Comp 341/441 - HCI

Spring Semester 2019 - Week 2

Dr Nick Hayward

Combinations in the brain

- our brain works on the principle of subtraction
- visual cortex at the back of our brain does the work
  - *neurons subtract signals coming along the optic nerves from S and M-cones*
  - *produces red-green difference signal channel*
  - *neurons subtract signals from L and S-cones*
  - *produces yellow-blue difference signal channel*
  - *third set of neurons as the signals from S and M-cones*
  - *produces an overall black-white, or luminance, channel*
- three channels known as *colour-opponent* channels

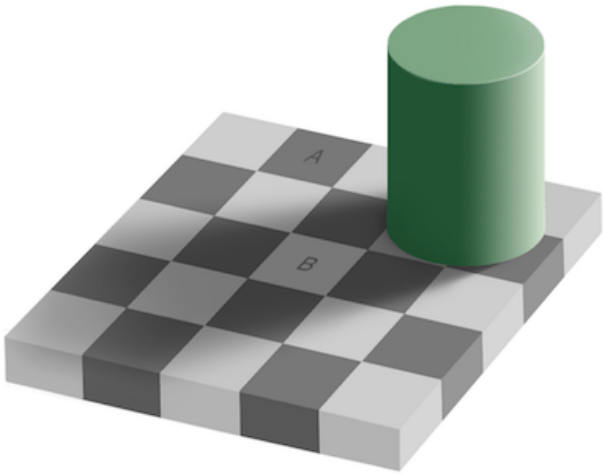
Vision & Contrast - 1

Sensitivity

- our vision is now much more sensitive to differences in colour and brightness
  - *greater sensitivity to contrasting colours and edges*
  - *less sensitivity to absolute brightness levels*
- greater sensitivity to contrast is an advantage
  - *more easily discern objects in varied light*
- sensitivity to colour contrasts rather than absolute colours
  - *allows us to discern colour of an object in bright light or shade*

Image - Vision & Contrast - 2

Optical Illusions

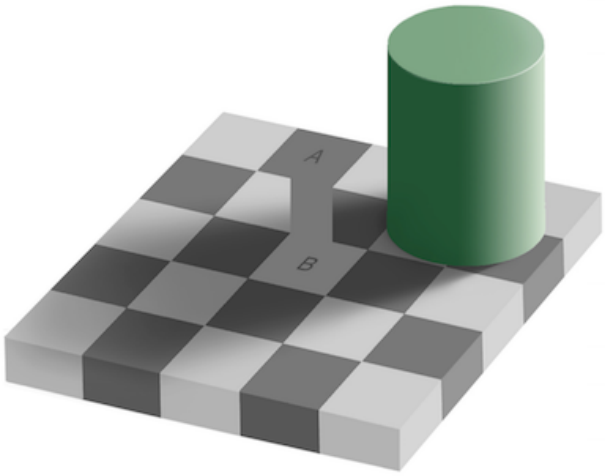


Grey Square Illusion

Grey square optical illusion - Edward H. Adelson (source: Wikipedia)

