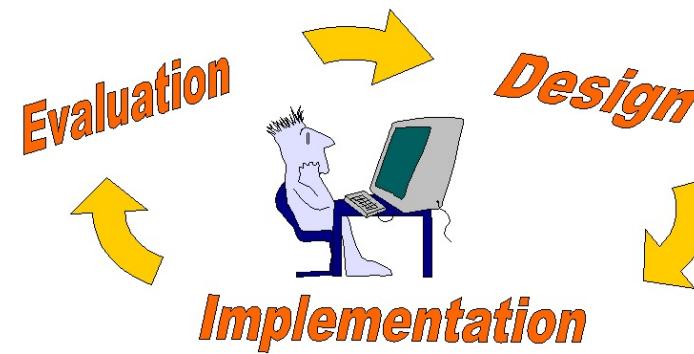
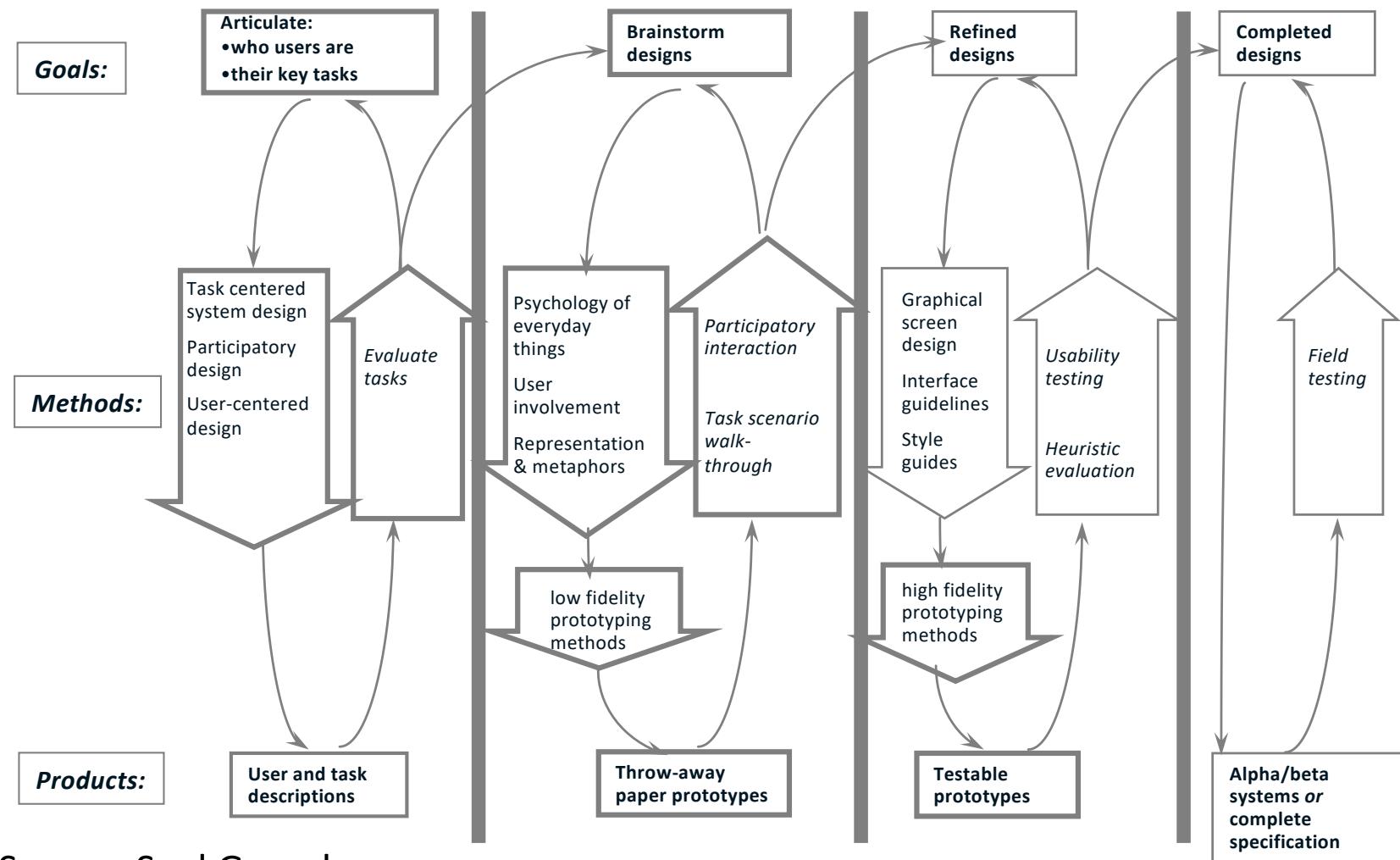


