

Cognitive aspects and understanding users

Ideas for today and tomorrow

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Overview

- What is cognition?
- What are users good and bad at?
- Describe how cognition has been applied to interaction design
- Mental Models
- Internals classic theories of cognition
- More recent external theories of cognition

Why do we need to understand users?

- Interacting with technology is cognitive
- Need to take into account cognitive processes involved and cognitive limitations of users
- Provides knowledge about what users can and cannot be expected to do
- Identifies and explains the nature and causes of problems users encounter
- Supply theories, modelling tools, guidance and methods that can lead to the design of better interactive products

Cognitive processes

- Attention
- Perception and recognition
- Memory
- Learning
- Reading, speaking and listening
- Problem-solving, planning, reasoning and decision-making

Attention

- Selecting things to concentrate on at a point in time from the mass of stimuli around us
- Allows us to focus on information that is relevant to what we are doing
- Involves audio and/or visual senses
- Focussed and divided attention enables us to be selective in terms of the mass of competing stimuli but limits our ability to keep track of all events
- Information at the interface should be structured to capture users' attention, e.g. use perceptual boundaries (windows), colour, reverse video, sound and flashing lights

Activity: Find the price of a double room at the Holiday Inn in Bradley

Pennsylvania
Bedford Motel/Hotel: Crinaline Courts
(814) 623-9511 S: \$18 D: \$20
Bedford Motel/Hotel: Holiday Inn
(814) 623-9006 S: \$29 D: \$36
Bedford Motel/Hotel: Midway
(814) 623-8107 S: \$21 D: \$26
Bedford Motel/Hotel: Penn Manor
(814) 623-8177 S: \$19 D: \$25
Bedford Motel/Hotel: Quality Inn
(814) 623-5189 S: \$23 D: \$28
Bedford Motel/Hotel: Terrace
(814) 623-5111 S: \$22 D: \$24
Bradley Motel/Hotel: De Soto
(814) 362-3567 S: \$20 D: \$24
Bradley Motel/Hotel: Holiday House
(814) 362-4511 S: \$22 D: \$25
Bradley Motel/Hotel: Holiday Inn
(814) 362-4501 S: \$32 D: \$40
Breezewood Motel/Hotel: Best Western Plaza
(814) 735-4352 S: \$20 D: \$27
Breezewood Motel/Hotel: Motel 70
(814) 735-4385 S: \$16 D: \$18

Activity: Find the price for a double room at the Quality Inn in Columbia

South Carolina						
City	Motel/Hotel	Area		Rates		
		code	Phone	Single	Double	
Charleston	Best Western	803	747-0961	\$26	\$30	
Charleston	Days Inn	803	881-1000	\$18	\$24	
Charleston	Holiday Inn N	803	744-1621	\$36	\$46	
Charleston	Holiday Inn SW	803	556-7100	\$33	\$47	
Charleston	Howard Johnsons	803	524-4148	\$31	\$36	
Charleston	Ramada Inn	803	774-8281	\$33	\$40	
Charleston	Sheraton Inn	803	744-2401	\$34	\$42	
Columbia	Best Western	803	796-9400	\$29	\$34	
Columbia	Carolina Inn	803	799-8200	\$42	\$48	
Columbia	Days Inn	803	736-0000	\$23	\$27	
Columbia	Holiday Inn NW	803	794-9440	\$32	\$39	
Columbia	Howard Johnsons	803	772-7200	\$25	\$27	
Columbia	Quality Inn	803	772-0270	\$34	\$41	
Columbia	Ramada Inn	803	796-2700	\$36	\$44	
Columbia	Vagabond Inn	803	796-6240	\$27	\$30	

Results

- Tullis (1987) found that the two screens produced quite different results
 - 1st screen - took an average of 5.5 seconds to search
 - 2nd screen - took 3.2 seconds to search
- Why, since both displays have the same density of information (31%)?
- Spacing
 - In the 1st screen the information is bunched up together, making it hard to search
 - In the 2nd screen the characters are grouped into vertical categories of information making it easier

Is color contrast good? Find italian

Black Hills Forest	Peters Landing	Jefferson Farms	Devlin Hall
Cheyenne River	Public Health	Psychophysics	Positions
Social Science	San Bernardino	Political Science	Hubard Hall
South San Jose	Moreno Valley	Game Schedule	Fernadino Beach
Badlands Park	Altamonte Springs	South Addison	Council Bluffs
Juvenile Justice	Peach Tree City	Cherry Hills Village	Classical Lit
Results and Stats	Highland Park	Creative Writing	Sociology
Thousand Oaks	Manchesney Park	Lake Havasu City	Greek
Promotions	Vallecito Mts.	Engineering Bldg	Wallace Hall
North Palermo	Rock Falls	Sports Studies	Concert Tickets
Credit Union	Freeport	Lakewood Village	Public Radio FM
Wilner Hall	Slaughter Beach	Rock Island	Children's Museum
Performing Arts	Rocky Mountains	Deerfield Beach	Writing Center
Italian	Latin	Arlington Hill	Theater Auditions
Coaches	Pleasant Hills	Preview Game	Delaware City
McKees Rocks	Observatory	Richland Hills	Scholarships
Glenwood Springs	Public Affairs	Experts Guide	Hendricksville
Urban Affairs	Heskett Center	Neff Hall	Knights Landing
McLeansboro	Brunswick	Grand Wash Cliffs	Modern Literature
Experimental Links	East Millinocket	Indian Well Valley	Studio Arts
Graduation	Women's Studies	Online Courses	Hughes Complex
Emory Lindquist	Vacant	Lindquist Hall	Cumberland Flats
Clinton Hall	News Theatre	Fisk Hall	Central Village
San Luis Obispo	Candlewood Isle	Los Padres Forest	Hoffman Estates

Are borders and white space better? Find french

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Counseling
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Duerksen Fine Art
EMT Program

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Choral Dept.
Alberg Hall
French
Spanish

Softball, Men's
McKinley Hall
Email
Dental Hygiene
Tenure
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Levitt Arena

Religion
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Koch Arena
Roster

Parents
Wrestling
Philosophy
Wichita Lyceum
Fairmount Center
Women's Museum

Instrumental
Nursing
Opera
Sports History
Athletic Dept.
Health Plan

Activity

- Weller (2004) found people took less time to locate items for information that was grouped
 - using a border (2nd screen) compared with using color contrast (1st screen)
- Some argue that too much white space on web pages is detrimental to search
 - Makes it hard to find information
- Do you agree?

Which is easiest to read and why?

What is the time?

Multitasking and attention

- Is it possible to perform multiple tasks without one or more of them being detrimentally affected?
- Ophir et al (2009) compared heavy vs light multi-taskers
 - heavy were more prone to being distracted than those who infrequently multitask
 - heavy multi-taskers are easily distracted and find it difficult to filter irrelevant information

Design implications for attention

- Make information salient when it needs attending to
- Use techniques that make things stand out like color, ordering, spacing, underlining, sequencing and animation
- Avoid cluttering the interface with too much information
- Avoid using too much because the software allows it

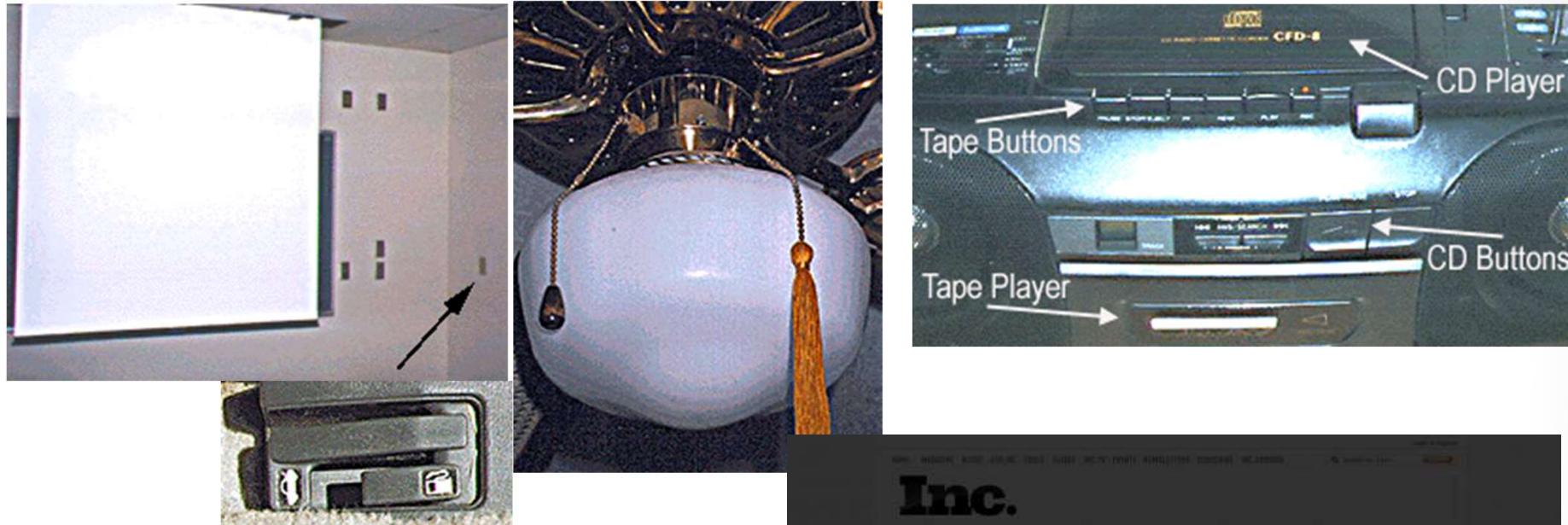
An example of over-use of graphics

The slide features a dark teal background with a horizontal orange bar containing the title 'Our Situation'. To the left of the title is a vertical grey sidebar with a pattern of white circles. The main content area is a teal rectangle containing two bullet points: '◆ State the bad news' and '◆ Be clear, don't try to obscure the situation'.

Our Situation

- ◆ State the bad news
- ◆ Be clear, don't try to obscure the situation

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[16]

Perception

- How information is acquired from the world and transformed into experiences
- Obvious implication is to design representations that are readily perceivable, e.g.
 - Text should be legible
 - Icons should be easy to distinguish and read

Senses and Constructivism

- Senses (sight, hearing, smell, taste, touch) provide data about what is happening around us
- Designing good Web materials requires knowledge about how people perceive
- Our brains do not create pixel-by-pixel images
- Our minds create, or *construct*, models that summarize what comes from our senses
- These models are what we perceive
- When we see something, we don't remember all the details, only those that have meaning for us
- Context plays a major role in what people see in an image

Example what do you see



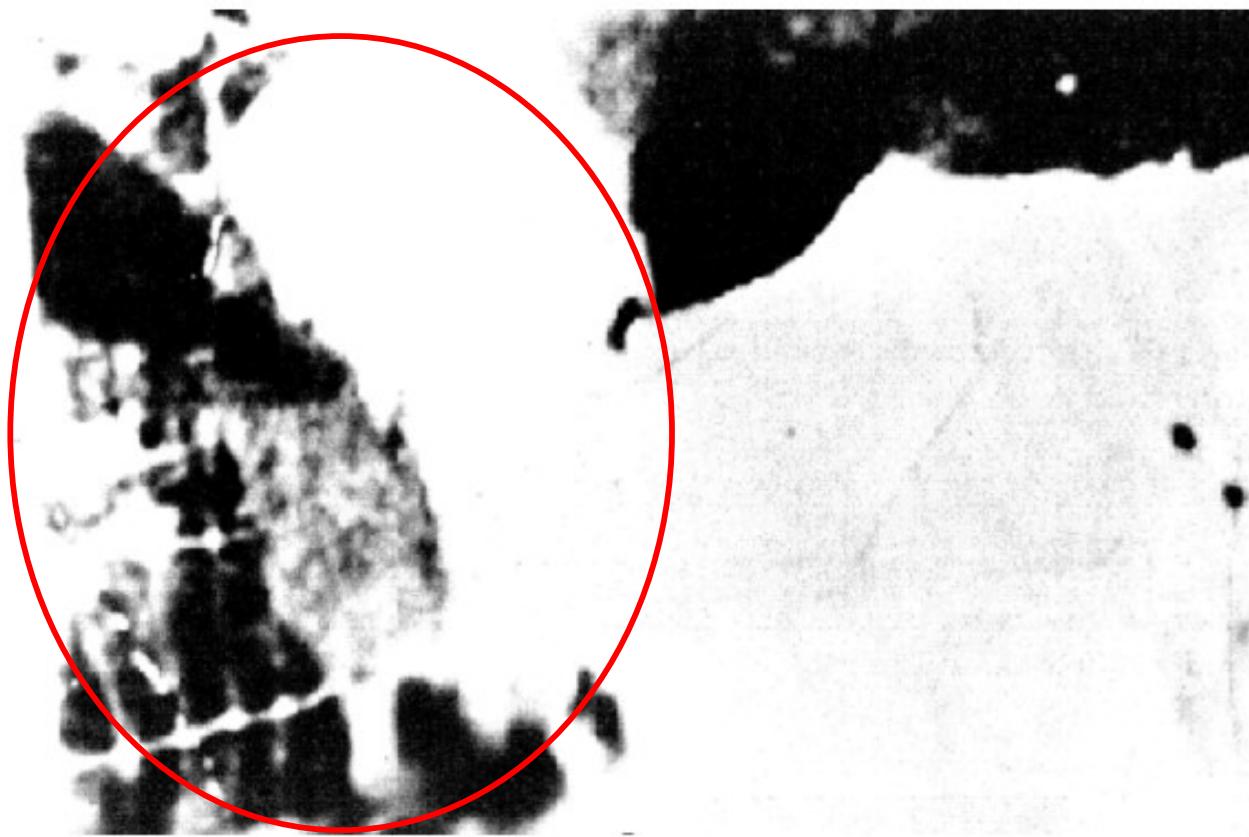
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Hint: it's an animal facing you