Image - Vision & Contrast - 3

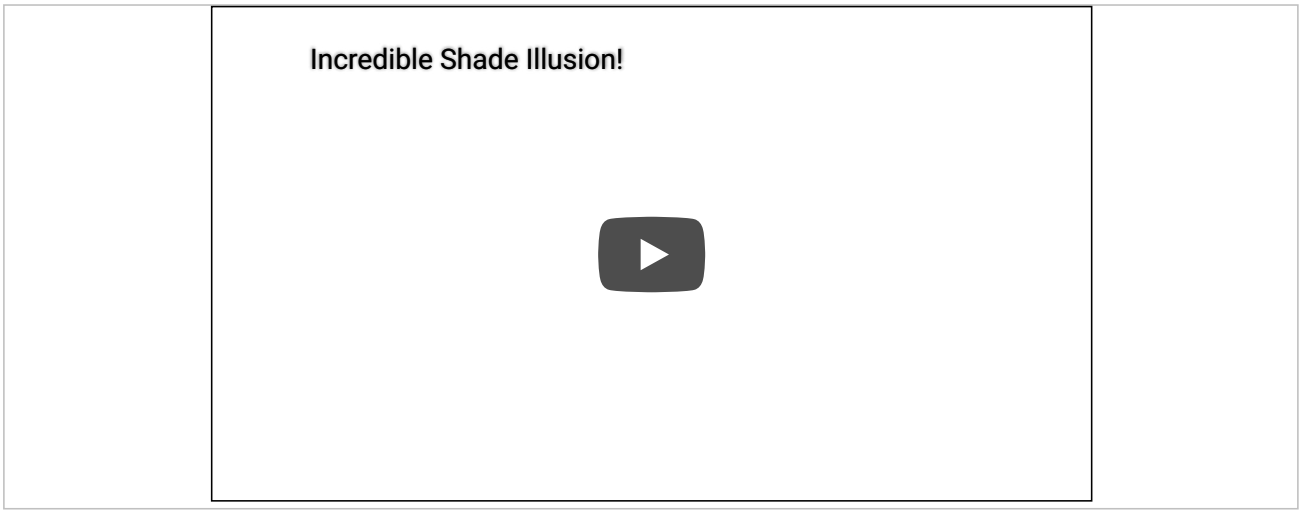
Optical Illusions



Grey Square Illusion

Grey square optical illusion - Edward H. Adelson (source: Wikipedia)

Video - Vision & Contrast - 4



Grey Square Optical Illusion - Source: YouTube

Vision & Contrast - 5

Shade and Shadow

- on the 2D plane
  - *we often struggle to understand why the two colours are the same*
- importance and effect of shade
  - *its effect on the brain's perception of colour*
- our brain is compensating
  - *for the shadow &*
  - *adjusting the colour of square B*
- our eyes see the squares as the same grey colour
- our brain adapts perception
  - *to match what we think is actually the real representation*
  - *i.e. real representation of colours and square B*

