.edu/the-mental-lexicon/iii-organization-of-the-lexicon/2-spreading-activation-models

III. Cognitive Systems



http://www.sophiq-software.com/pdca-plan-do-check-act/

III.I Attention



http://visual-measurement.eye-square.com/img/e2_VM_SpotlightAttention.jpg

Nielsen's Response Time Limits Law

- **0.1 seconds:** feeling of **instantaneous** response
  - Good for direct manipulation
- **1 second**: keeps the flow of thought **seamless**
  - OK for navigation
- **10 seconds**: keeps the user's **attention**, but
  - Often makes users leave immediately
  - Have a sense of incapability
  - Unpleasant

http://www.eyegaze.com/eye-tracking-for-research-and-human-computer-interaction/

Implications from Eye-tracking Data

https://www.hotjar.com/heatmaps

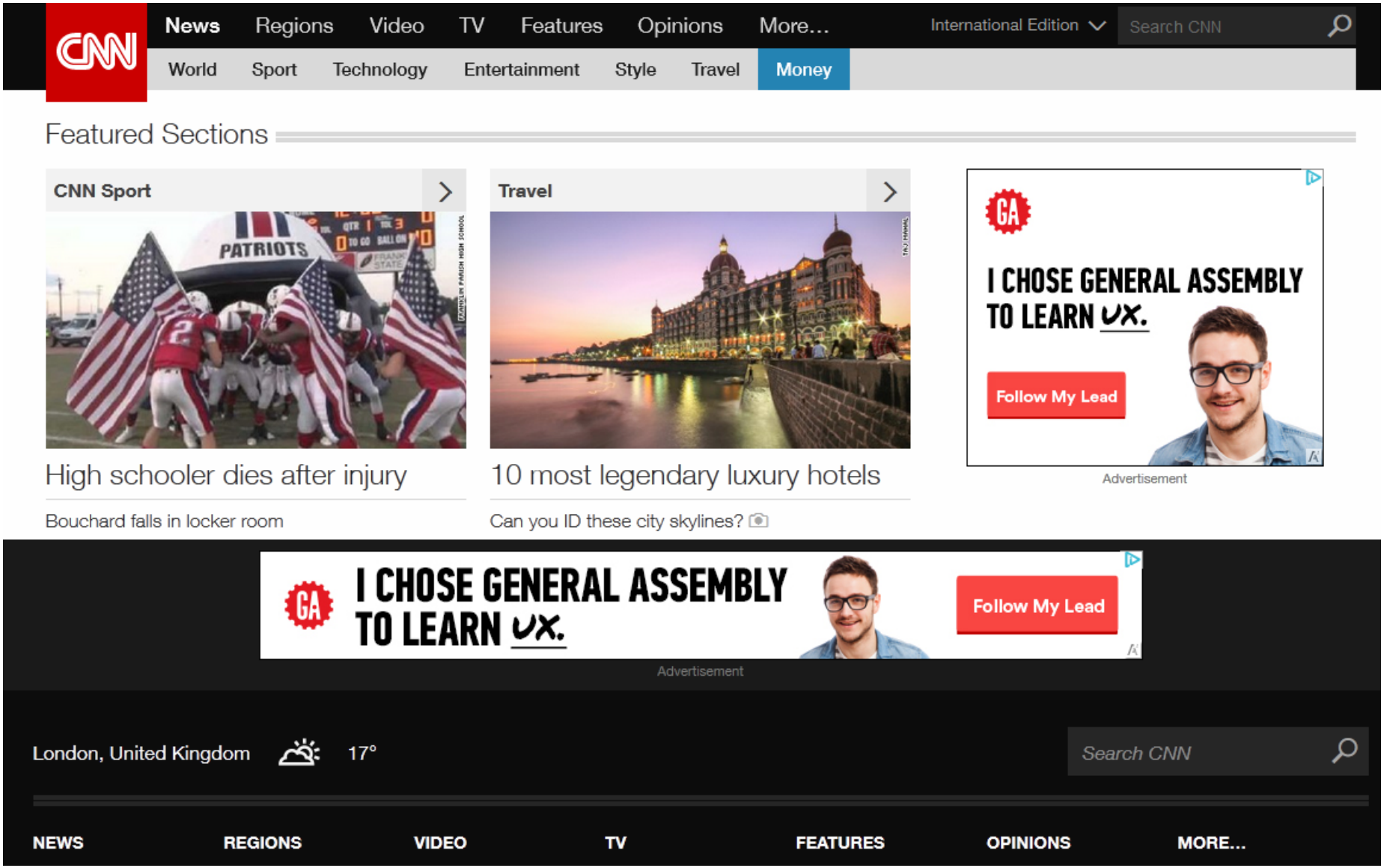
III.I Attention

Attentional / Situational Blindness

"Inability to see something that that is visibly there"