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Hint: This animal gives milk



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Gestalt psychology

- Gestalt psychology
- “Gestalt” is German for “shape,” but as the
- term is used in psychology it implies the
- idea of perception in context
- We don’t see things in isolation, but as
- parts of a whole

Figure and ground

- Images are partitioned into
 - – Figure (foreground) and
 - – Ground (background)
- • Sometimes figure and ground are
- ambiguous

Figure and ground: Example 1



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Figure - Ground

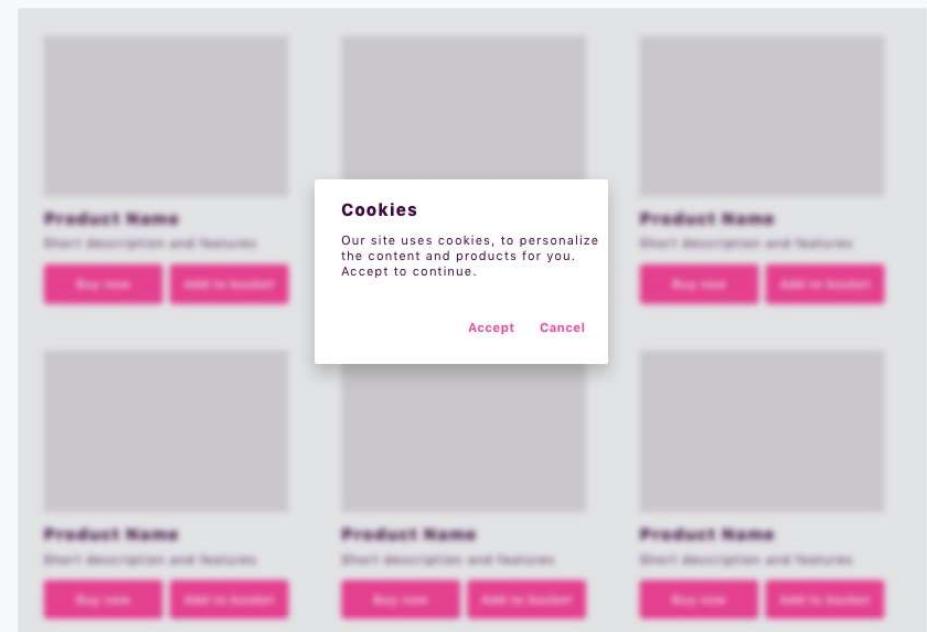
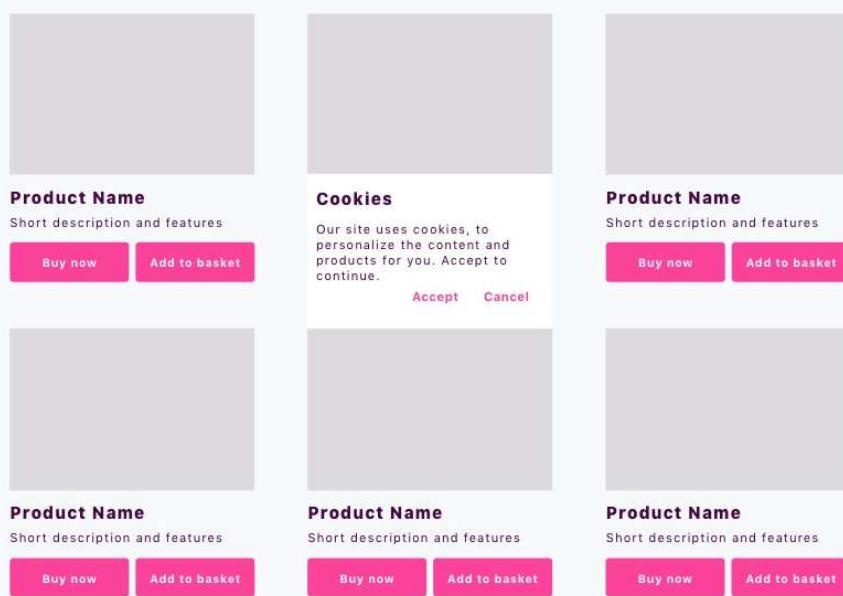




Figure 3.A: The logo of visitnorway.com



Figure 3.B: The logo of the Gnome Desktop Environment

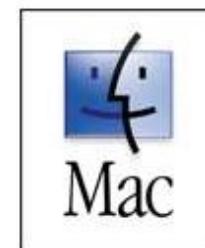


Figure 3.C: The logo of the Macintosh



Hey, I'm Marc

Digital designer & front-end developer.

Currently a frontend engineer
making magical bedtimes at
Wonderbly.

Previously worked with Vanity
Fair, Great Little Place, Glamour,
and Discovery Network.



GET IN TOUCH

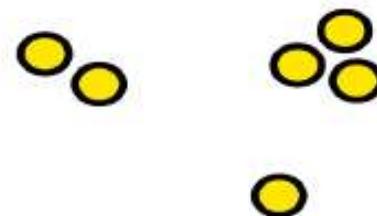
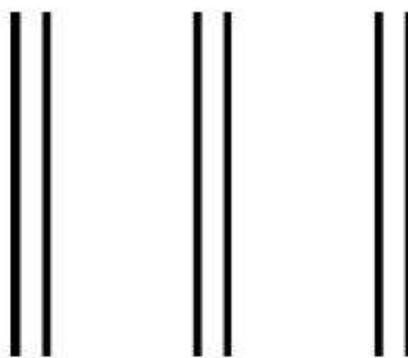


Five Principles of Gestalt

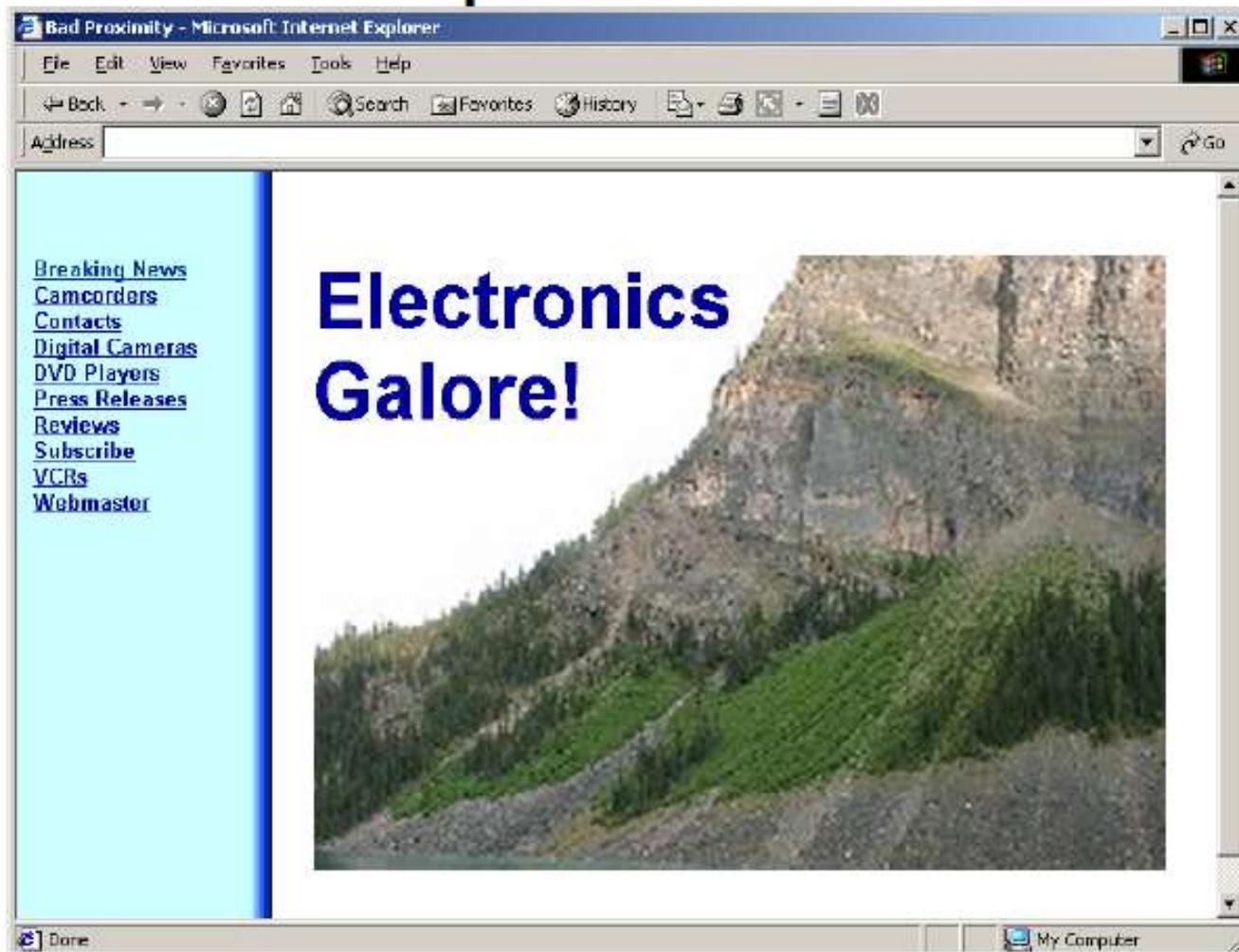
- We organize things into meaningful units
- using
 - – Proximity: we group by distance or location
 - – Similarity: we group by type
 - – Symmetry: we group by meaning
 - – Continuity: we group by flow of lines
 - (alignment)
 - – Closure: we perceive shapes that are not
 - (completely) there

Proximity

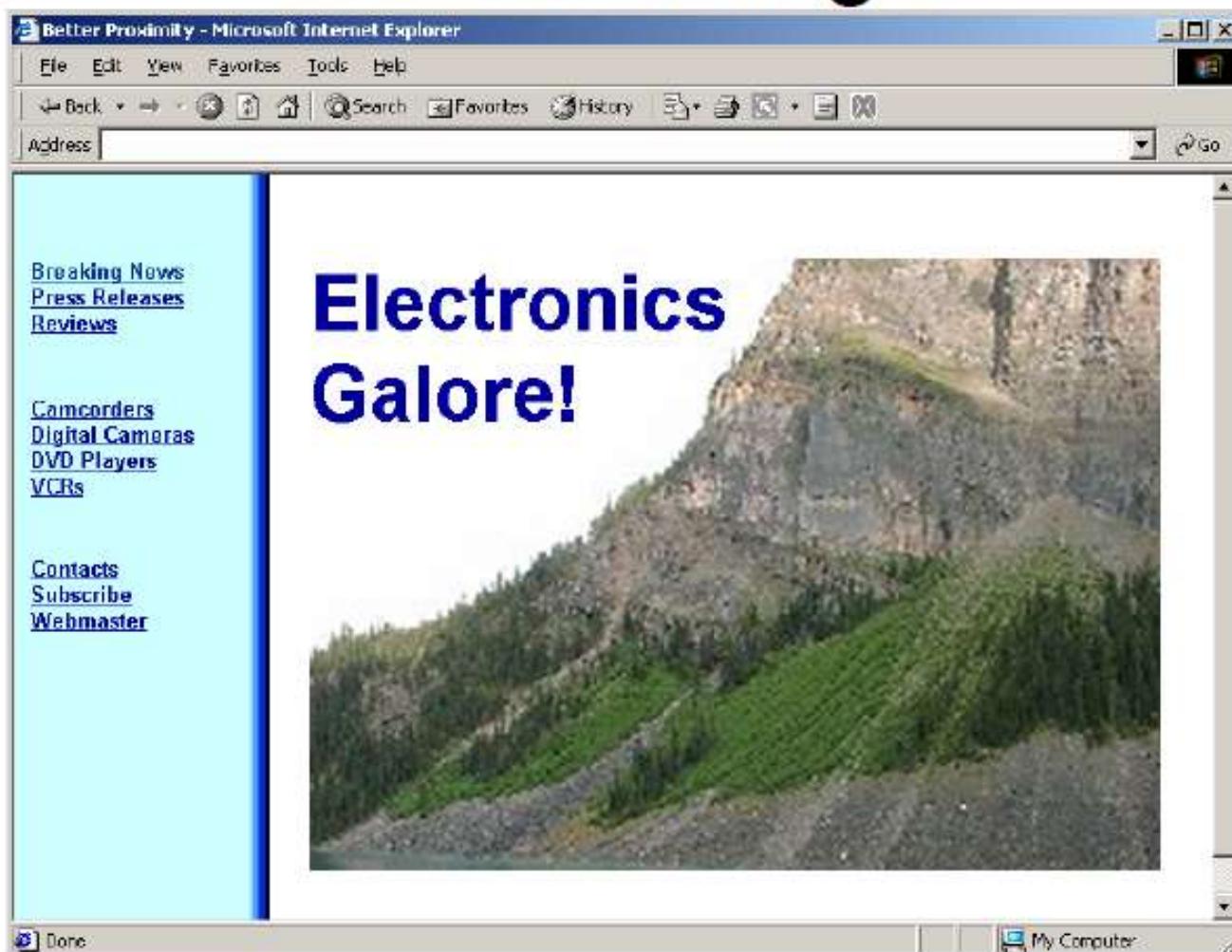
Proximity



Example: a page that can be improved . . .



