Principles of GUI Design and Programming

Cognitive Aspects in User Interface Design

Contents

- Attention

- Perception

- Memory

- External cognition

Attention

- To perceive information,
  - we isolate it from the surroundings and focus our attention on it
- Changing the focus of our attention
  - takes time and should be avoided if possible
- We can only focus on so much at once

Attention

- This lets us focus on some details but we might lose the big picture while focused on details
- We can use multiple senses (visual and auditory) to convey more information

Limits of Attention

▸ Cognitive capacity

   ▸ We receive about 11 million bits of data per second but can only process 50 bits per second

   ▸ Clearly, we have to discard most of the input and focus on a small portion of it

▸ Multitasking

   ▸ Humans multitask poorly

   ▸ They work far better when performing one task at a time

Limits of Attention

▸ **The eye has a small central portion that is more sensitive**

  ▸ It is called the fovea

  ▸ We use it to focus in on an area of interest

  ▸ The periphery is not sufficient to see detail

  ▸ This limits what e can focus on

▸ **We are very sensitive to motion anywhere in our field of view**
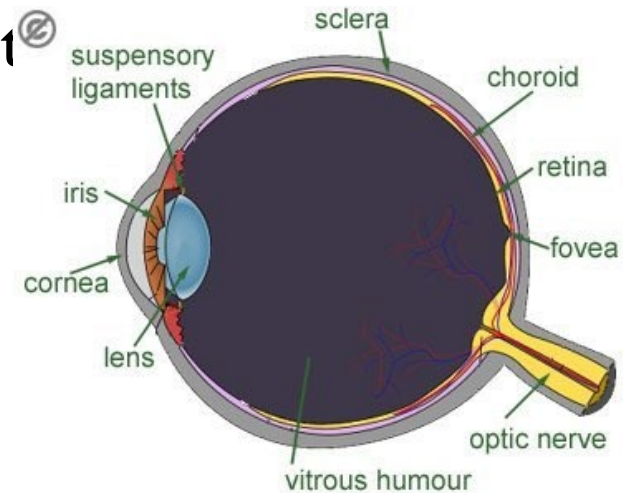
Inattentional Blindness

▶ We can focus on a task very effectively

▶ This focus can cause us to miss of things which are happening in our field of vision

▶ https://youtu.be/z-Dg-06nrnc

Aiding Attention

- Make different areas visually distinct
  - Use spaces to separate information
  - Use boxes around areas or colours to set information apart
  - Use different fonts for different information
  - Use sound or flashing lights to create boundaries around information

Find the Price of a Room in Belleville

Holiday Inn: Toronto(dtwn) 416-555-8371 s:189 d:240

Comfort Inn: Trenton 613-555-9928 s: 130 d:150

Motel 6: Trenton 613-555-8746 s:125 d:140

Motel 6: Cobourg 613-555-2274 s:119 d:134

Comfort Inn: Belleville 613-555-7382 s:134 d:145

Comfort Inn: Brampton 905-555-3735 s:139 d:149

Motel 6: Brampton 905-555-8468 s:129 d:154

Red Roof Inn: Etobicoke 416-555-5873 s:139 d:164

Motel 6: Oakville 905-555-7749 s:139 d:159

Comfort Inn: Ottawa 613-555-6428 s: 139 d:159

Motel 6: Hamilton 905-555-2473 s:119 d:134

Holiday Inn: Ottawa 613-555-8941 s:199 d:245

Find the Price of a Room in Etobicoke

City	Motel/Hotel	Area Code	Phone	Single	Double
Belleville	Comfort Inn	613	555-7382	134	145
Brampton	Comfort Inn	905	555-3735	139	149
Brampton	Motel 6	905	555-8468	129	154
Cobourg	Motel 6	613	555-2274	119	134
Etobicoke	Red Roof Inn	905	555-5873	139	164
Hamilton	Motel 6	905	555-2473	119	134
Oakville	Motel 6	905	555-7749	139	159
Ottawa	Comfort Inn	613	555-6428	139	159
Ottawa	Holiday Inn	613	555-8941	199	245
Trenton	Comfort Inn	613	555-9928	130	150
Trenton	Motel 6	613	555-8746	125	140
Toronto	Holiday Inn (dtwn)	416	555-8371	189	240

Using Contrast to Manage Focus

- You can use font sizes and bold to focus attention on to important parts of the document
- You can use grey for parts of the text which are less important

Using Contrast to Manage Focus

One Major Topic

By John Q. Public

This is an important message to our leaders about the state of our nation that needs urgent attention

Another Big Topic

By Suzie Queue

I just wanted to reiterate the importance of the point above

Using Colours to Manage Focus

- Colours can be used to draw attention
  - Items in red are frequently of high importance
- Warmer tones tend to attract the eye
  - Red, yellow, orange
- These expand when placed on a cooler background (blue, green)
- Similarly, cooler colours contract on a warmer background

Using Colours to Manage Focus

- "We're Hiring" stands out due to colour

Whitespace for Focus

‣ Whitespace can be used to effectively separate parts of the interface

‣ Putting text closer together indicates related items

‣ Leaving space between items provides a clear separation between them

Whitespace for Focus

Equally Spaced

WhiteSpace

Whitespace can be used to visually separate parts of a document.