Inhibition of Return

Inhibition of Return



III.II Learning

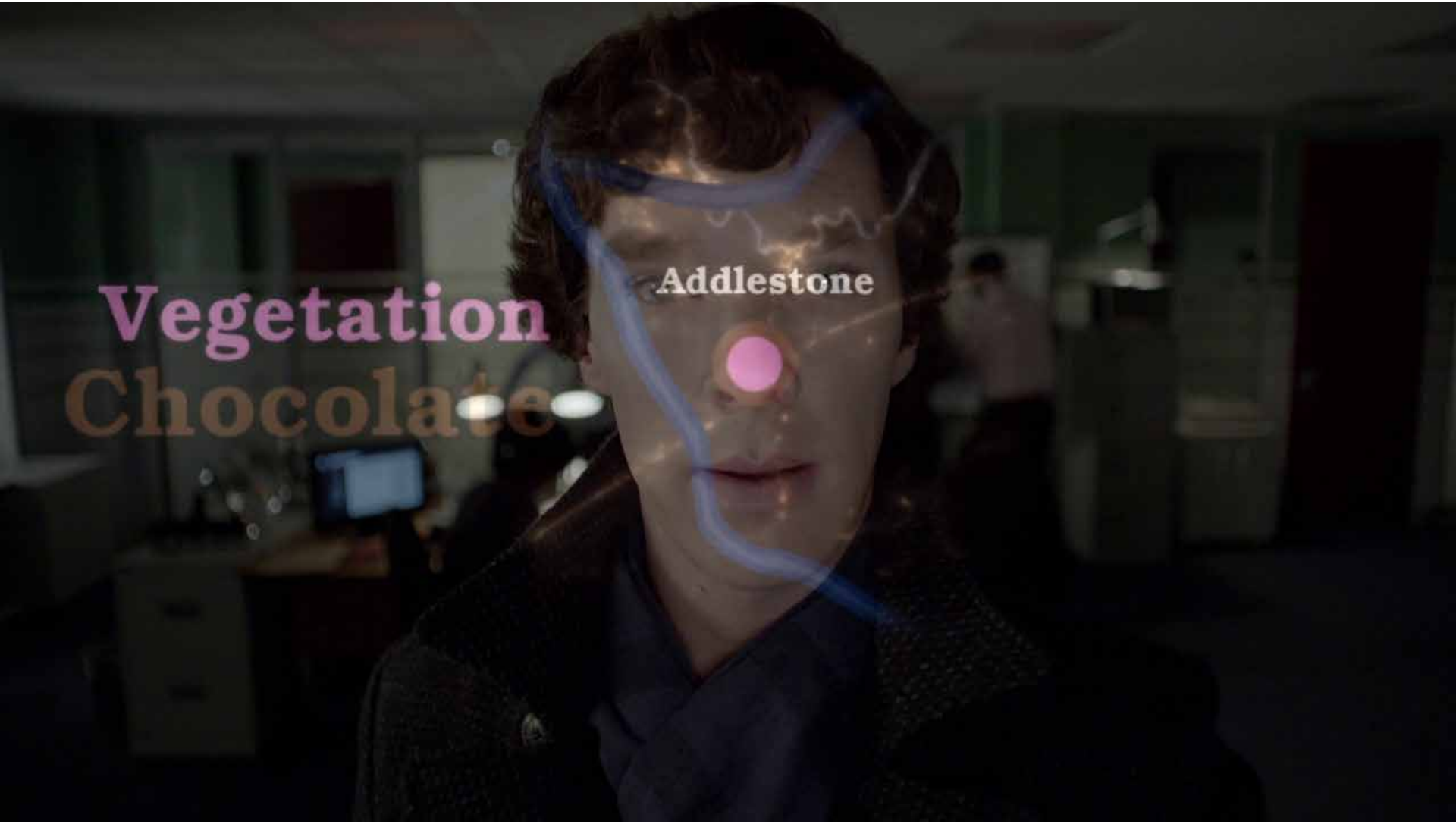
- Two types:
  - Procedural – How to do something
  - Declarative – Facts about something
- Facilitated by
  - Analogy
  - Structure & organization
  - Incremental units
  - Repetition
- Hindered by
  - Previous knowledge (move from Mac to Windows)
  - Personal belief