By using proximity to group related things



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Founder

Sameer Sharma

Co-Founder

Neha Khaitan

Visual Designer

Christopher Zango

Design Lead

Kevin Wong

Content Writer

Victoria Crew

Editor

Sam Flick

Founder

Sameer Sharma

Co-Founder

Neha Khaitan

Visual Designer

Christopher Zango

Design Lead

Kevin Wong

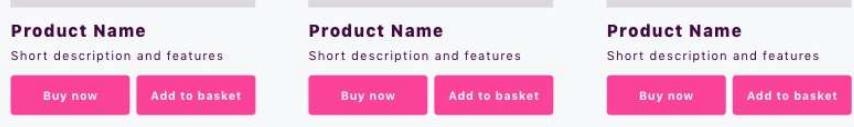
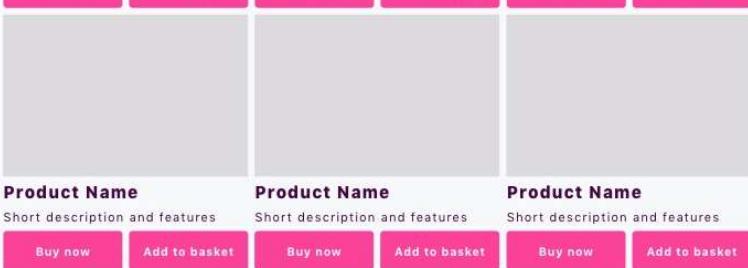
Content Writer

Victoria Crew

Editor



Proximity



Good Example

Good use of
spacing

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Los Angeles Times

Thursday, Jan. 7, 2010
3:16 p.m. PST

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Francine Orr / Los Angeles Times

Obama takes responsibility for airline security

By Michael Muskal and Christi Parsons | 2:39 p.m.

"Ultimately, the buck stops with me," the president says, calling for more vigilance and better use of a terrorist watch list.

- Read the security review at the White House blog

EPA announces strict new smog standards

By Jim Tankersley

The new rules announced today, the toughest ever, could put large parts of the country in violation of federal air quality regulations.

2 ex-Blackwater guards charged with murder

By Michael Muskal | 12:40 p.m.

The former contractors have been arrested and charged in the killings of two Afghans last year in Kabul.

Times to close O.C. printing operations

By Michael Brand, director of Getty Museum, stepping down | 1:10 p.m.

Perez elected Assembly speaker in party-line vote | 1:15 p.m.

4.1 Bay Area earthquake widely felt in north

Iraq bars major Sunni party from election

By Michael Muskal | 1:48 p.m.

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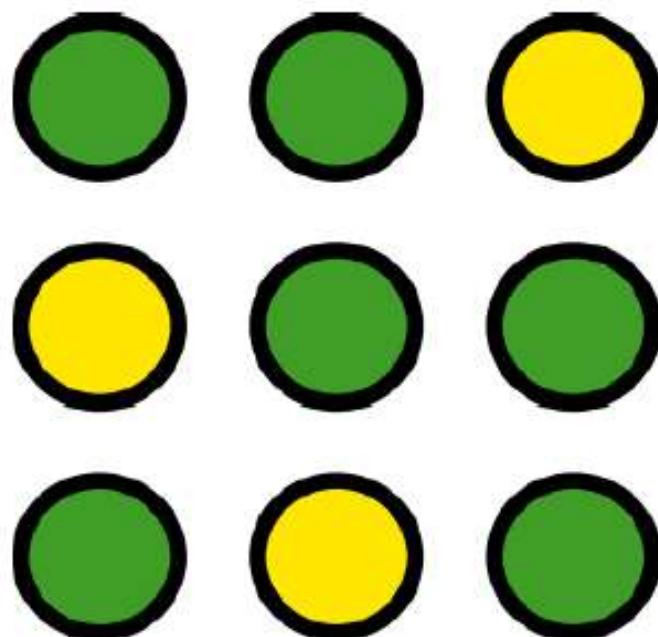


Fantasia Barrino's long and

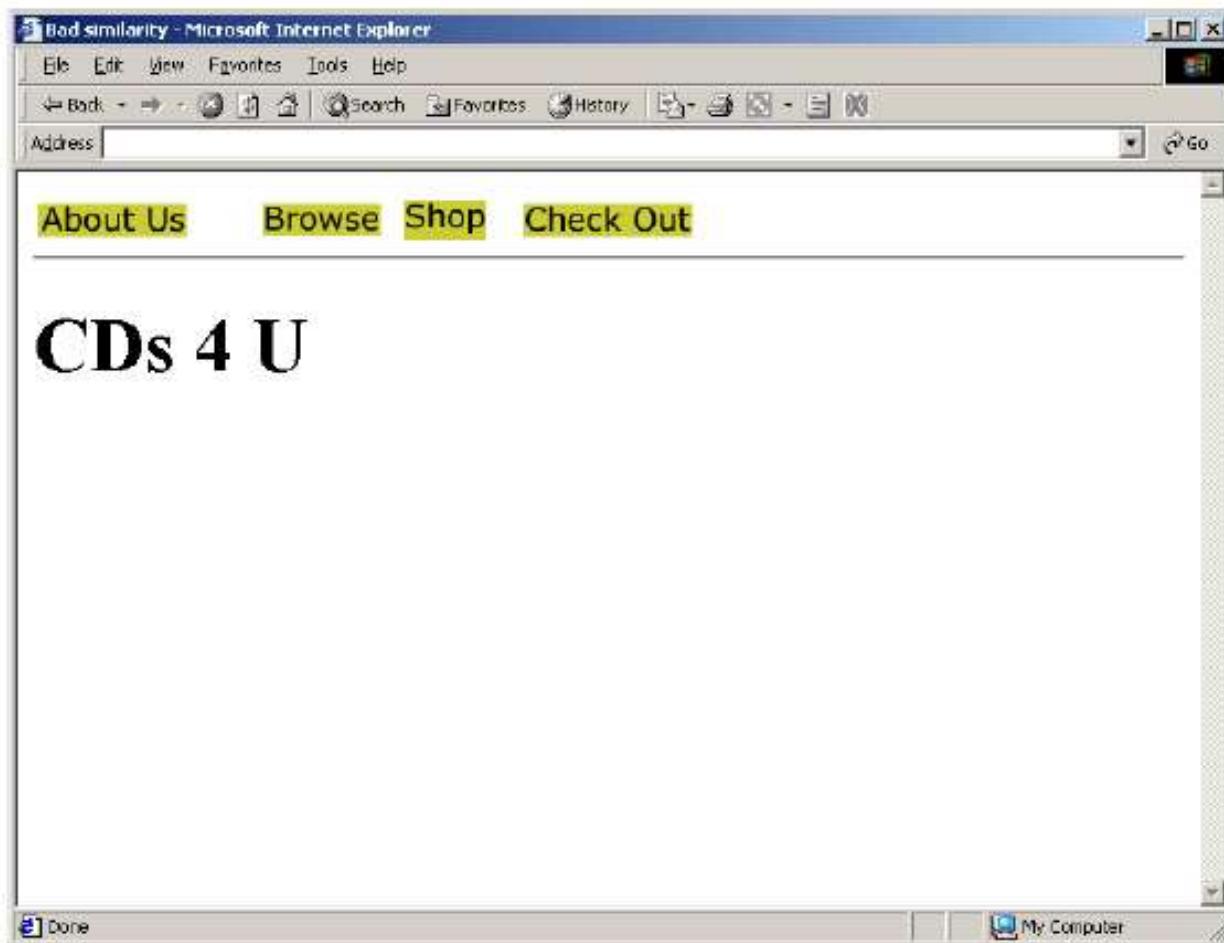
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[34]

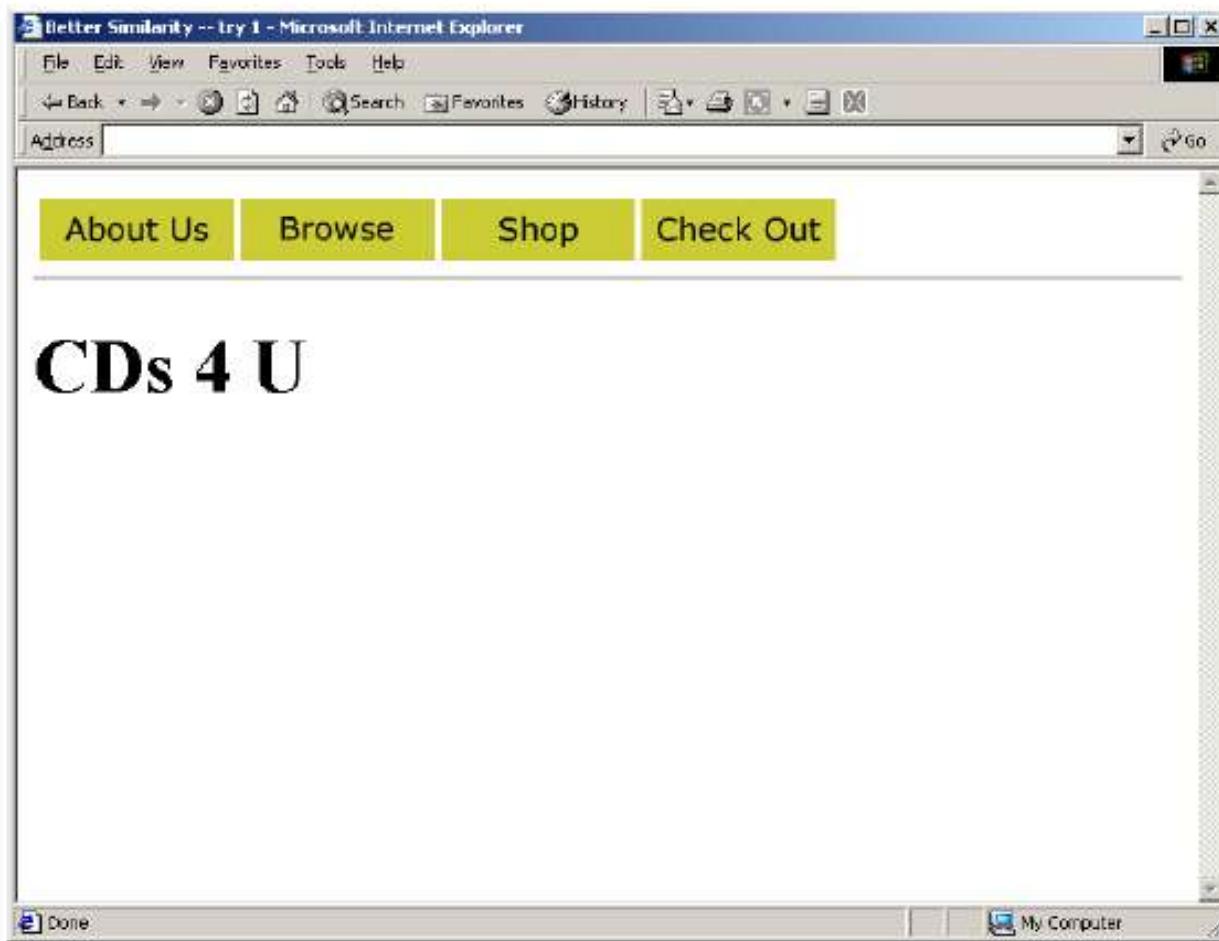
Similarity



Example: can you use similarity to improve this page?