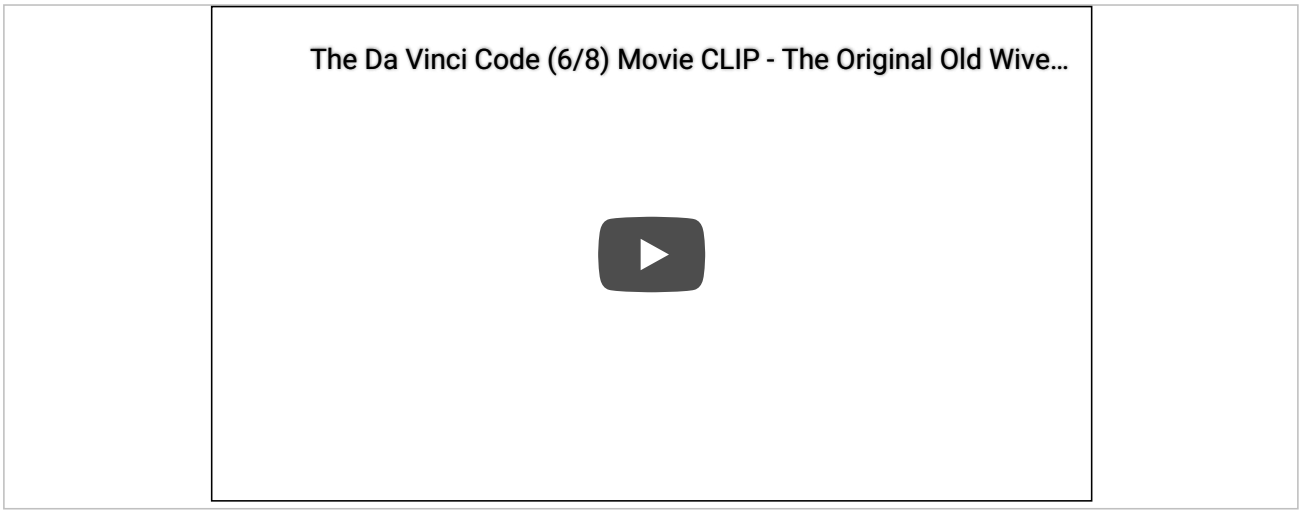
Image - Vision & Contrast - 6

Chiaroscuro

Supper at Emmaus, Caravaggio

Supper at Emmaus, Caravaggio. Further details

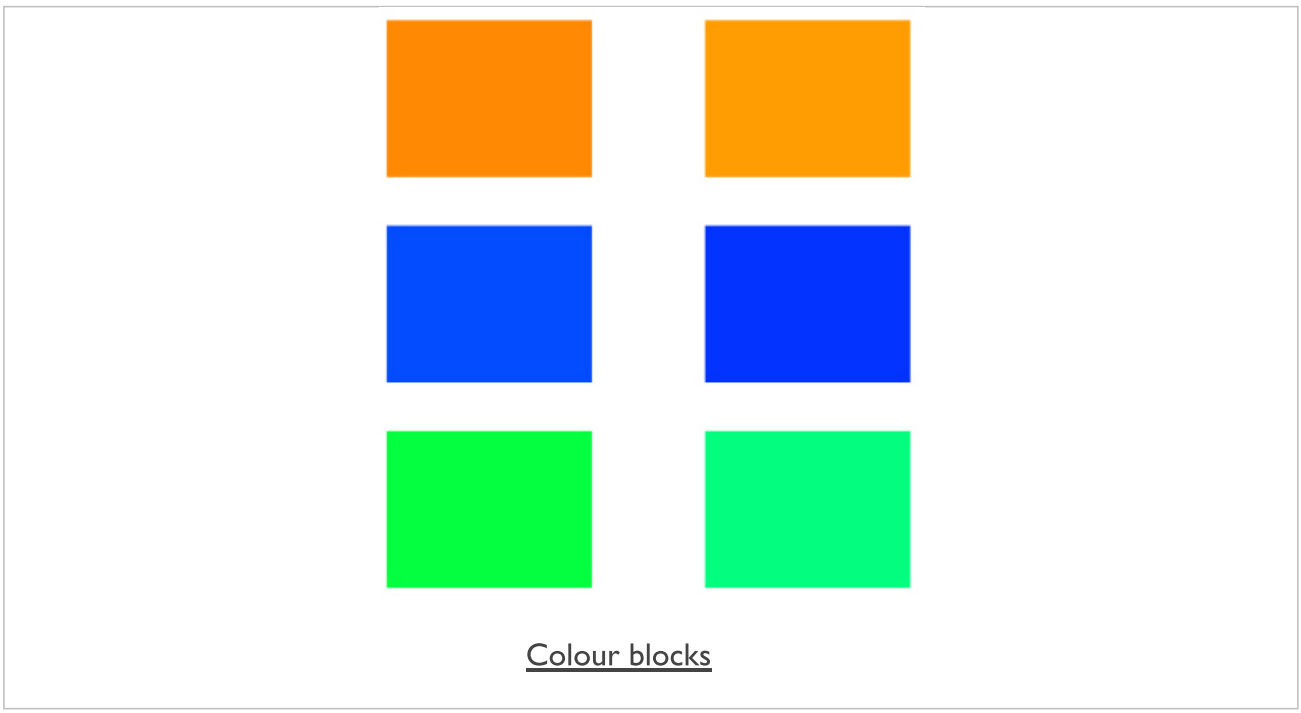
Video - Vision & Contrast - 7



Scotoma - The Da Vinci Code - Source: YouTube

Image - Vision & Contrast - 8

Colour presentation



Colour blocks

Colour Presentation (source: National Geographic - Modified)

Vision & Contrast - 9

Presentation factors

- **colour patch size**
  - *harder to discern colour as objects get smaller or thinner*
  - *text is a good example of thin rendering*
  - *text colour is often hard to discern - e.g. black and navy...*
- **paleness**
  - *as colours become more pale, it's harder to differentiate similar tones*
- **separation**
  - *as colour blocks become more separated*
  - *harder to determine their colours*
  - *particularly true with eye motion from one colour block to another*

a few suggestions

A few things to avoid in images & graphics

- try to avoid overly pale colours
- avoid pale colours juxtaposed
- avoid pale colours for smaller blocks or zones
  - *often simply lost in the noise of larger zones and blocks*
- carefully consider chosen colours for charts, graphs, infographics...