Unequal Spacing

By using unequal spacing between elements we can further emphasize the difference between them.

The Result

Is easier to read as we can pick out the areas more easily.

Spaced for Focus

WhiteSpace

Whitespace can be used to visually separate parts of a document.

Unequal Spacing

By using unequal spacing between elements we can further emphasize the difference between them.

The Result

Is easier to read as we can pick out the areas more easily.

Fonts for Focus

▸ Sans serif fonts are usually used for headlines as the are easier to read.

▸ Serif fonts are used for text as the serifs make it easier for the eye to follow each line.

▸ You might want to use sans serif fonts for text on low resolution displays

a b c d e f t
Calabri (sans)

a b c d e f t
Garamond

a b c d e f t
Times Roman

Fonts for Focus

- On the web, you might have limited fonts that can be used in all browsers

- One way to emphasize titles is to increase the spacing between letters

- This can be specified with the letter spacing property in css

- h2 { font-family: Helvetica; font-size: 27px; letter-spacing: -1px; }

Design Implications

- Make information available when it is needed
- Use animations, colour or whitespace to direct the user towards the information
- Avoid displaying too much information at one and the over use of irrelevant graphics
- Create fill-in forms that are simple and easy to use

Bad design

Bad design

Perception

- Perception is how information is gathered from the interface and transformed into understanding
- Obviously
    - Text should be easy to read
    - Icons should be big enough to see

Gestalt Laws

- This is a series of laws that show how to group things so that it draws attention to them and makes it easier to perceive them.

Law of Similarity

▸ When objects are similar

  ▸ Colour, size, shape

  ▸ We perceive them as related to one another

▸ We can use this to use similarities to group items which we want the user to perceive as being related.

Since triangles are used throughout the image, we perceive the triangles are related.

Law of Continuation

- The eye naturally follows lines from one part of an image to another
- We can use this to control
  - The order the user perceives things
 - To join one part of an interface to another

Law of Closure

▸ The eye tends to complete common shapes, even if there are gaps in the shapes

▸ We might not need to use complete figure or high resolution since the eye will fill in the gaps

Law of Proximity

▸ Things which are closer together are perceived to be part of the same thing

▸ We can use this to group related items closer to one another
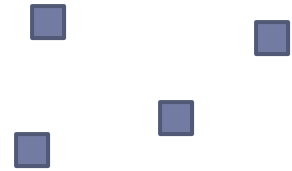
Separate things
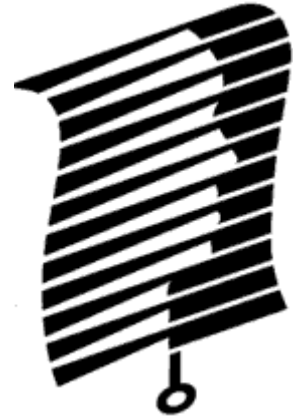
Parts of one thing

Law of Figure and Ground

▸ The eye perceives an object (figure) against a background (ground)

▸ We can change the relationship between these to influence what is perceived
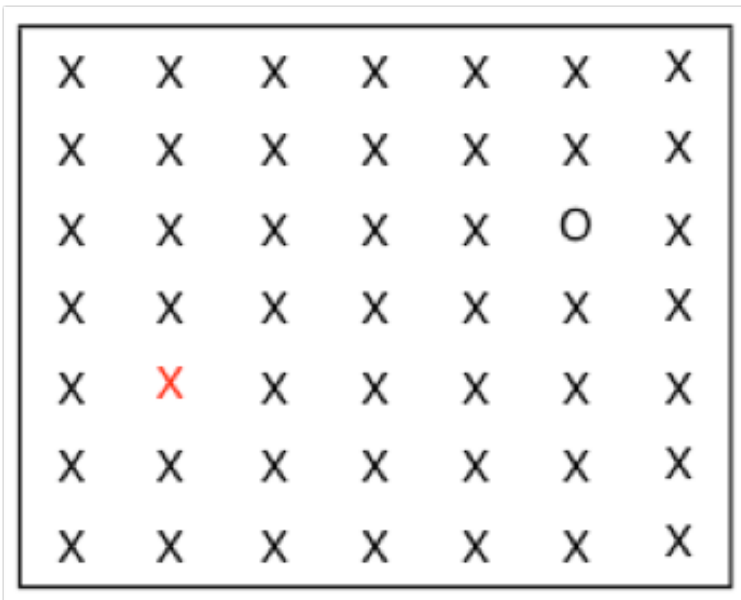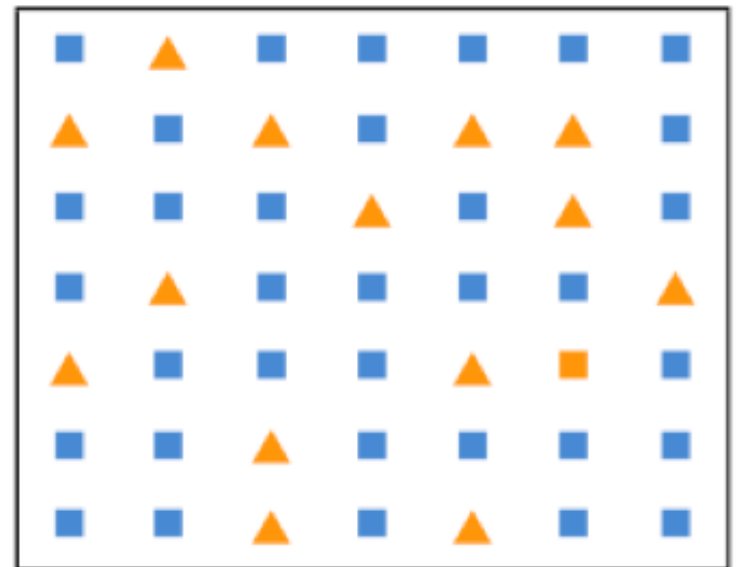
Is the figure a face or a shade?