Sure: make the buttons the same size:





Product Name

Description: Lorem Ipsum has been the industry's standard dummy text ever since the 1500s

Edit

Remove



Product Name

Description: Lorem Ipsum has been the industry's standard dummy text ever since the 1500

Edit

Remove



Similarity

Product Name

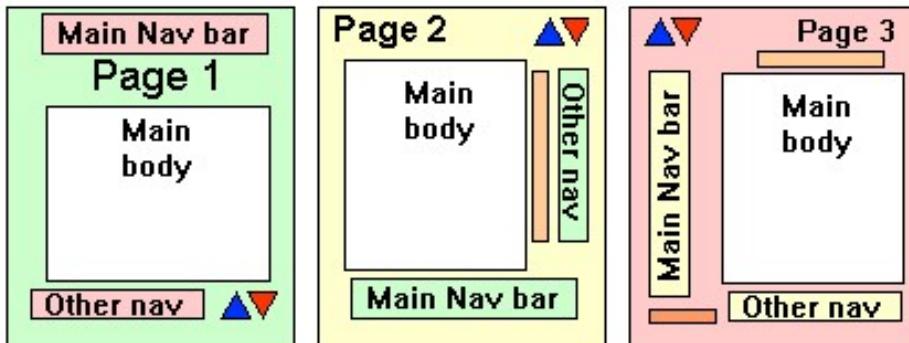
Description and features

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Remove

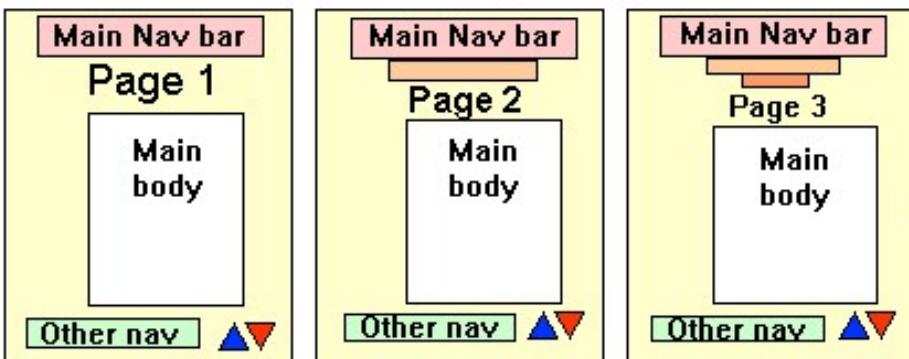


Inconsistent page design.



The Bad: Inconsistent Page Design

Consistent page design.



The Good: Consistent Page Design

Symmetry: we use our experience and expectations to make groups of things

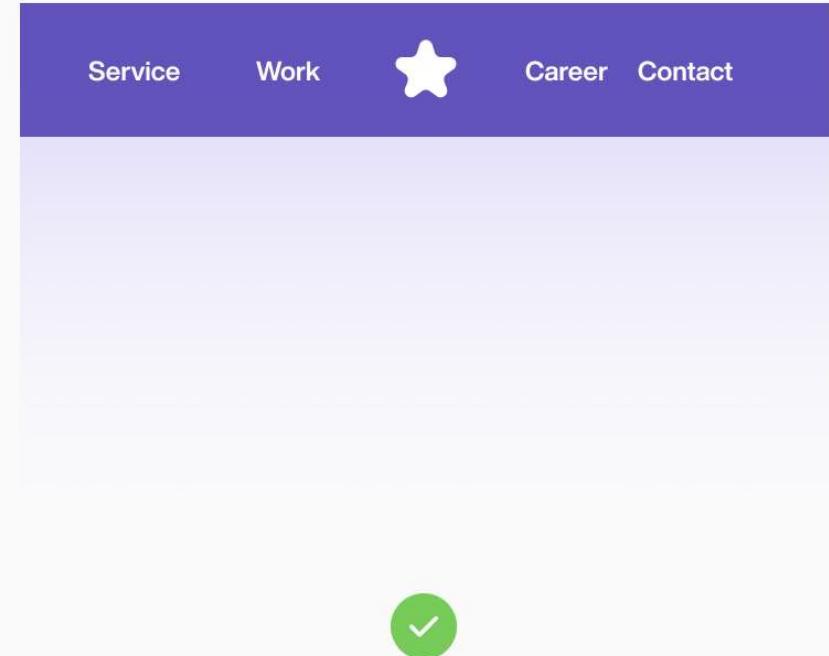
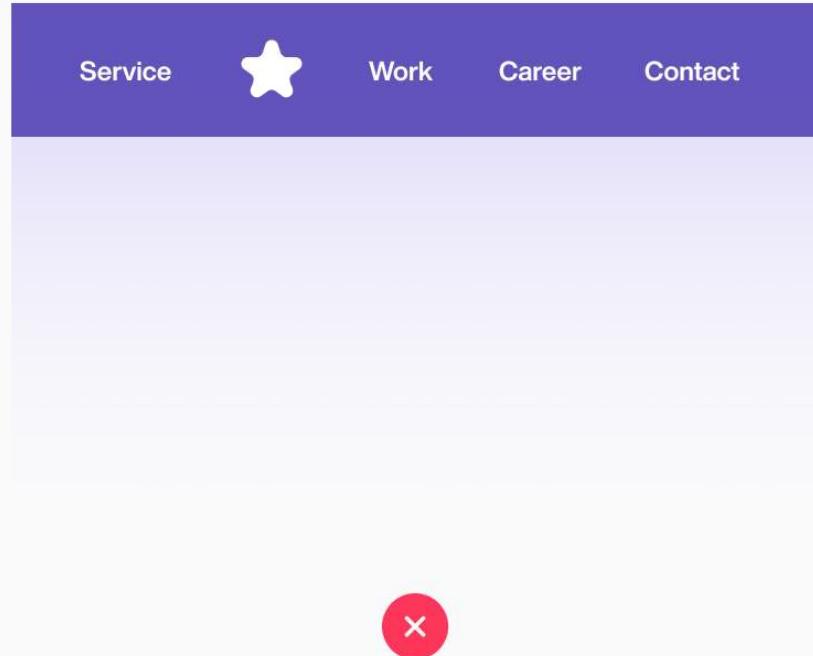


We see two triangles.



We see three groups of paired square brackets.

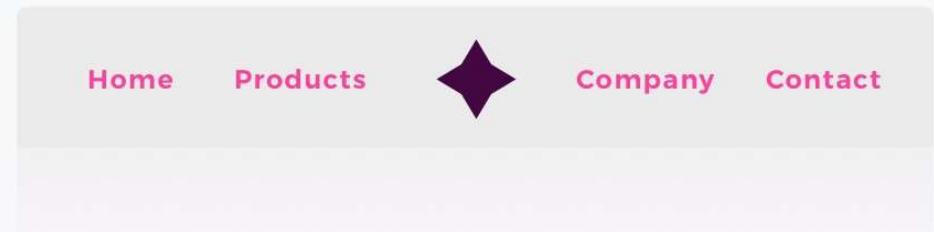




Gestalt
Principles

QED42.design

Symmetry



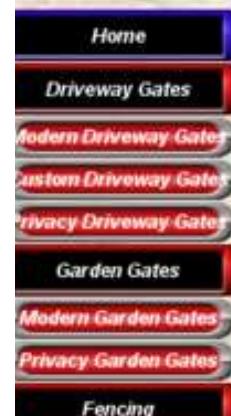
Gestalt Principles

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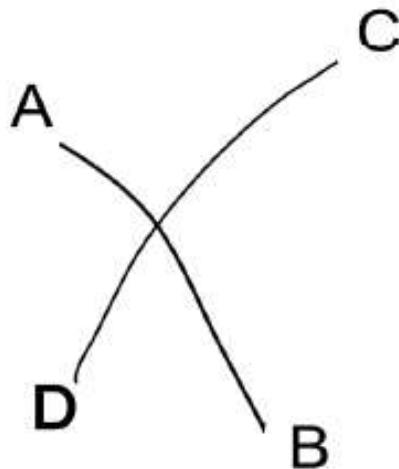
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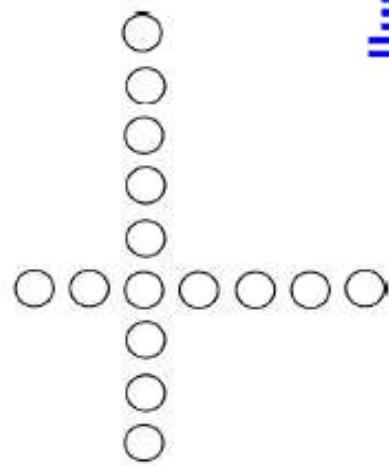


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Continuity: flow, or alignment



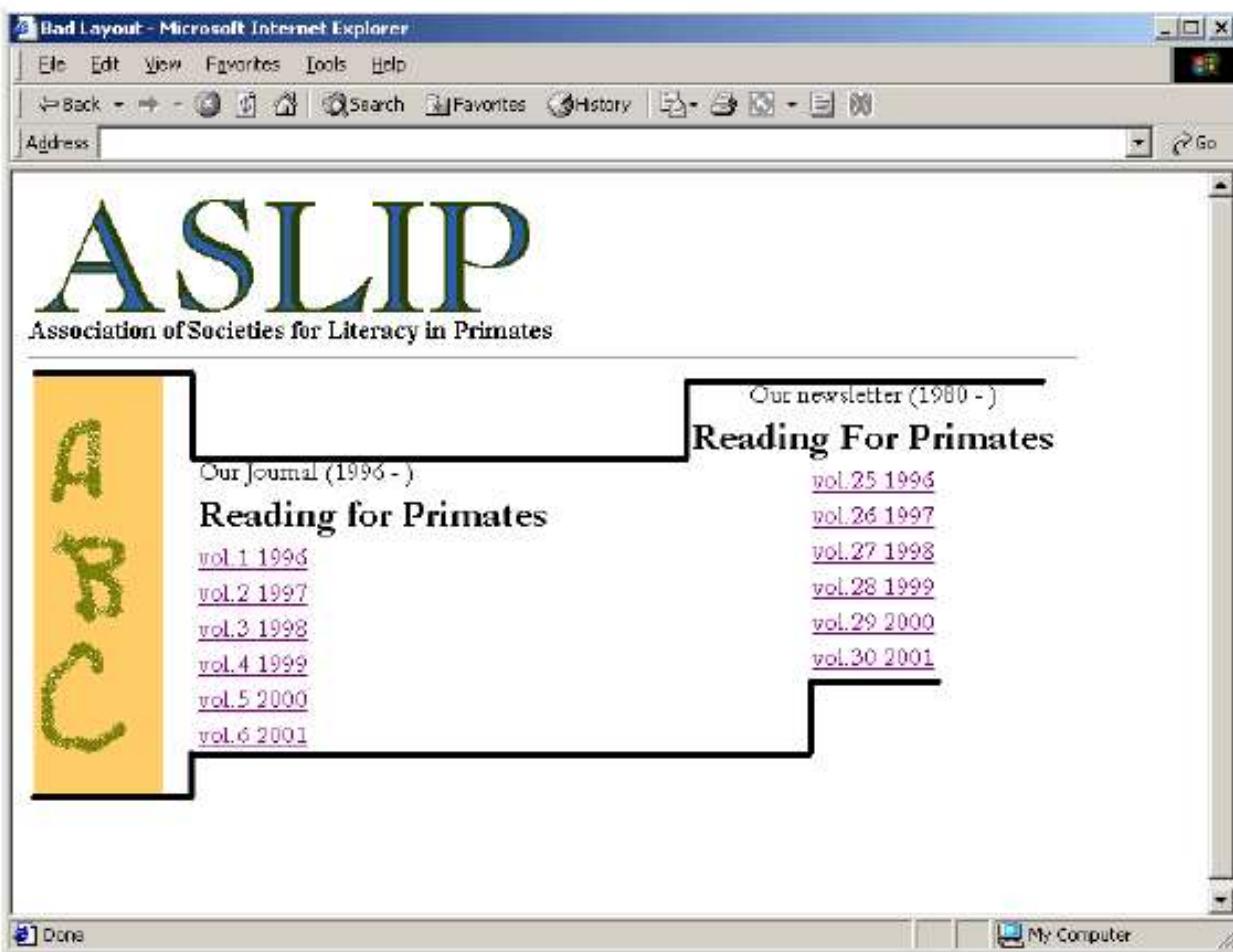
We see curves AB and CD, not AC and DB, and not AD and BC