Vision issues - I

colour blindness

- does not infer an inability to see colours
  - *a defect with one or more colour subtraction channel*
- makes it difficult to distinguish certain pairs of colours
- most common form of colour blindness is lack of red-green perception
- ~8% of men & ~0.5% of women suffer
  - *source: Wolfmaier, 1999*

Image - Vision issues - 2

human colour perception

Key

- left = normal human colour vision
- right = human Red-Green colour blindness

Colour Blindness

Colour Blindness - Red-Green (source: Ask a Mathematician / Ask a Physicist)

Video - Vision issues - 3

Colour blind

'No Such Thing as Color - what it's like to be color blind'
Source: YouTube

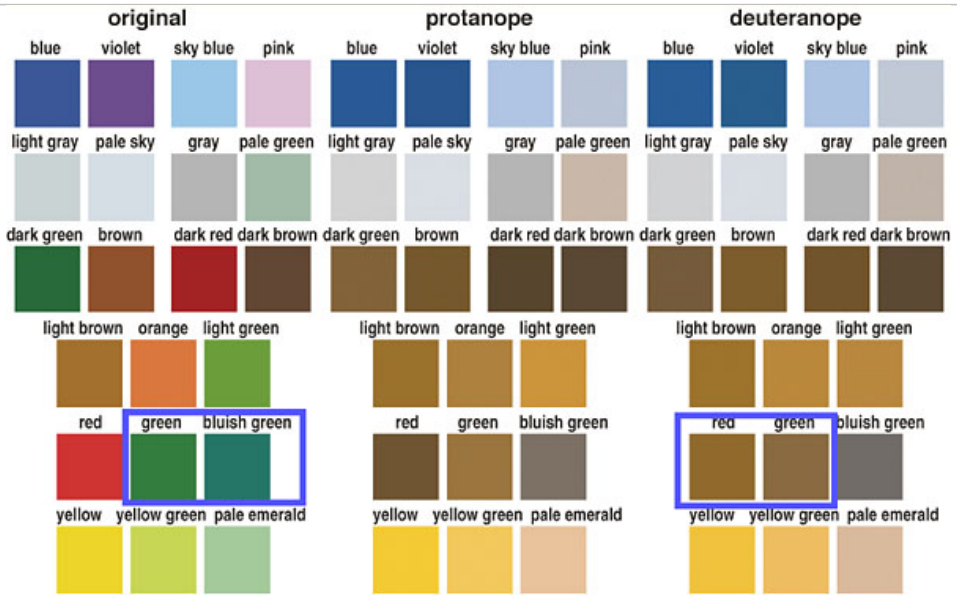
Vision issues - 4

colour differentiation & impact

- consider data visualisation
  - *we may use colour to differentiate quantity, scale, percentages...*
- for a person with red-green colour blindness
  - *impacts their ability to discern such data differentiation solely based upon colour*
- we may rectify this issue in at least two respects
  - *modify our colours to match those perceived by red-green colour blindness*
  - *offer supporting data and explanation for the visualisation*
- not always possible to create a full data visualisation for colour blindness
  - *e.g. one that easily differentiates such quantities and values*
  - *due to limited palette for red-green colour blindness*

Image - Vision issues - 5

colour differentiation



Colour Differention - Red/Green Blindness

Colour perception (source: Okabe, M & Ito, K. 2008)

other issues to consider...

Other issues to consider...

