Comp 388/441 - Human-Computer Interface Design

Week 6 - 25th February 2016

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Cognitive Load - 3

Thinking

- reduce cognitive loads by awareness of types of user thinking an app requires
- for example:
    - *working out the next step in a procedure*
    - *using working memory to help complete an ongoing task*
    - *recall of commands, facts, procedures from long-term memory*
    - *memorising commands, facts, procedures etc for long-term memory*
    - *referencing information from another source*
    - *making decisions or considering judgements*
    - *mental integration of information from disparate sources*
    - *including research, reference, or simply general peripheral sources...*

Users & Interaction - Video Second Try...

Filter photographs based on metadata

Source: Adobe Lightroom Tutorials

Cognitive Load - 4

- our goal is not to reduce thinking relative to our application
    - *intellectual thinking different from forced, unnecessary thinking due to poor design...*
- our app should promote and facilitate thinking, and record results where applicable
- our app should try to limit extraneous cognitive load for activities such as
    - *active research activities*
    - *creative development and output*
    - *general problem solving and issue resolution*
    - *reading, note taking, and other general tasks...*
- cognitive load reduced by an app's focus upon
    - *the task in hand, relevancy of UI information and implementation, reduction in extraneous content...*
- reduce interface induced thinking additional to the primary task
    - *better contextual support and research*

Cognitive Load - 5

Distraction-free

Source - Amazon Kindle Paperwhite

Cognitive Load - 6

Consider your app's big green button...

Source - Fuji Xerox Printers

Quantify Cognitive Load

- interested in how we can quantify the cognitive load
  - *required by a user for performing a given task*
- better understanding of load issues within our application and interface
  - *helps guide us in apportioning emphasis and control in design*
- for a particular task we can compile a list of actions, steps...
  - *estimate a score (% etc) which represents our understanding of required effort*
  - *total all of the action scores to assign an overall score for the effort required*
  - *evaluate different design options by comparing overall scores...*
- KLM-GOMS model
  - ***Keystroke-Level Model for the Goals, Operators, Methods, and Selection Rules***
  - *Card et al. "The Psychology of Human-Computer Interaction." 1983.*

KLM-GOMS Model - 1

- users divide goals into a series of tasks
    - *each task requiring some initial thought and preparation*
- preparation known as **task acquisition time**
    - *can be very short for simple, routine tasks*
    - *may be much longer, perhaps a few minutes, for more creative, original tasks*
- user will then continue with their chosen task
    - *using a sequence of actions or operations*
- total required time to complete the actions is known as **task execution time**
- total time required to complete task is the sum of
    - ***task acquisition time*** + ***task execution time***
- modified models for mobile devices, such as phones...
    - *eg: Keystroke-level model for advanced mobile phone interaction*

KLM-GOMS Model - 2

Code	Operation	Time (in seconds)
K	Key press & release (keyboard)	Best Typist (135 wpm) = 0.08
		Good Typist (90 wpm) = 0.12
		Avg. Skilled Typist (55 wpm) = 0.20
		Poor Typist (40 wpm) = 0.28
		Typing Random Letters = 0.50
		Typing Complex Codes = 0.75
		Worst Typist = 1.20
P	Point mouse to an object on screen	1.10
B	Button press or release (mouse)	0.10
H	Hand from keyboard to mouse & vice-versa	0.40
M	Mental preparation (operation)	1.20
T(n)	Type string of characters	n x K seconds

wpm = words per minute

Source: Kieras, D. 1993. Wikipedia

KLM-GOMS Model - 3

Example implementation - text search including mental operators

Action	KLM-GOMS Code	Time (in seconds)
move mouse to **search** menu	H (hand to mouse)	0.40
	M + P (search menu)	1.20 + 1.10
select **search** menu...	BB (select search menu)	2 * 0.10
click on ***find text*** link...	M + P (find text menu item)	1.20 + 1.10
	BB (select menu item)	2 * 0.10
	H (hand from mouse to keyboard)	0.40
enter search term ***et***	KK (type ***et*** characters)	2 * 0.20 (avg. typist)
click the ***OK*** button	H (hand from keyboard to mouse)	0.40
	M + P (***OK*** button)	1.20 + 1.10
	BB (click button)	2 * 0.10
Total		9.10

BB = double button press to simulate mouse click and release (0.20 seconds)

Reducing Cognitive Load - I

A few tips and tricks

- consistent use of icons, labels, names, and general visual presentation
    - *consistency should include design for multiple tasks as well*
- clear navigation for process steps...wizards, paged results etc
- include visual cues and clues...saves users having to remember functionality
- avoid popups except for explicit intervention reasons...warnings, errors etc
- avoid redundancy in content and rendering
- relational material should be organised in close proximity to one another
- identify and remove unnecessary steps
- automate processes, steps where possible
- reduce delays and latency as much as possible...use progress updates, bars
- option for templates, tutorials for new documents in productivity apps etc
- video and audio tutorials often easier to follow and understand than text only
- repetitive user data entry can be avoided
    - *app should not force a user to continually remember such data and information*