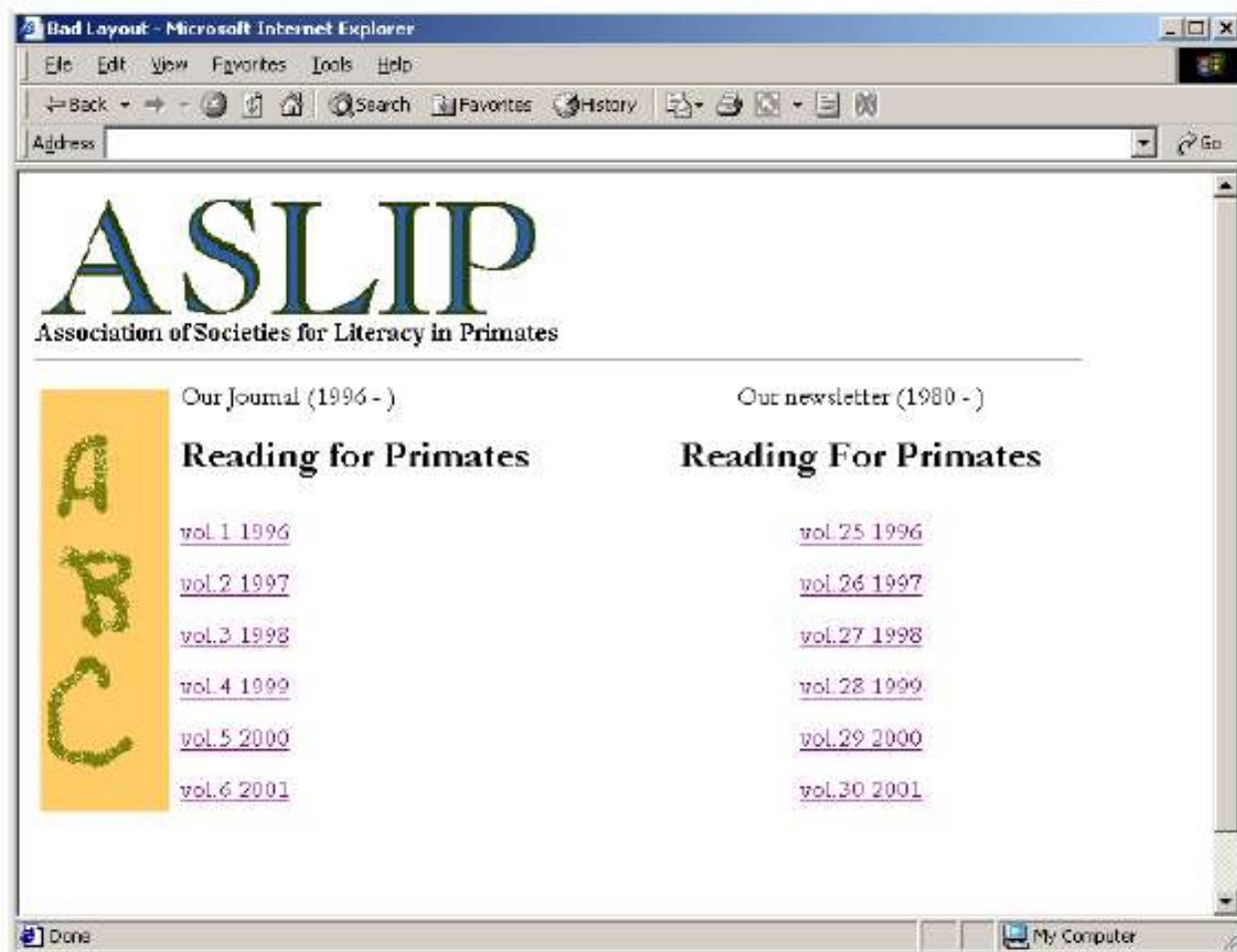
We see two rows of circles, not two L-shaped groups



Can you use alignment (one form of continuity) to improve this page?



Sure: the lines on the previous slide show how to use horizontal alignment



But why stop? Left-align both columns to get vertical alignment also

The screenshot shows a Microsoft Internet Explorer window with the title bar "Better Alignment, Macro and Micro level - Microsoft Internet Explorer". The menu bar includes File, Edit, View, Favorites, Tools, and Help. The toolbar below has Back, Forward, Stop, Refresh, Search, Favorites, History, and other navigation icons. The address bar is empty. The main content area displays the following:

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Association of Societies for Literacy in Primates

<p>Our Journal (1996 -)</p> <p>Reading for Primates</p> <ul style="list-style-type: none">vol 1 1996vol 2 1997vol 3 1998vol 4 1999vol 5 2000vol 6 2001 	<p>Our newsletter (1980 -)</p> <p>Reading For Primates</p> <ul style="list-style-type: none">vol.25 1996vol.26 1997vol.27 1998vol.28 1999vol.29 2000vol.30 2001
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

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 EN Hello Account & Lists Orders Cart

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PERKS HAVE ARRIVED
 JOIN NOW Ad feedback

Make Dad the man about town

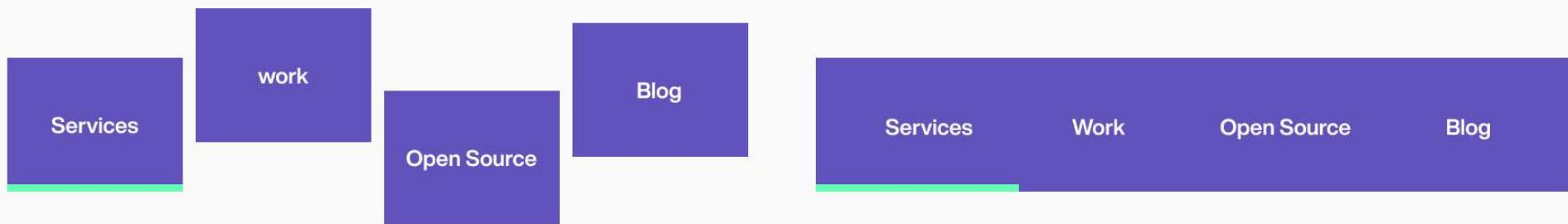
Father's Day Gift Shop

Budget apparel with FREE shipping

50 Great 70s Rock Songs music | ▶

49

Dr Ayman Ezzat modified version
 of Dr. Frank Kriwaczek



Gestalt
Principles

QED42.design

Continuation

Home Services Contact

Home Services Contact

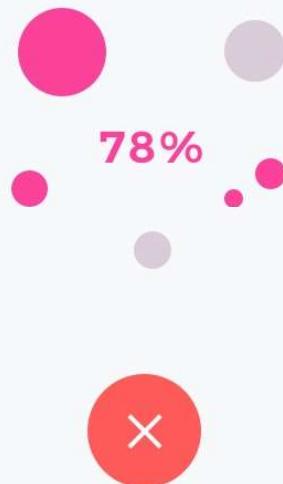


Gestalt Principles

<https://uxmisfit.com>



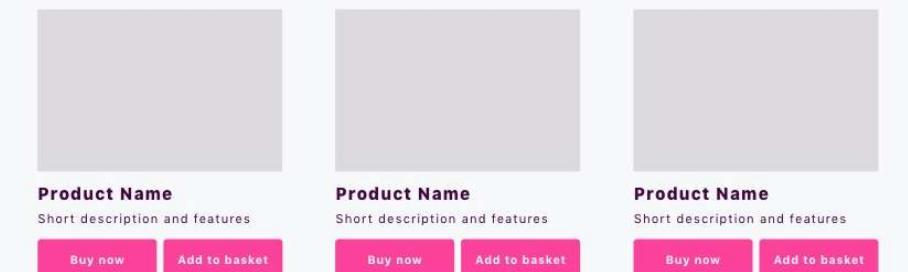
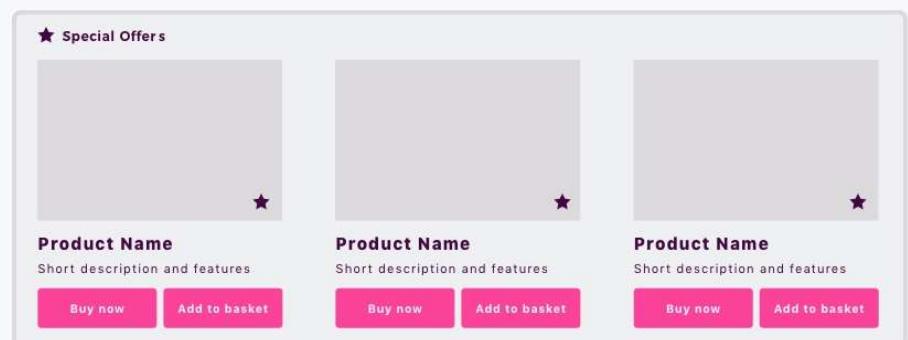
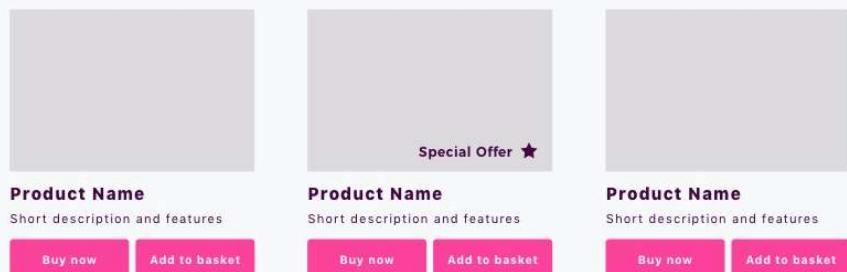
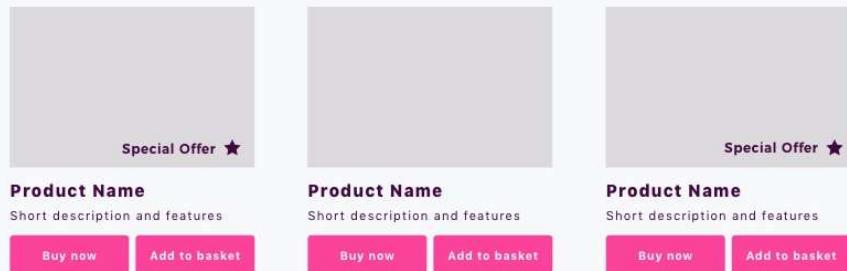
Closure



Gestalt Principles

<https://uxmisfit.com>

Common Region





Pacific Northwest X-Ray Inc.

Simply the best!



X-Ray and Radiology? You are at the source! Here you will find hundreds of pages of X-Ray related accessories, parts, supplies, and equipment. Accessories from Lead Aprons to Lead Markers. X-Ray equipment including portables. Not to mention X-Ray parts. Be sure to keep checking back as our web design team is constantly updating the information on the current items and adding new products as they become available.

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[Our Story](#) [The Farm](#)

ono

Made for You [Get Started](#)



Ono is
Chef-created.



Design implications

- Icons should enable users to readily *distinguish* their meaning
- Bordering and spacing are effective visual ways of grouping information
- Sounds should be audible and distinguishable
- Speech output should enable users to distinguish between the set of spoken words
- Text should be legible and distinguishable from the background
- Tactile feedback should allow users to recognize and distinguish different meanings

Memory

- Involves first encoding and then retrieving knowledge
- We don't remember everything - involves filtering and processing what is attended to
- Context is important in affecting our memory (i.e. where, when)
- We recognize things much better than being able to recall things

Processing in memory

- Encoding is first stage of memory
 - determines which information is attended to in the environment and how it is interpreted
- The more attention paid to something...
- The more it is processed in terms of thinking about it and comparing it with other knowledge...
- The more likely it is to be remembered
 - e.g. when learning about HCl, it is much better to reflect upon it, carry out exercises, have discussions with others about it, and write notes than just passively read a book, listen to a lecture or watch a video about it

Context is important

- Context affects the extent to which information can be subsequently retrieved
- Sometimes it can be difficult for people to recall information that was encoded in a different context:
 - “You are on a train and someone comes up to you and says hello. You don’t recognize him for a few moments but then realize it is one of your neighbors. You are only used to seeing your neighbor in the hallway of your apartment block and seeing him out of context makes him difficult to recognize initially”

Activity

- Try to remember the dates of your grandparents' birthday
- Try to remember the cover of the last two DVDs you bought or rented
- Which was easiest? Why?
- People are very good at remembering visual cues about things
 - e.g. the color of items, the location of objects and marks on an object
- They find it more difficult to learn and remember arbitrary material
 - e.g. birthdays and phone numbers

Recognition versus recall

- Command-based interfaces require users to recall from memory a name from a possible set of 100s
- GUIs provide visually-based options that users need only browse through until they recognize one
- Web browsers, MP3 players, etc., provide lists of visited URLs, song titles etc., that support recognition memory