- ambient lighting has a direct impact upon a user's display
  - *washed out, distorted colours*
  - *light and dark areas may persist*
  - *mobile & wearable considerations*
- display viewing angle affects a user's interpretation of colour
  - *cheaper, non-IPS displays offer poor viewing angles and colour shifting*
- mono or greyscale displays directly influence design choices
- variation in colour across competing display technologies
  - *deeper blacks, richer colours, varied viewing angles*

The Bible with Sources Revealed - Source: Amazon

Colour suggestions

Colours - Red/Green Blindness

- subtle colour differences versus saturation, brightness, and hue
  - *test in monochrome to discern zones of coloured differences*
- distinctive colours aid a user's visual system in the combination of colours and visual recognition
  - *black, white, red, green, yellow, and blue*
- try to avoid colour pairs that colour blind people can't distinguish
  - *eg: dark red vs black, dark red vs dark green, blue vs purple, and light green vs white*
  - *try those colours against yellows and greens*
- try adding supporting recognition to colours within your interface
  - *eg: icons, keys, notes...*

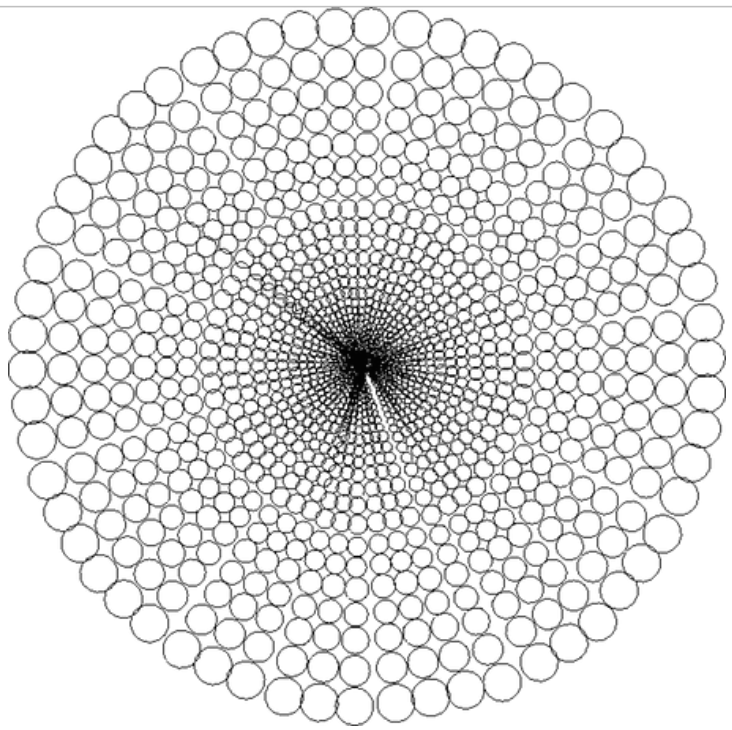
Peripheral vision

Peripheral vision - consider spatial resolution in human vision

- spatial resolution drops greatly from the centre to the periphery
- three known reasons for this phenomenon
  - *data compression*
    - information compressed, associated data loss from visual periphery
  - *pixel density*
    - eye has ~ 6-7 million cone cells in the retina
    - cones densely packed in centre of vision, known as **fovea**
  - *processing*
    - fovea is ~ 1% of the retina
    - brain's visual cortex uses ~ 50% of its area for input from the fovea
    - remaining area for other 99%
- vision has much greater resolution in the centre than elsewhere
  - *Waloszek, G. 2005*

Image - Vision & Resolution

foveal resolution



Foveal Image

Foveal Image (source: Illustrated Dictionary of Computer Vision)

is peripheral vision any use?

Is peripheral vision any use?

Three primary functions for peripheral vision:

- better vision in the dark
- detects motion
- guides the fovea, our centre of vision

Vision & Interfaces

application in user interfaces

- one of the primary issues is a user's focal point relative to other interface elements
- error messages are an example of this issue
  - *user's focal point at button or clicked link...*
  - *messages often missed if presented within peripheral vision relative to link...*
  - *messages need to be obvious relative to focal point of fovea*
- other design considerations for peripheral vision
  - *standard design options*
  - *colour, font or icon size, relative positioning, opacity...*

Vision & Interfaces

make messages visible...