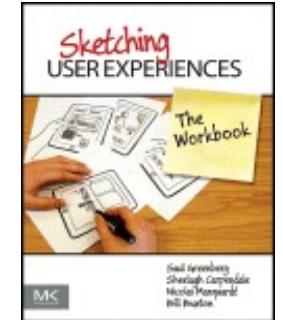
Interface Design



Design Process

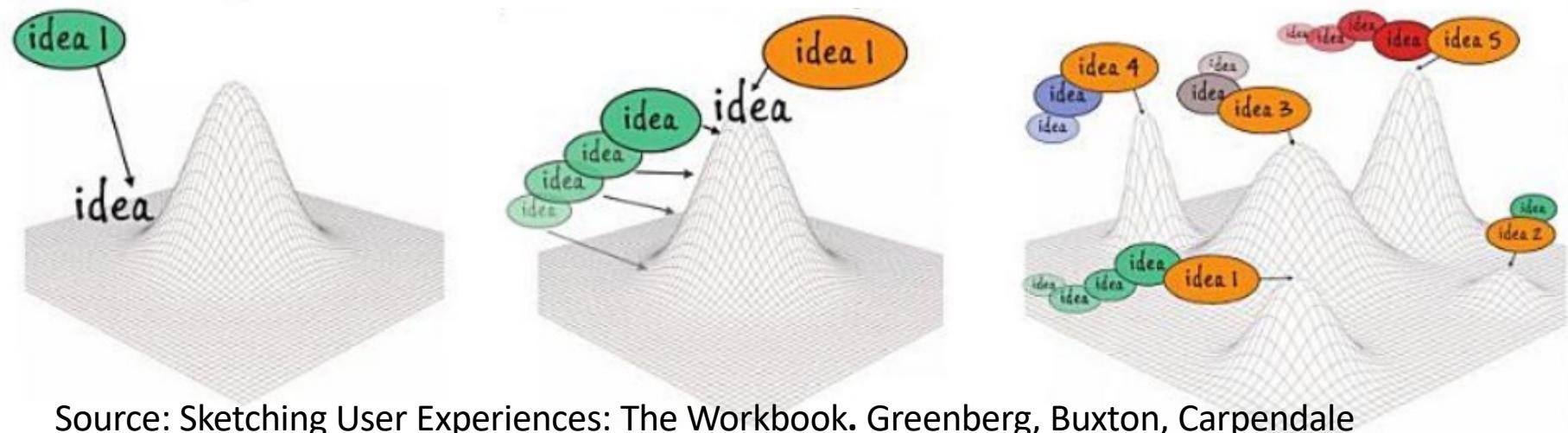


Source: Saul Greenberg



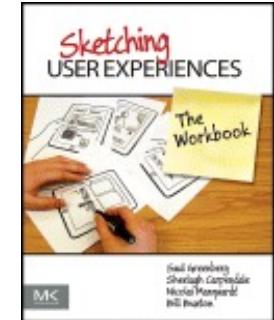
Iterative Design

- Designs are iteratively refined based on evaluative feedback
- Beware of tunnel vision, premature commitment, local hill-climbing. Bad early decisions stay bad

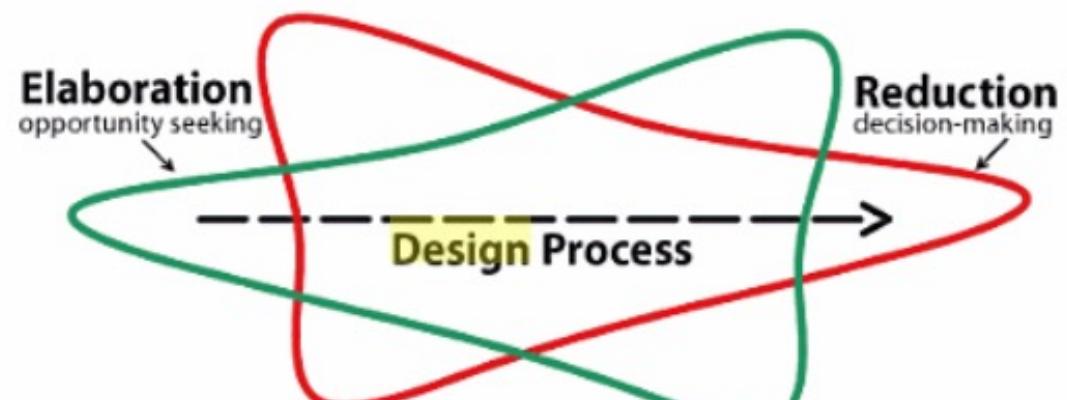
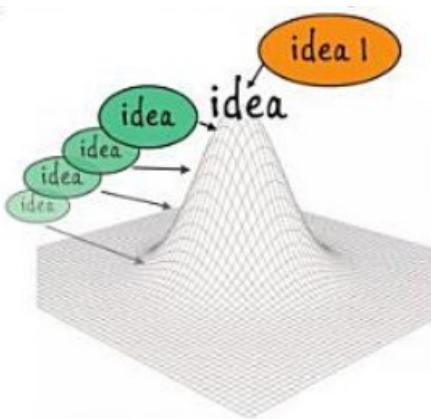
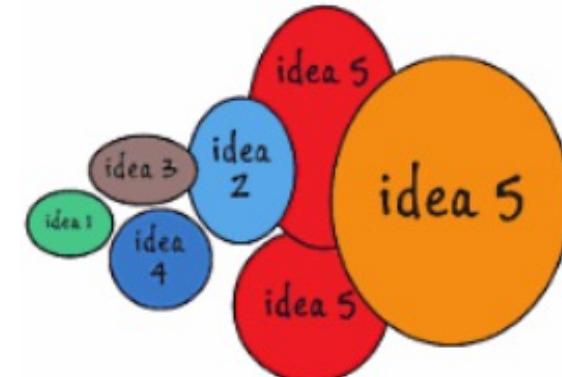