https://www.onergys.de/out/pictures/wysiwigpro/Icons%20complete%20png%20rgb/ONERGYS_Icon_06_1_00_Beratung%20u%20Schulung_rgb.png

III.III Problem Solving (Reasoning)

- Deductive
  - If A, then B
  - "Select before copy" – provide hints
- Inductive
  - Generalizing from previous cases, knowledge transfer
  - "Also select before cut" – put similar things together
- Abductive
  - Reasons from a fact to the causal action or state
  - "grey out paste" – direct interpretation

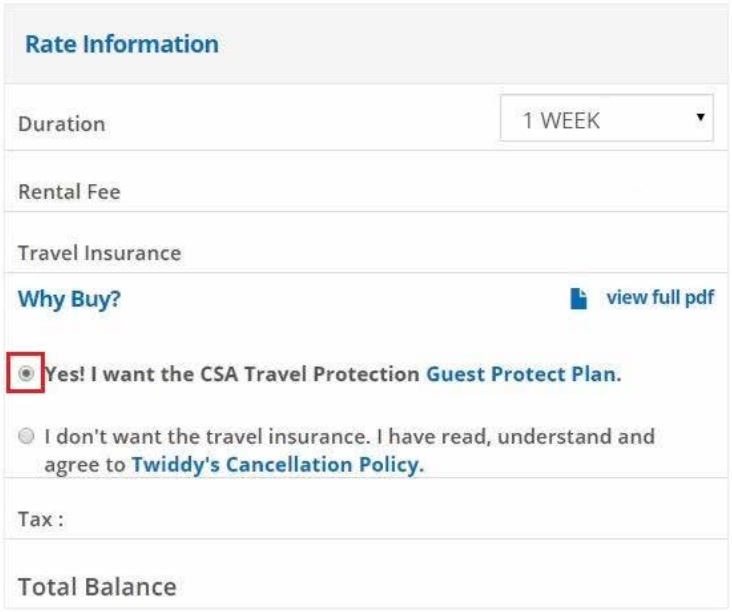
http://www.pasqualecirillo.eu/Consulting/files/icon-identity-consulting.png

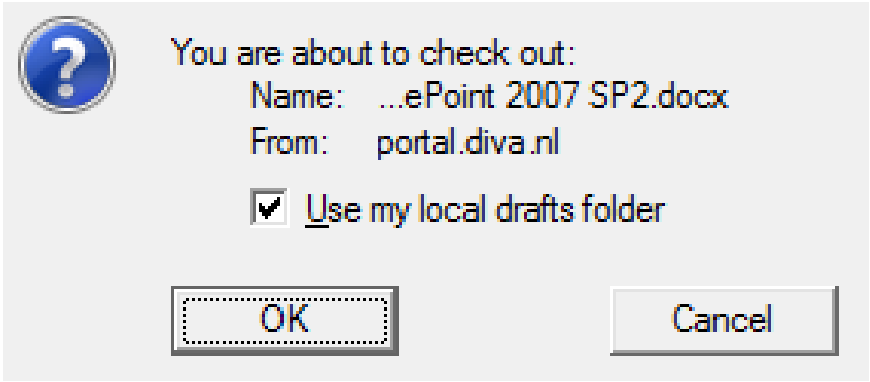


https://boddhisattvasiddhartha.files.wordpress.com/2012/12/sherlock-203-12443.jpg

Hick-Hyman's Law

- Choice Difficulty
  - The more options, the harder (longer time) to decide
- The Default Effect
  - A default option has a higher likelihood to be chosen