Visual search

- Which is easier to find?
- It is easier to find one unique thing than one of several similar things

A red X

An orange square

Fitt's Law

▸ It is easier to hit a larger target closer to you than a smaller target further away

- ▸ Place related controls close to each other
- ▸ Make them large enough to click easily

Click Me!

Contrast

Text is easy to read when there is good contrast between foreground and Background.

If the contrast is too low, the text can become difficult to read.

Sometimes complementary colors can be annoying and create visual effects.

Colour blindness can make This difficult to read.

Colour Blindness

- Reduced red sensitivity
  - Have trouble distinguishing reds, greens, browns, oranges
  - Have trouble distinguishing blue from purple
- Reduced green sensitivity
  - Similar to reduced red and makes the most common form known as red-green colour blindness
- Reduced blue sensitivity
  - This is very rare
- Avoid colours that are difficult for red-green blindness

Memory

▶ Humans have two types of memory

  ▶ Long term

    ▶ Huge capacity but it takes a long time to add new memories

  ▶ Short term

    ▶ Can have new items added quickly

    ▶ Limited to 7 (±2) items

▶ We have to design interfaces that reduce the load on the user's short term memory

Memory Processing

‣ Encoding is the first stage of memory processing

  ‣ This extracts information from the environment and determines what is important

‣ You are likely to remember something if

  ‣ The more attention you pay to it

  ‣ The more time you spend thinking about it

  ‣ The more often you see it

Context

- Sometimes, people remember something in one context but not in another

- You might see a person you met elsewhere and not recognize them

- You might have to use things in the same context to have them remembered

Memory Strengths

▸ People are good at remembering

  ▸ The colour of objects

  ▸ The location of objects

  ▸ Marks on an object

▸ They are not good at remembering arbitrary information like serial numbers

Recognition versus Recall

▸ Command lines require you to remember a large number of commands and options

▸ GUIs present you with lists of commands you can recognize and select

▸ You do not need to limit lists or buttons to 7 since they are being recognized, not recalled

Support User Memory

- Use a history list to show the user where they have navigated

- Chunk information to reduce the number of items to be remembered

  - 5, 8, 3, 6 are four items while 5836 is just one item

- Provide visual feedback to show what the mode of the interface is

Support User Memory

- Use recognition rather than recall whenever possible

- Do not move things in the interface since people remember where they are positioned

- Provide simple steps to accomplish tasks rather than a complex set of steps

External Cognition

- We interact with many external representations of information
  - Maps
  - Spreadhseets
  - books
  - Web pages
  - Notes
  - diagrams

External Cognition

- Internally, we have a different representation of the same information

- Using an external representation

  - Can reduce the load on our memories

  - Give us a representation of more than our memories can hold

  - Give us an external representation of what we are thinking about

External Cognition

> We can use external cognition to help us remember things which are difficult to remember

> - Birthdays
> - Appointments
> - Serial numbers
> - Lists

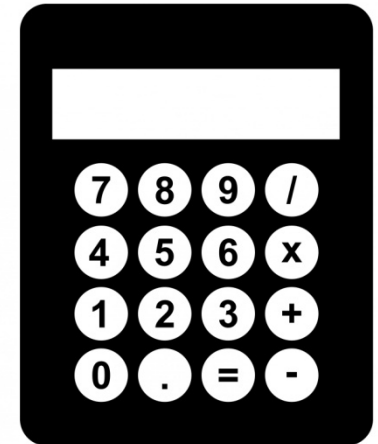> Many smartphone apps have been built to help with these tasks

December 2015 calendar

>

Computational Offloading

▸ Humans are not good at doing arithmetic

▸ This can be offloaded by

  ▸ Using a pen and paper

  ▸ Calculator apps

  ▸ Forms that do automatic calculations

Annotating and Cognitive Tracing

‣ We can annotate an external representation
   ‣ To show when we have finished something
   ‣ To mark something which is important
   ‣ This reduces the load on our memory
‣ Cognitive tracing lets you record what you have been doing
   ‣ Tracking the web pages you have visited
   ‣ Recording the steps in a long transaction
   ‣ Saving the steps in a long calculation

‣