Source: Sketching User Experiences: The Workbook. Greenberg, Buxton, Carpendale
<https://sketchbook.cpsc.ucalgary.ca/>

Iterative Design: Elaboration/Reduction Tension

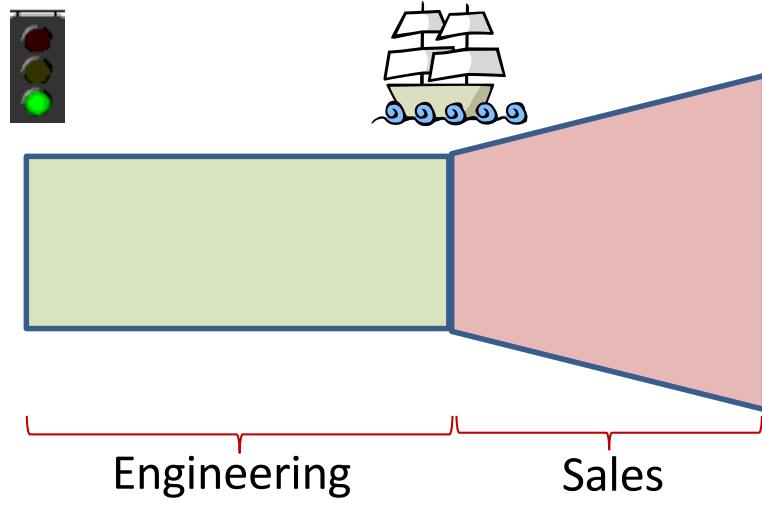
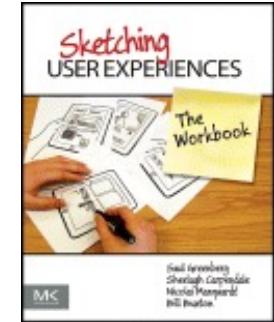