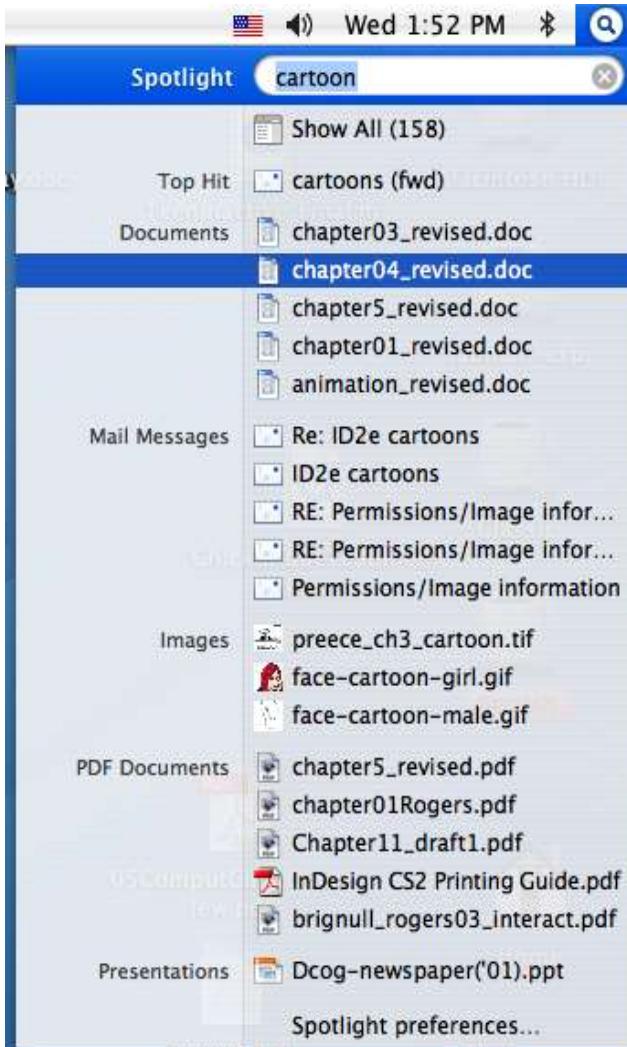
Personal information management

- Personal information management is a growing problem for many users
 - vast numbers of documents, images, music files, video clips, emails, attachments, bookmarks, etc.,
 - where and how to save them all, then remembering what they were called and where to find them again
 - naming most common means of encoding them
 - but can be difficult to remember, especially when have 1000s and 1000s
 - How might such a process be facilitated taking into account people's memory abilities?

Personal information management

- Memory involves 2 processes
 - recall-directed and recognition-based scanning
- File management systems should be designed to optimize both kinds of memory processes
 - e.g. Search box and history list
- Help users encode files in richer ways
 - Provide them with ways of saving files using colour, flagging, image, flexible text, time stamping, etc

Is Apple's Spotlight search tool any good?



Memory aids

- SenseCam developed by Microsoft Research Labs
- a wearable device that intermittently takes photos without any user intervention while worn
- digital images taken are stored and revisited using special software
- Has been found to improve people's memory, suffering from Alzheimers

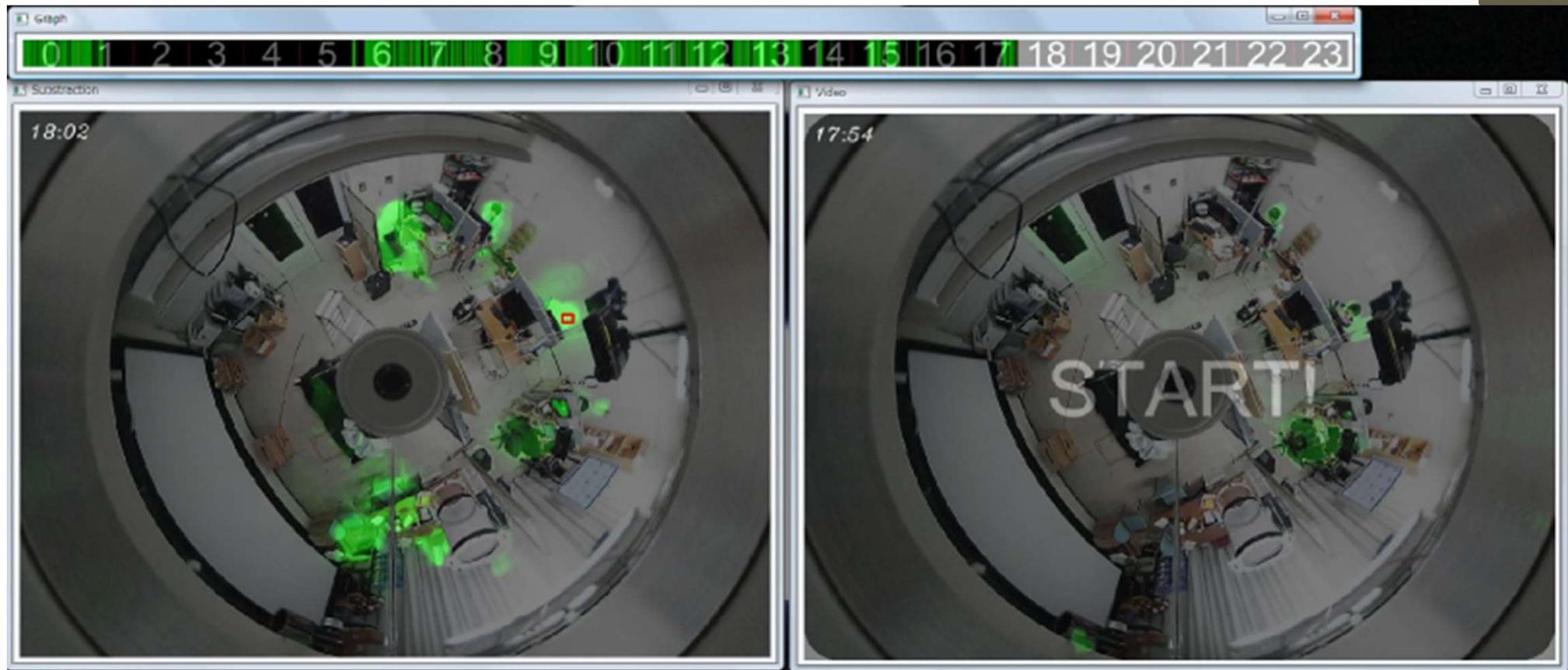
Sense Cam (Stop)



Design implications

- Don't overload users' memories with complicated procedures for carrying out tasks
- Design interfaces that promote recognition rather than recall
- Provide users with various ways of encoding information to help them remember
 - e.g. categories, color, flagging, time stamping

24 hours lab visualization, Nogami Tsukuba, Japan



Cook's collage



Learning

- How to learn to use a computer-based application
- Using a computer-based application to understand a given topic . People find it hard to learn by following instructions in manual prefer to learn by doing.



Near Field Communication



Android manual

Design implications

- Speech-based menus and instructions should be short
- Accentuate the intonation of artificially generated speech voices
 - they are harder to understand than human voices
- Provide opportunities for making text large on a screen

Reading, speaking, and listening

- The ease with which people can read, listen, or speak differs
 - Many prefer listening to reading
 - Reading can be quicker than speaking or listening
 - Listening requires less cognitive effort than reading or speaking
 - Dyslexics have difficulties understanding and recognizing written words

Applications

- Speech-recognition systems allow users to interact with them by using spoken commands
 - e.g. Google Voice Search app
- Speech-output systems use artificially generated speech
- e.g. written-text-to-speech systems for the blind
- Natural-language systems enable users to type in questions and give text-based responses
 - e.g. Ask search engine

Design implications

- Design interfaces that encourage exploration
- Design interfaces that constrain and guide learners
- Dynamically linking concepts and representations can facilitate the learning of complex material

Problem-solving, planning, reasoning and decision-making

- All involves reflective cognition
 - e.g. thinking about what to do, what the options are, and the consequences
- Often involves conscious processes, discussion with others (or oneself), and the use of artifacts
 - e.g. maps, books, pen and paper
- May involve working through different scenarios and deciding which is best option

Design implications

- Provide additional information/functions for users who wish to understand more about how to carry out an activity more effectively
- Use simple computational aids to support rapid decision-making and planning for users on the move



Mentality

Mental models

- Users develop an understanding of a system through learning about and using it
- Knowledge is sometimes described as a mental model:
 - How to use the system (what to do next)
 - What to do with unfamiliar systems or unexpected situations (how the system works)
- People make inferences using mental models of how to carry out tasks

Mental models

- Craik (1943) described mental models as:
 - internal constructions of some aspect of the external world enabling predictions to be made
- Involves unconscious and conscious processes
 - images and analogies are activated
- Deep versus shallow models
 - e.g. how to drive a car and how it works

Everyday reasoning and mental models

- (a) You arrive home on a cold winter's night to a cold house. How do you get the house to warm up as quickly as possible? Set the thermostat to be at its highest or to the desired temperature?

- (b) You arrive home starving hungry. You look in the fridge and find all that is left is an uncooked pizza. You have an electric oven. Do you warm it up to 375 degrees first and then put it in (as specified by the instructions) or turn the oven up higher to try to warm it up quicker?

Heating up a room or oven that is thermostat-controlled

- Many people have erroneous mental models (Kempton, 1996)
- Why?
 - General valve theory, where '**more is more**' principle is generalised to different settings (e.g. gas pedal, gas cooker, tap, radio volume)
 - Thermostats based on model of on-off switch model

Heating up a room or oven that is thermostat-controlled

- Same is often true for understanding how interactive devices and computers work:
 - poor, often incomplete, easily confusable, based on inappropriate analogies and superstition (Norman, 1983)
 - e.g. elevators and pedestrian crossings - lot of people hit the button at least twice
 - Why? Think it will make the lights change faster or ensure the elevator arrives!



Exercise: ATMs

- Write down how an ATM works
 - How much money are you allowed to take out?
 - What denominations?
 - If you went to another machine and tried the same what would happen?
 - What information is on the strip on your card? How is this used?
 - What happens if you enter the wrong number?
 - Why are there pauses between the steps of a transaction? What happens if you try to type during them?
 - Why does the card stay inside the machine?
 - Do you count the money? Why?

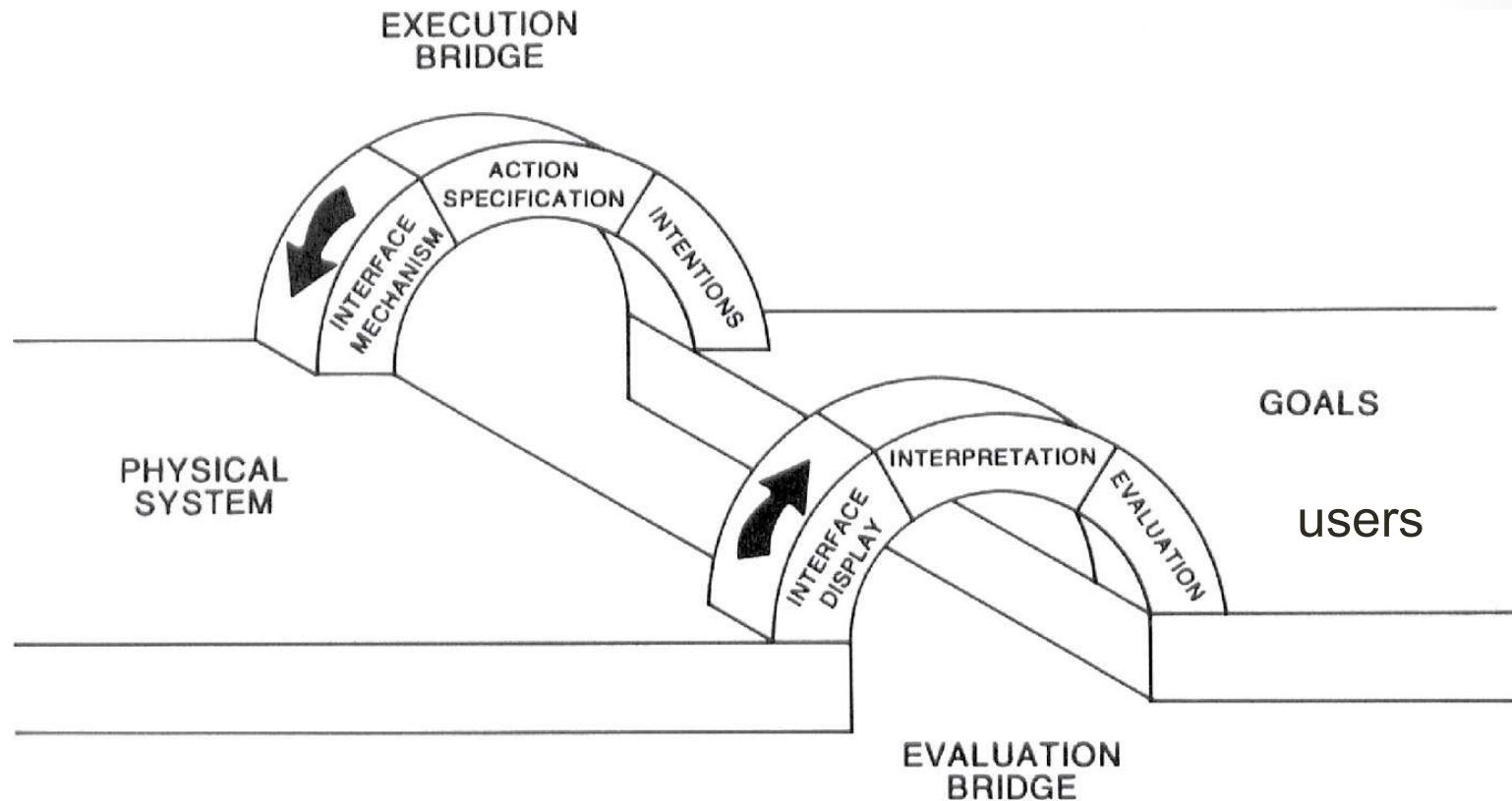
How did you fare?