- use a user's focal point to our advantage as designers
  - *put the message at the focal point*
- user's tend to focus in a predictable manner with user interface interaction
- inherent predictability can be used to guide design
  - *western users tend to follow a pattern of movement for forms, panels &c.*
  - *top left to bottom right*
  - *click a link and obtain focal point*
- mark an error prominently to help users
  - *normally place the message near the source of the error*
  - *or relocate to focal point if discrepancy in the user interface*

Vision & Interfaces

make messages visible...cont'd

- consider adding an error icon or symbol to the message output
  - *ensure icon or symbol is consistent throughout application, website...*
- reserve a single colour for error messages throughout the interface
  - *customarily red colour used for error and danger messages*
  - *consider red colour relative to company or brand image*
  - *red considered good luck, auspicious in Chinese culture*
    - often associated with death in Egypt...
  - *if necessary, change colour and add error icon &c. to help reinforce different colour*

overt interface options

There are also more obvious options for attracting a user's attention.

- a message in an error dialog or modal box
  - *gets attention quickly and forces a user to interact before continuing*
  - *use with caution, can be very annoying if abused*
  - *carefully consider context before deploying modal options*
  - *traditional popups can be overridden in browser settings*
- use sound to reinforce an error message
  - *system beep or warning common tool for notifying users*
  - *notifies a user to check the interface for more information*
  - *consider as a support, reinforcement to visual messages*
  - *again, quickly becomes annoying if abused*
  - *environmental conditions important as well*
  - *vibrations an alternative for mobile apps...*

Vision & Interfaces

overt interface options...cont'd

- animated notifications work with our peripheral vision's motion tracking
  - *peripheral vision's ability to detect motion*
  - *detection causes reflexive eye movement towards the screen*
  - *animations often seen in interface menu selections*
    - menu blinks or flashes to indicate selection of option

Considerations

- these options should be used sparingly in a user interface design
- such visual options are often associated with annoying advertisements
- context is important
- consider advanced options to cancel or limit such interface options

Vision & Interfaces

positive highlighting and focus

- peripheral vision useful as a trigger for the fovea to focus
- moving, overt objects and triggers quickly draw the fovea's attention
- *searching* is another important role for our vision
  - *peripheral vision plays key role*
  - *dependent upon search target, style, colour, movement...*
- design can help our vision focus upon search target
  - *text decoration, highlighting, weight, emphasis...*
  - *bold that* ***pops***

text example 1

Test 1

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nunc et libero et mi porttitor scelerisque. Mauris gravida enim nec mi vulputate, quis aliquet dolor suscipit. Aenean rutrum sapien vitae lobortis bibendum. Donec vitae interdum diam. Maecenas dapibus facilisis elit vel imperdiet. Cras ultrices tempor dictum. Fusce ex eros, egestas at congue non, venenatis nec nisl. Donec fringilla pulvinar augue eu vulputate. Etiam metus est, aliquam quis sem et, ultricies tincidunt arcu. Integer eu sem nisi. Proin gravida odio urna, vitae scelerisque enim ornare et. Integer placerat massa viverra, aliquam arcu et, porta augue. Aliquam erat volutpat.

text example 2

Test 2

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nunc et libero et mi porttitor scelerisque. Mauris gra**v**ida enim nec mi **v**ulputate, quis aliquet dolor suscipit. Aenean rutrum sapien **v**itae lobortis bibendum. Donec **v**itae interdum diam. Maecenas dapibus facilisis elit **v**el imperdiet. Cras ultrices tempor dictum. Fusce ex eros, egestas at congue non, **v**enenatis nec nisl. Donec fringilla pul**v**inar augue eu **v**ulputate. Etiam metus est, aliquam quis sem et, ultricies tincidunt arcu. Integer eu sem nisi. Proin gra**v**ida odio urna, **v**itae scelerisque enim ornare et. Integer placerat massa **v**i**v**erra, aliquam arcu et, porta augue. Aliquam erat **v**olutpat.