Reducing Cognitive Load - 2

Concept of **Flow** by **Mihaly Csikszentmihalyi**

- user's creativity and productivity are high
    - *performance of activity occurs naturally and unconsciously*
- user experiences deep concentration and immersion in their current activity
    - *user is effectively both alert and relatively relaxed*
- living in the moment
    - *sensation of being so engrossed in an activity a user is unaware of the passage of time*
- balancing interest and challenge
- user is confident and exhibits a sense of control over their current situation
- user is working progressively towards achieving a specific goal
    - *eg: in games this might be as simple as getting to the next level*

TED 2004 - Flow, the secret to happiness

Working Memory and the Concept of Flow

TED 2013 - Peter Doolittle: How your "working memory" makes sense of the world

Reducing Cognitive Load - 3

Flow states and software

- unusual for beginners to be able to gain a sense of **flow**
  - *normally requires some level of comfort or familiarity*
  - *ease with the general operation and control of the application*
- acquiring a state of **flow** is quite difficult
  - *focused concentration is often not enough*
  - *reducing cognitive load in apps can aid in the process*
- interruptions in the real world can break a user's sense of **flow**
  - *visual clutter and noise in interfaces can have the same effect*
  - *interface distractions can also break a user's sense of **flow***

Reducing Cognitive Load - 4

Interface suggestions for **flow**

- reduce interruptions in the interface unless intentional for warnings, errors...
  - *non-important modal popups, notifications should be avoided*
- keep visual presentation simple
  - *bright, loud colours and images are jarring to the user's eye*
  - *unnecessary, prolonged or repetitive animations are distracting*
- sequential navigation should be obvious
  - *do not require the user to search the interface for **next**...*
- avoid switching between tabs, windows, pages for related information
- saving a document, work etc should be easy and intuitive for a user
- output and display progress reports for ongoing activities
  - *progress bars, spinning wheels, timers...*
- offer feedback in a prompt and consistent manner within the interface
- multi-tasking for users is difficult
  - *don't ask your users to perform too many interface tasks at once...*

Incentives, Offers, and Games - I

Motivating our users

- consider motivation, persuasion, or helpful *nudging* in our designs
- design our interfaces to encourage and help increase productivity
- particularly useful for certain types of applications and sectors
    - *user participation apps*
    - *productivity tools*
    - *community related apps*
- compare this type of application to gaming
    - *often adept at engaging and keeping a user's attention*
- consider how and where games are compelling and addictive
    - *adapt applicable concepts for our own design*

Incentives, Offers, and Games - 2

Compelling and addictive nature of gaming

- current trend in design to apply addictive qualities of gaming to application design
  - *known as **gamification***
- most games have some goals and rewards, which encourage and incentivise a user
  - *often a built-in incentive to reach the next level, a sense of satisfaction*
- games may include elaborate systems of player rankings
  - *rankings act as system of validation, offers easily quantified feedback to users*
- multiplayer games offer an element of direct competition
  - *user's sense of skills, standing, and validation enhanced by opportunity to compete and win*
  - ***high scores** on a leaderboard help this sense of competition*
- multiplayer games also offer sense of **social** connection and community
  - *head-to-head gaming, group playing, or simply ability to share, compare, discuss...*
- online role-plaing games a good example of social awareness and collaboration

Gamification Examples

1. Good examples of the use of gamification within social context

   Source - Yu-Kai Chou & Gamification

2. Khan Academy Knowledge Map

   Source - Khan Academy

3. Play to Learn with Khan Academy

   Source - GCO

4. Scratch Programming Language

   Source - MIT

Games and Simulations - I

Changing the brain game...

"*The immense amount of time spent with games during a child's formative years has led them to be literally 'hardwired' in a different way than those who came before.*"

Carstens, A., and Beck, J. *Get ready for the gamer generation.* Tech Trends 49. PP.22-25. 2005.

"*Immense changes in technology over the past thirty years, of which video games are a major part, have dramatically and discontinuously changed the way those people raised in this time period think, learn, and process information...The change has been so enormous that today's younger people have, in their intellectual style and preferences, very different minds from their parents and, in fact, all preceding generations.*"

Prensky, M. *Digital game-based learning.* McGraw-Hill. P.17. 2001.

Games and Simulations - 2

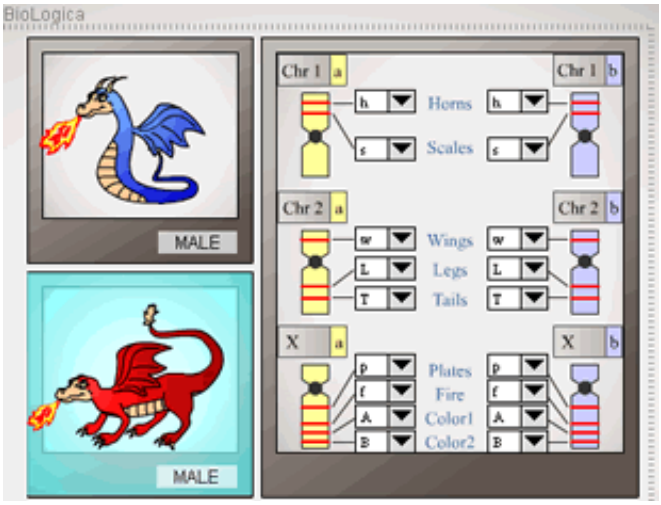
What are simulations?