- Your mental model
 - How accurate?
 - How similar?
 - How shallow?
- Payne (1991) did a similar study and found that people frequently resort to analogies to explain how they work
- People's accounts greatly varied and were often ad hoc

Gulfs of execution and evaluation

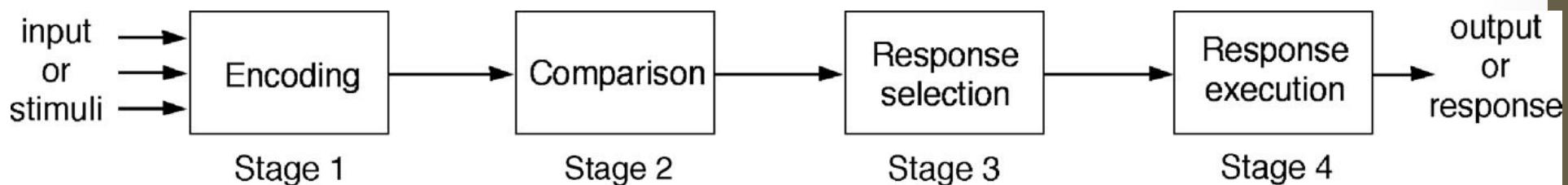
- The ‘gulfs’ explicate the gaps that exist between the user and the interface
- The gulf of execution
 - the distance from the user to the physical system
- The gulf of evaluation
 - the distance from the physical system to the user
- Bridging the gulfs can reduce cognitive effort required to perform tasks

Bridging the gulfs (Stop)



Information processing

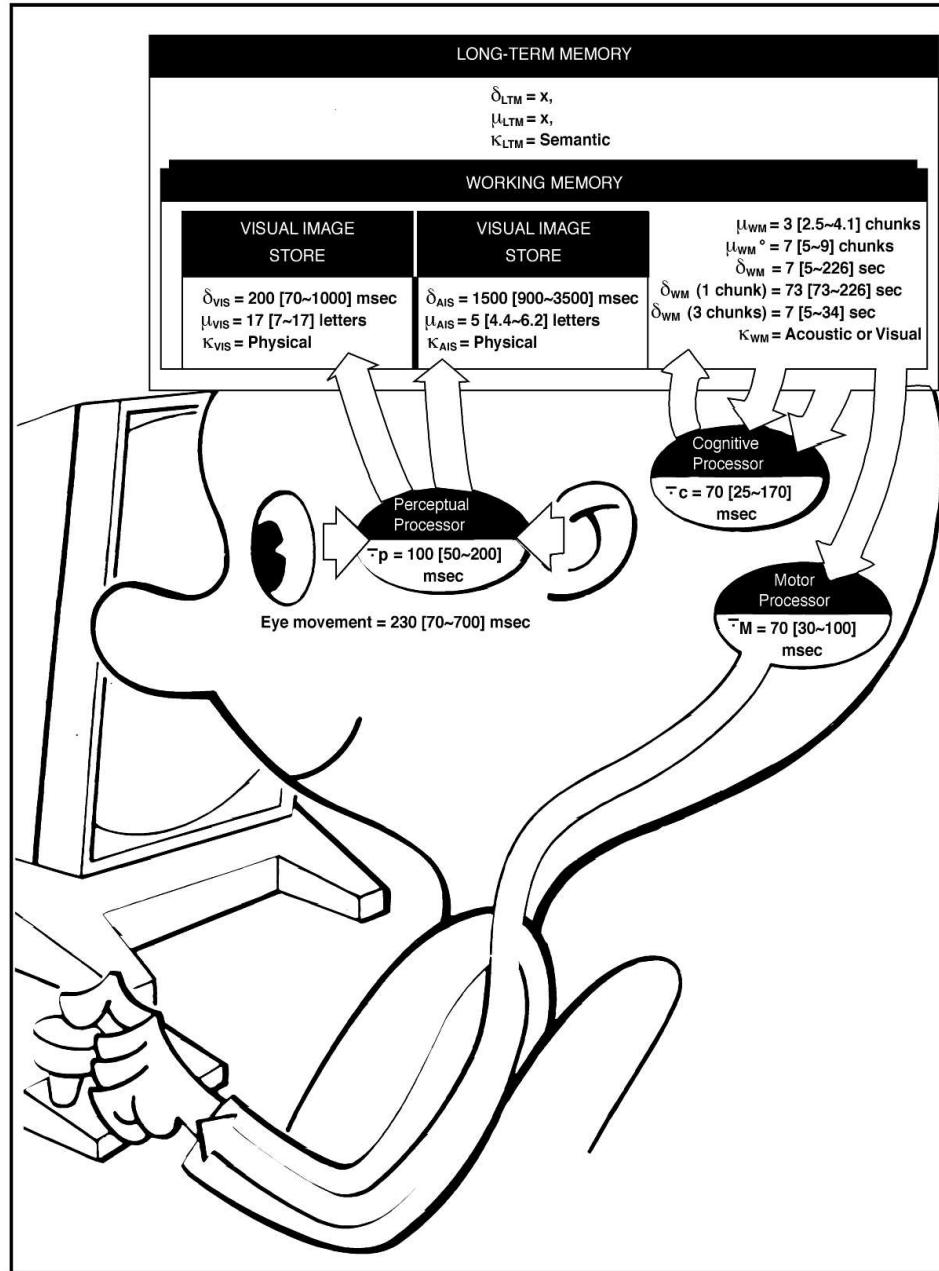
- Conceptualizes human performance in metaphorical terms of information processing stages



Model Human processor (Card et al, 1983)

- Models the information processes of a user interacting with a computer
- Predicts which cognitive processes are involved when a user interacts with a computer
- Enables calculations to be made of how long a user will take to carry out a task

The human processor model



Limitations

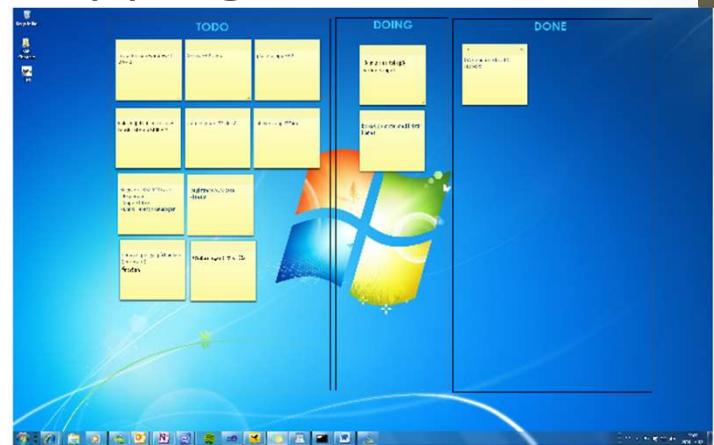
- based on modeling mental activities that happen exclusively inside the head
- do not adequately account for how people interact with computers and other devices in real world

External cognition

- Concerned with explaining how we interact with external representations (e.g. maps, notes, diagrams)
- What are the cognitive benefits and what processes involved
- How they extend our cognition
- What computer-based representations can we develop to help even more?

Externalizing to reduce memory load

- Diaries, reminders, calendars, notes, shopping lists, to-do lists
 - written to remind us of what to do
- Post-its, piles, marked emails
 - where placed indicates priority of what to do
- External representations:
 - Remind us that we need to do something (e.g. to buy something for mother's day)
 - Remind us of what to do (e.g. buy a card)
 - Remind us when to do something (e.g. send a card by a certain date)



Computational offloading

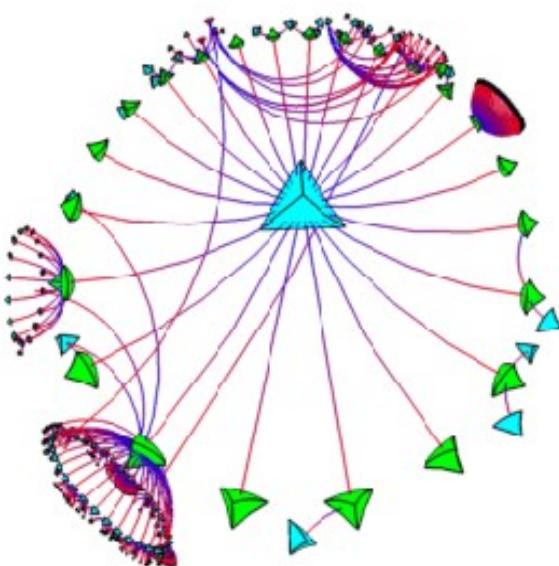
- When a tool is used in conjunction with an external representation to carry out a computation (e.g. pen and paper)
- Try doing the two sums below (a) in your head, (b) on a piece of paper and c) with a calculator.
 - $234 \times 456 = ??$
 - $\text{CCXXXI} \text{III} \times \text{CCCC} \text{XXXXVI} = ???$
- Which is easiest and why? Both are identical sums

Annotation and cognitive tracing

- Annotation involves modifying existing representations through making marks
 - e.g. crossing off, ticking, underlining
- Cognitive tracing involves externally manipulating items into different orders or structures
 - e.g. playing Scrabble, playing cards

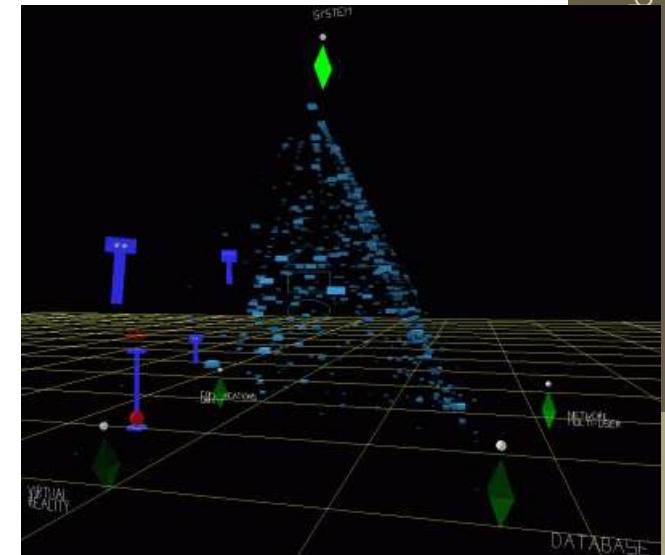
Design implication

- Provide external representations at the interface that reduce memory load and facilitate computational offloading



e.g. Information visualizations have been designed to allow people to make sense and rapid decisions about masses of data