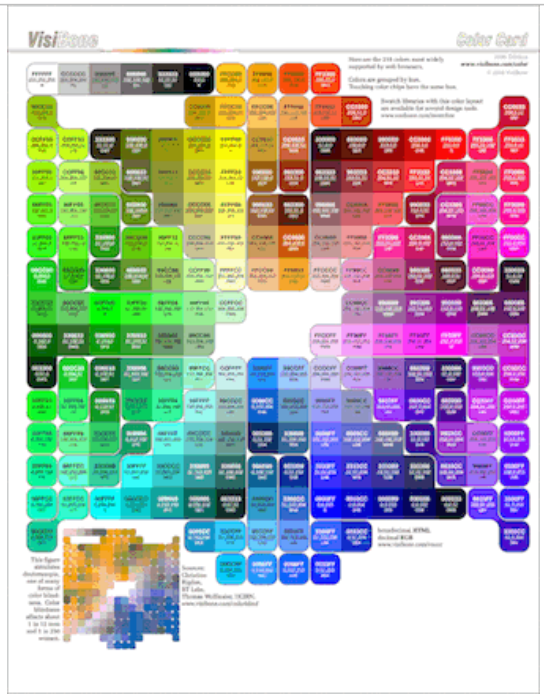
text example 3

Test 3

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nunc et libero et mi porttitor scelerisque. Mauris gravida enim nec mi vulputate, quis aliquet dolor suscipit. Aenean rutrum sapien vitae lobortis bibendum. Donec vitae interdum diam. Maecenas dapibus facilisis elit vel imperdiet. Cras ultrices tempor dictum. Fusce ex eros, egestas at congue non, venenatis nec nisl. Donec fringilla pulvinar augue eu vulputate. Etiam metus est, aliquam quis sem et, ultricies tincidunt arcu. Integer eu sem nisi. Proin gravida odio urna, vitae scelerisque enim ornare et. Integer placerat massa viverra, aliquam arcu et, porta augue. Aliquam erat volutpat.