III.III Problem Solving: Implications for HCI

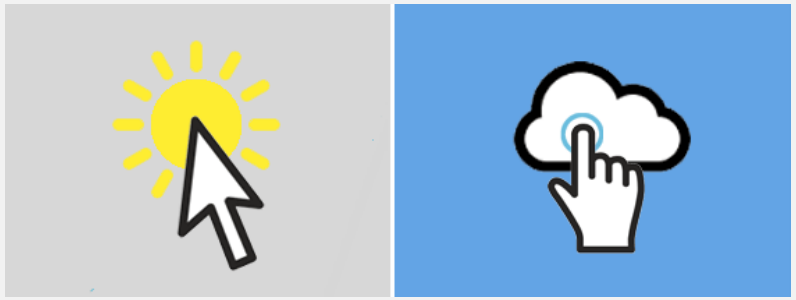
- More heuristic than algorithmic
  - Quick shots rather than plan (do not read manuals)
  - Allow different ways of doing (in some context)
- Choose suboptimal strategy for low priority task
  - Just get it done
  - Block inefficient path
- Learn better strategies through practices
  - Trial and error
  - Provide active help

http://images.clipartpanda.com/problem-Problem_solving.png

Benefiting from Legacy Bias

- Use common template

- Provide clear cues



- Follow consistent path

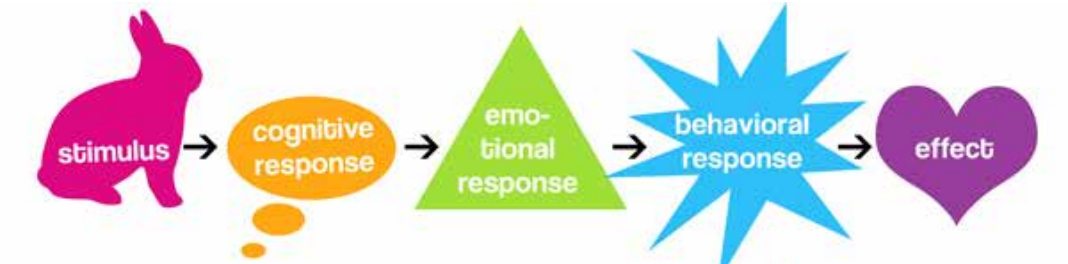
http://interactions.acm.org/archive/view/september-october-2015/benefiting-from-legacy-bias

III.IV Language

- Speech and writing
- Production and comprehension

http://www.skypeenglishclassesonline.com/wp-content/uploads/2014/07/conversation.jpg

IV. Emotion



http://media.mediatemple.netdna-cdn.com/wp-content/uploads/2011/04/stimuluschart.jpg

https://evelynzheng5133.files.wordpress.com/2015/07/wheellarge.png

Recap: Human Capabilities

- Good
  - Multiple sensory channels
  - Infinite LTM capacity
  - High learning capacity
  - Powerful attention mechanism
  - Powerful pattern recognition
  - Rich emotions
- Bad
  - Limited sensory resources
  - Limited STM span
  - Biased learning process
  - Error-prone information processing
  - Slow information processing
  - Too rich emotions

Familiarize with Ted Talks (due Feb 19)

- Watch
  - https://www.ted.com/talks/sergey_brin_why_google_glass?language=en
  - https://www.ted.com/talks/daniele_quercia_happy_maps?language=en#
  - https://www.ted.com/talks/jennifer_golbeck_the_curly_fry_conundrum_why_social_media_likes_say_more_than_you_might_think?language=en#

- Take screenshots of scenes that interest you
  - Open #hw02-ted_talk_review channel in Slack
  - Upload one screenshot for each talk
  - Comment on why you like it / what impresses you

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- Harrison, Chris, and Scott E. Hudson. "A new angle on cheap LCDs: making positive use of optical distortion." In *Proceedings of the 24th annual ACM symposium on User interface software and technology*, pp. 537-540. ACM, 2011.
- Seah, Sue Ann, Diego Martinez Plasencia, Peter D. Bennett, Abhijit Karnik, Vlad Stefan Otrocol, Jarrod Knibbe, Andy Cockburn, and Sriram Subramanian. "SensaBubble: a chrono-sensory mid-air display of sight and smell." In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems*, pp. 2863-2872. ACM, 2014.
- Nakamura, Hiromi, and Homei Miyashita. "Development and evaluation of interactive system for synchronizing electric taste and visual content." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 517-520. ACM, 2012.


Question?
Thank you J
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