- linear interactive tutorial versus a simulation
- model of a real world system
    - *respond in dynamic and rule-based ways to user responses*
- two basic types of simulation
    - *operational and conceptual*
- operational primarily used to teach procedural skills
- conceptual simulations

Games and Simulations - 3

What are games?

- online games include a broad array of formats and features
- common elements such as
    - *competitive activity with a challenge and goal*
    - *set of rules and constraints*
    - *specific context*



Source - BioLogica

Games and Simulations - 4

Match game to learning goal

"Jeopardy-style games, a staple of games in the classroom, are likely to be best for promoting the learning of verbal information (facts, labels, and propositions) and concrete concepts. Arcade-style games...are likely to be best at promoting speed of response, automaticity, and visual processing. Adventure games are likely to be best for promoting hypothesis testing and problem solving. It is critical, therefore, that we understand not just how games work, but how different types of games work and how game taxonomies align with learning taxonomies.."

Van Eck, R.N. "Digital game-based learning." Educause Review 41. PP.17-30. 2006.

- a game can often take over a tutorial
  - *Hays, R.T. 2005.*
- medical simulations
  - *Issenberg, S.B. et al. 2005.*

Processing Visual Information - I

- how do users actually process a page or screen within an application?
    - *designers and developers interested in working out how to guide a user*
    - *optimise viewing experience for user's focal point*
- graphical artists use emphasis and position to draw attention
- cartoonists carefully compose and sketch out cartoons
    - *draw attention to speech-bubbles etc in correct order...*
- we can compose our visual page elements to influence a user's viewing order
- by knowing common patterns for user viewing
    - *we can design our apps to accommodate such usage patterns*
    - *putting relevant information where users actually look*

Processing Visual Information - 2

Source - The Curious Dog Log

Processing Visual Information - 3

How do users read a page?

- Western readers follow a pattern for reading
    - *look at first word in the top left corner of a page*
    - *then scan across the line from left to right*
    - *read the words*
    - *skip to the beginning of the next line*
- reader's eyes scan across the line of text
    - *not a smooth action*
    - *user's focus jumps rapidly between given spots on the page*
    - *known as* ***fixation points***
    - *jumps from point to point known as* ***saccades***
    - *brain does not receive visual information during* ***saccades***
    - *brain capable of combining images received at each* ***fixation point***
    - *brain* ***sees in a line***

Processing Visual Information - 4

Perceiving more complicated pages...

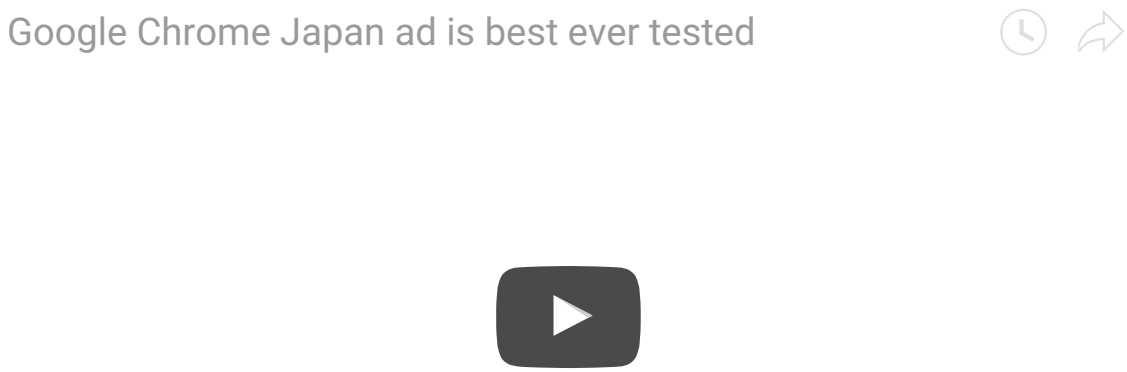
- consider page layouts with a more complex design and pattern
  - *slightly harder to discern exactly how a user's eyes move across the page*
- some generalisations we can consider and transfer
  - *users get an initial impression of a page or document*
  - *z-shaped pattern*
  - *upper left, read title, then scan from upper right*
  - *diagonal to lower left, then scan to lower right*
  - *return focal point to areas of interest*
- uncertain how flashy, loud images etc will impact this pattern
  - *tend to break or interrupt a user's pattern of scanning the page*
- user searching a page for something specific will often follow a different pattern

Processing Visual Information - 5

- researchers have conducted eye-tracking studies
    - *using specialised cameras and software*
- capable of identifying where and what a user views on screen
- software can replay a user's **scanpath**
    - *a series of **fixations** and **saccades***
- replay tells us the areas of interest and how long each user viewed
- aggregate **scanpaths** to form a **heatmap** diagram
    - *shows predominant areas of interest to our users*

Processing Visual Information - 6

Eye tracking a Google Chrome Advert in Japan



Google Chrome Japan - Source: YouTube

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