Image - Vision & Interfaces

web safe & browser colours

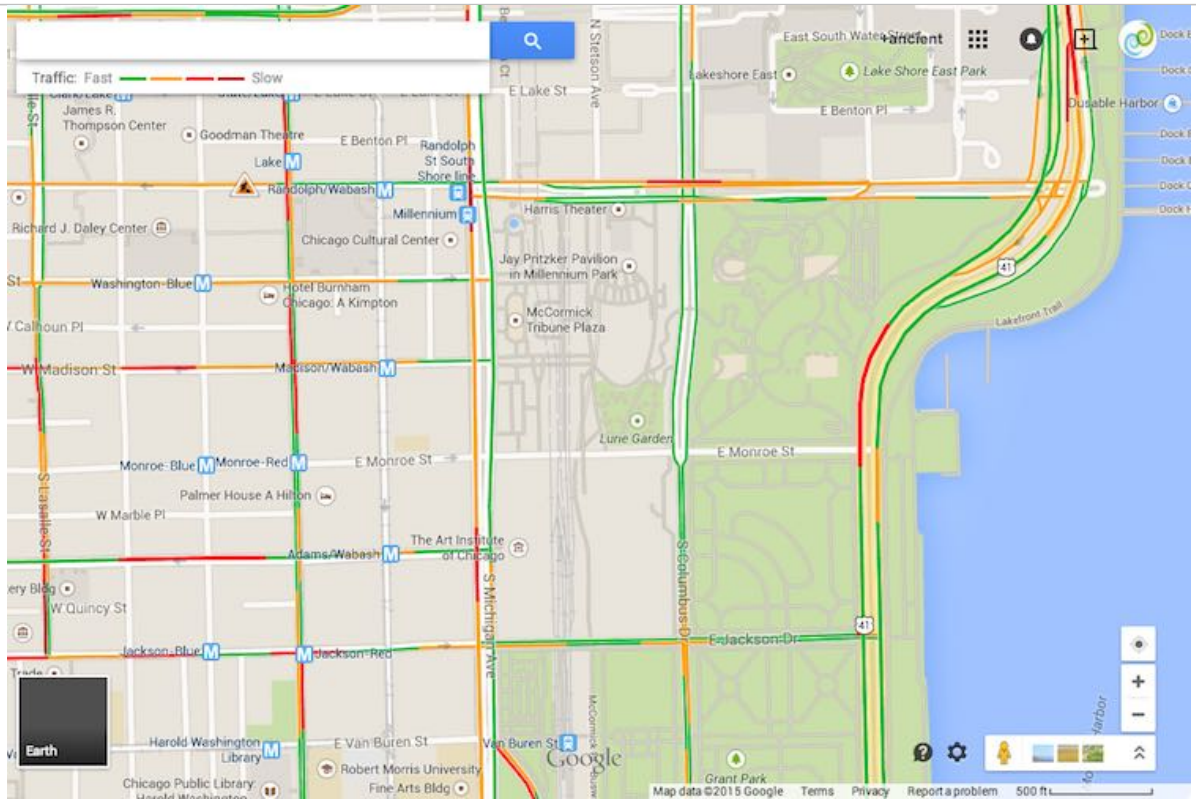


Safe Colours

Browser colours & colour blindness (source: VisiBone)

Image - Vision & Interfaces

design pop...



Traffic

Image - Vision & Interfaces

design example

Art Institute

Email Survey - (source: Art Institute Chicago)

Users & Interaction

consideration of interaction

- GUIs tend to present graphical controls for user interaction
  - *buttons, drop-down boxes and menus, sliders...*
- users interact either directly or indirectly
  - *gesturing on a touchscreen...*
  - *pointing device such as a mouse, keyboard...*
- inherent assumption users know required actions for a given application

Users & Interaction

hierarchical breakdown

- normally a predictable model involving a hierarchical breakdown
  - ***goals**: user's high-level goal for interaction with application*
    - write a letter, take a photo, read a book, book a holiday...
    - goals become ***what*** the user wants to do
    - instead of ***how*** they will do it
  - ***tasks**: allow a user to fulfill their goals*
    - perform some general steps
    - follow a structured path of activities
  - ***actions**: user carries out their tasks by performing interface actions*
    - specific operations in the user interface
    - click a button, select a menu item, drag and drop an element, text entry...

example

Example - user editing of photo metadata within image library application

- users wants to edit some metadata for a photo in their image library application
  - *open the required image document in image application*
  - *select a menu item to view the current metadata record*
  - *edit existing text entries in the metadata record*
  - *enter new text for missing data*
  - *spell check user input*
  - *preview the updated image metadata*
  - *tag or categorise the image*

example

Example - user editing of photo metadata within image library application

- click a menu item to select metadata record
- click on *edit* option to start modifying record
- delete some data from the record
- enter some new text data
- click the *update* or **save** button to close the metadata record

Users & Interaction

patterns emerging

- important to realise and understand is that a predictable pattern emerges
- **goals** often achieved by means of various sets of **tasks**
- **tasks** often be achieved by various sets of **actions**
- such interface patterns can be achieved in multiple ways
  - *e.g. both keyboard shortcuts and mouse inputs*
- pattern from **goal** to **task** to **action**
  - *will, more often than not, be the same*
- necessary to keep such actions flexible and re-usable
  - *combine and mix them to achieve multiple disparate tasks*

Video - Users & Interaction

filter photos based on metadata

- Filter photographs based on metadata
- Source: Adobe Lightroom Tutorials

Resources

- Laing, R.D., Phillipson, H. & Russell Lee, A. *Interpersonal perception: a theory and a method of research* Tavistock Publications. 1966.
- Okabe, M. & Ito, K. *Color Universal Design (CUD) - How to make figures and presentations that are friendly to Colorblind people.*
  - *J Fly. 2008. http://jfly.iam.u-tokyo.ac.jp/color/.*
- Waloszek, G. *Vision and visual disabilities: An introduction.* SAP Design Guild. 2005. http://www.sapdesignguild.org/editions/highlight_articles_01/vision_physiology.asp
- Wolfmaier T. *Designing for the color-challenged: A challenge*. ITG Publication. 1999.