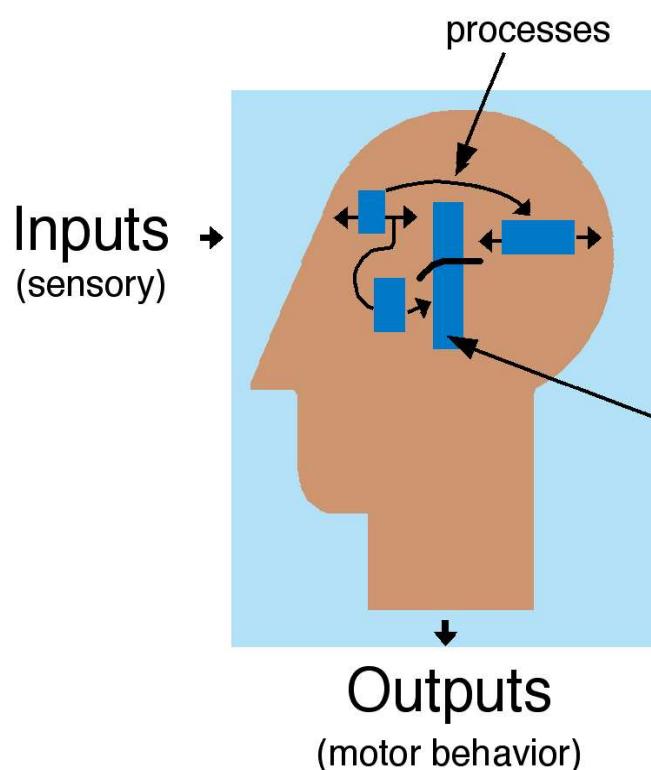
<https://gephi.github.io/features/>



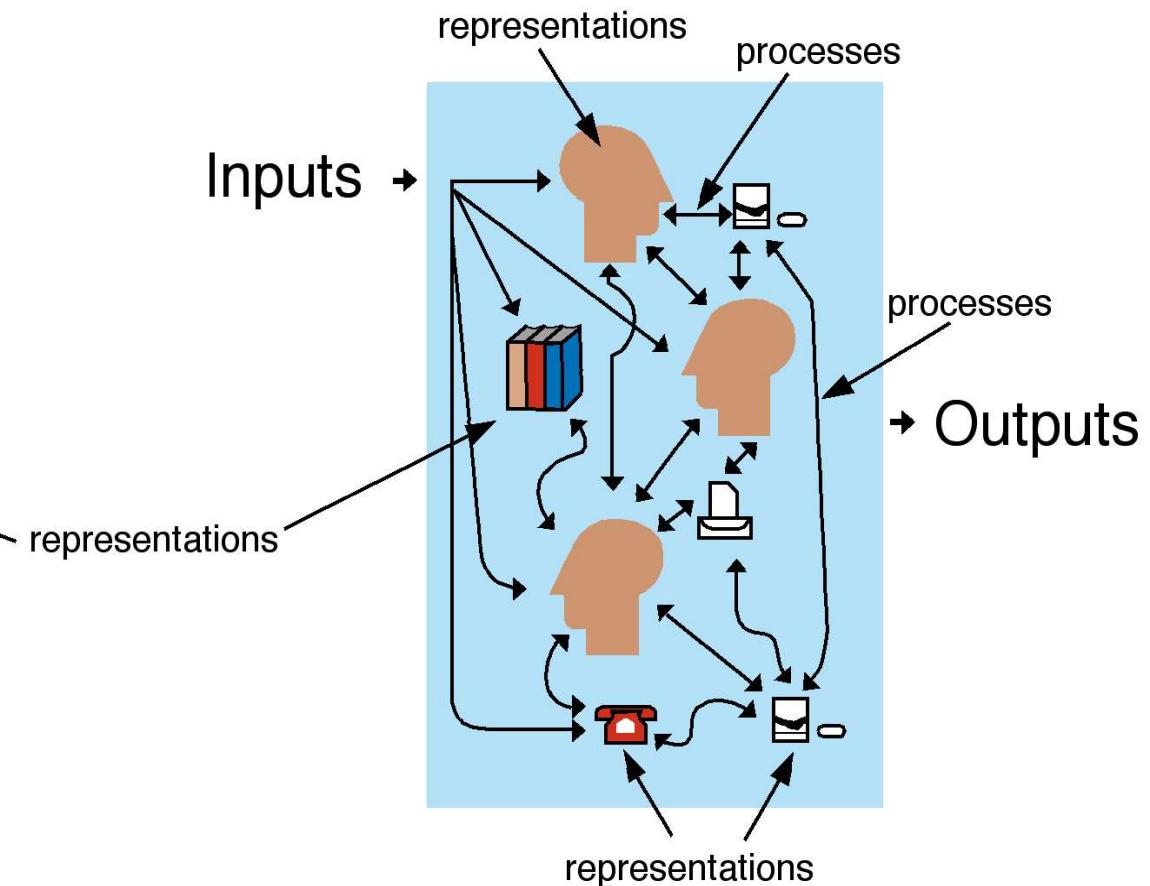
Distributed cognition

- Concerned with the nature of cognitive phenomena across individuals, artifacts, and internal and external representations (Hutchins, 1995)
- Describes these in terms of propagation across representational state
- Information is transformed through different media (computers, displays, paper, heads)

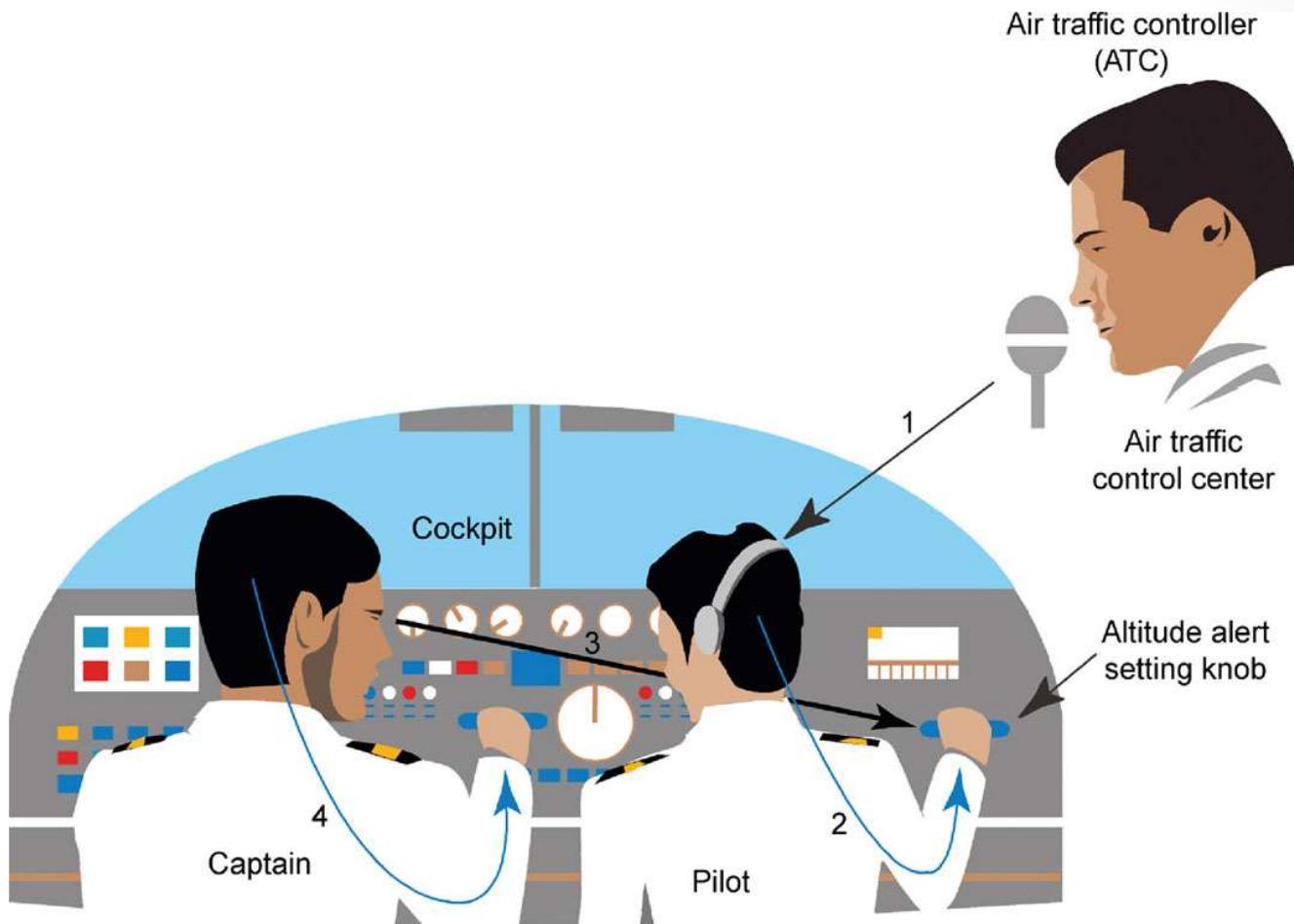
How it differs from information processing



1. Traditional model



2. Distributed model



Propagation of representational states:

- 1 ATC gives clearance to pilot to fly to higher altitude (verbal)
- 2 Pilot changes altitude meter (mental and physical)
- 3 Captain observes pilot (visual)
- 4 Captain flies to higher altitude (mental and physical)

Principles of Good Design

- Principle 1: Recognize the Diversity
- Principle 2: Use Golden Rules of HCI Design
- Principle 3: Prevent Errors
- Principle 4: Follow the Guidelines for Data Display
- Principle 5: Follow the Guidelines for Data Entry
- Principle 6: Balance the Automated and Human Control

Principles of Good Design



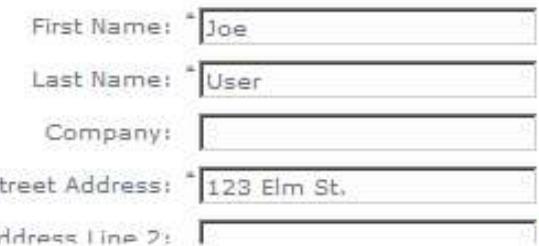
Principle 1: Recognize the Diversity

(diversity of users, tasks, and interaction styles)



- Direct manipulation (in GUI or VR)
- Form Fill-in
- Command language
- Natural language

Interaction Styles

	Advantages	Disadvantages
	Direct manipulation Visually presents task concepts Allows easy learning Allows easy retention Allows errors to be avoided Encourages exploration Affords high subjective satisfaction	May be hard to program May require graphics display and pointing devices
	Menu selection Shortens learning Reduces keystrokes Structures decision making Permits use of dialog-management tools Allows easy support of error handling	Presents danger of many menus May slow frequent users Consumes screen space Requires rapid display rate
	Form fillin Simplifies data entry Requires modest training Gives convenient assistance Permits use of form-management tools	Consumes screen space
	Command language Appeals to "power" users Supports user initiative Allows convenient creation of user-defined macros	Has poor error handling Requires substantial training and memorization
	Natural language Relieves burden of learning syntax	Is unpredictable

Principles of Good Design



Principle 2: Use Golden Rules of HCI Design

1. **Consistency** (terms, icons, data / command flow)
2. **Universal Usability** (novices → intermittent users → experts)
3. **Informative feedback**
4. **Dialogs with closure** (beginning → end)
5. **Prevent errors** (highlight required actions, selection rather than freestyle typing, automatic completion, well-defined messages)
6. **Reversal of actions** (undo)
7. **User in control** (automated adaptability can cause confusion)
8. **Reduce short term memory** (keep displays simple)

Principles of Good Design



Principle 3: Prevent Errors

- highlight required actions
- selection rather than freestyle typing
- automatic completion
- well-defined, polite messages

Billing & Shipping Shipping Options

Please correct the errors indicated in red below:

billing information [\[int'l customers\]](#)

* required fields

Please enter your billing address (where credit card statements are sent) below.

! Select a state.

First Name: *

Last Name: *

Company:

Street Address: *

Address Line 2:

City: *

State: *

Country: United States [\[int'l customers\]](#)

Zip Code: *

Phone: *

Principles of Good Design



Principle 4: Follow the Guidelines for Data Display

- Consistency
 - (terms, colors, abbreviations)
- Efficient information assimilation by the user
 - (data outlining, lining up of decimal points, spacing)
- Minimal Memory Load on the user
 - (no need to remember information from screen to screen)
- Provision of user control of data display
 - (font size, contrast, volume, views)
- Appropriate and not overly usage of techniques for getting user attention

Principles of Good Design



Principle 4: Follow the Guidelines for Data Display

- Appropriate and not overly usage of techniques for getting user attention
 - Intensity
 - Marking
 - Size
 - Fonts
 - Blinking
 - Colour
 - Audio

Hello!

Principles of Good Design

➡ Principle 5: Follow the Guidelines for Data Entry

- Consistency (similar style for similar data)
- Minimal input actions
 - (selection rather than freestyle typing)
 - (automatic completion)
- Minimal memory load
- Provision of user control of data entry
 - (e.g., experts may prefer command language)

SEARCH & FILTERS CHARTING

Please correct the errors indicated in red below:

billing information [\[int'l customer\]](#)

* required fields

Please enter your billing address (where credit card statements are sent) below.

! Select a state.

First Name: *

Last Name: *

Company:

Street Address: *

Address Line 2:

City: *

State: *

Country: United States [\[int'l customers\]](#)

Zip Code: *

Phone:

Principles of Good Design

→ Principle 6: Balance the Automated and Human Control

Humans Generally Better

Sense low-intensity stimuli
Detect stimuli in noisy environment
Excellent pattern recognition abilities
Abstract reasoning

- remember principles
- draw on experience
- generalise from observations
- can act in novel situations
- develop new solutions

Sensitivity to details
Subjective evaluation
Adapt

Machines Generally Better

Sense stimuli humans cannot sense
Count and measure physical quantities
Store large amounts of data accurately
Monitor pre-specified events
Consistent
Rapid
Recall information accurately
Deductive reasoning – infer from general principle
Simultaneous processing
Tireless

successful designs ⇔ purposeful (instead of ‘Turing-test’) systems

Thanks

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