- Elaboration: get the Right Design
- Reduction: get the Design Right

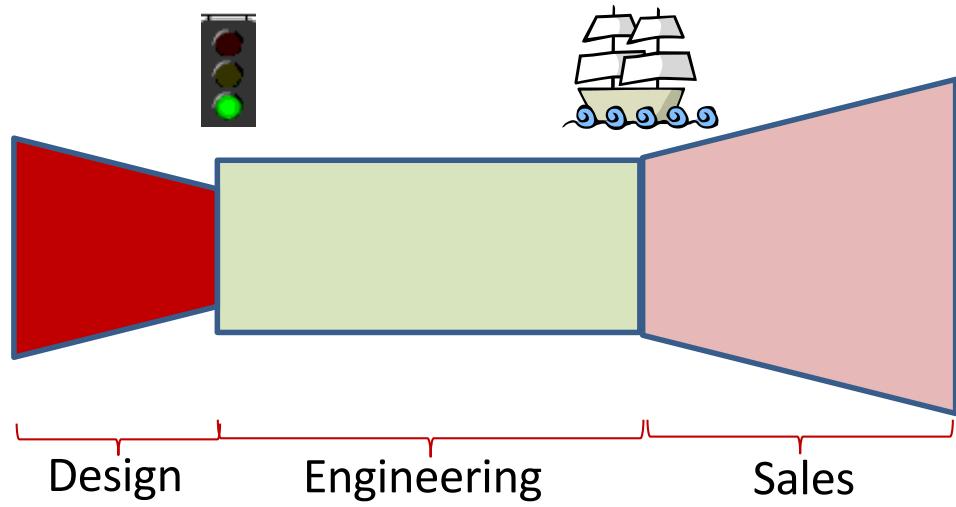


Source: Sketching User Experiences. Greenberg, Buxton, Carpendale

Iterative Design: The Design Funnel

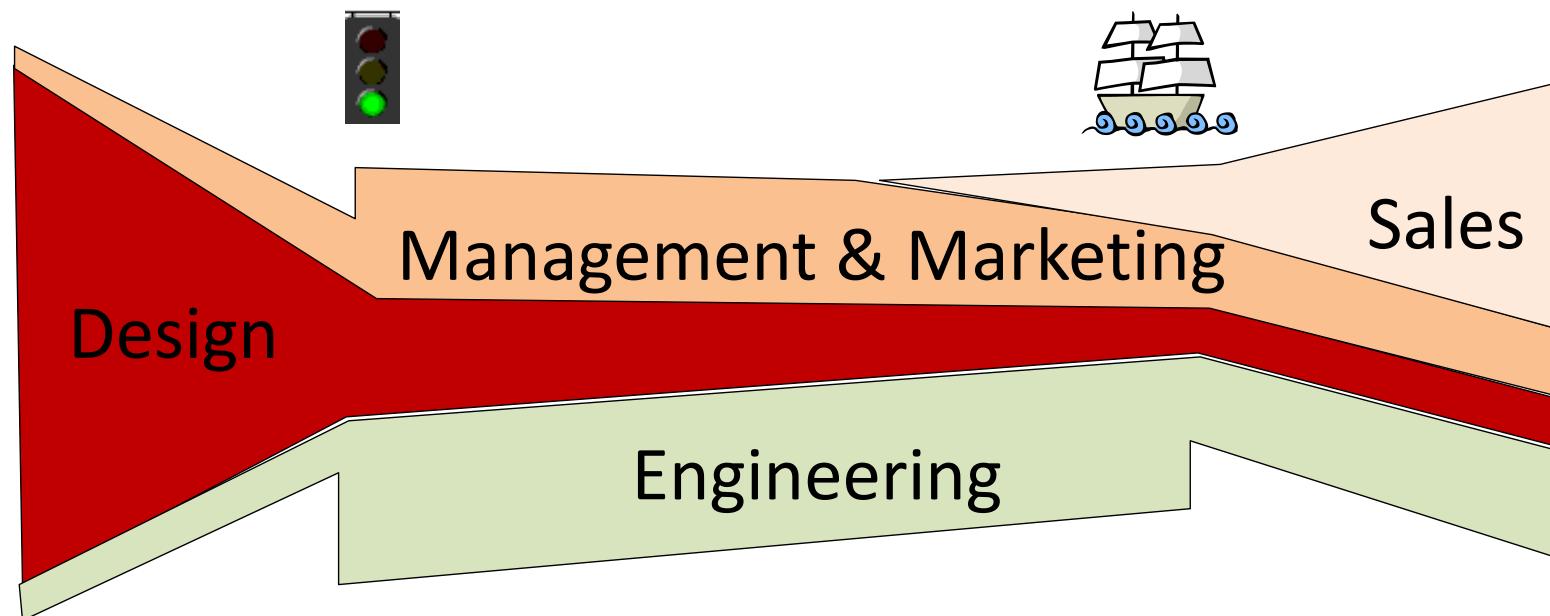
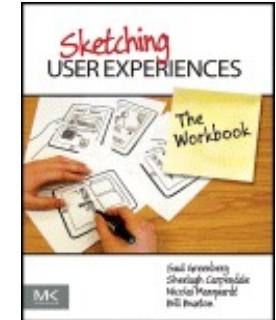


Naive product view



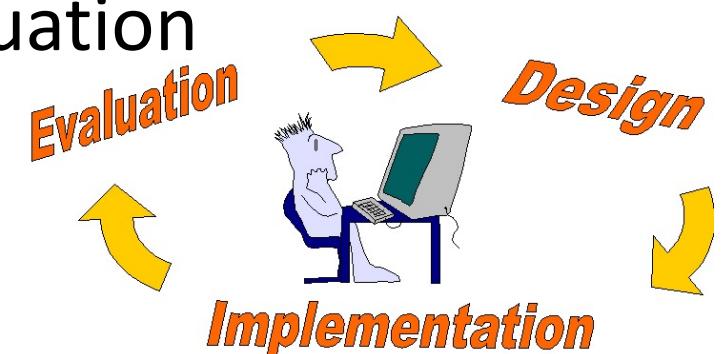
Naive design funnel

Iterative Design: The Design Funnel



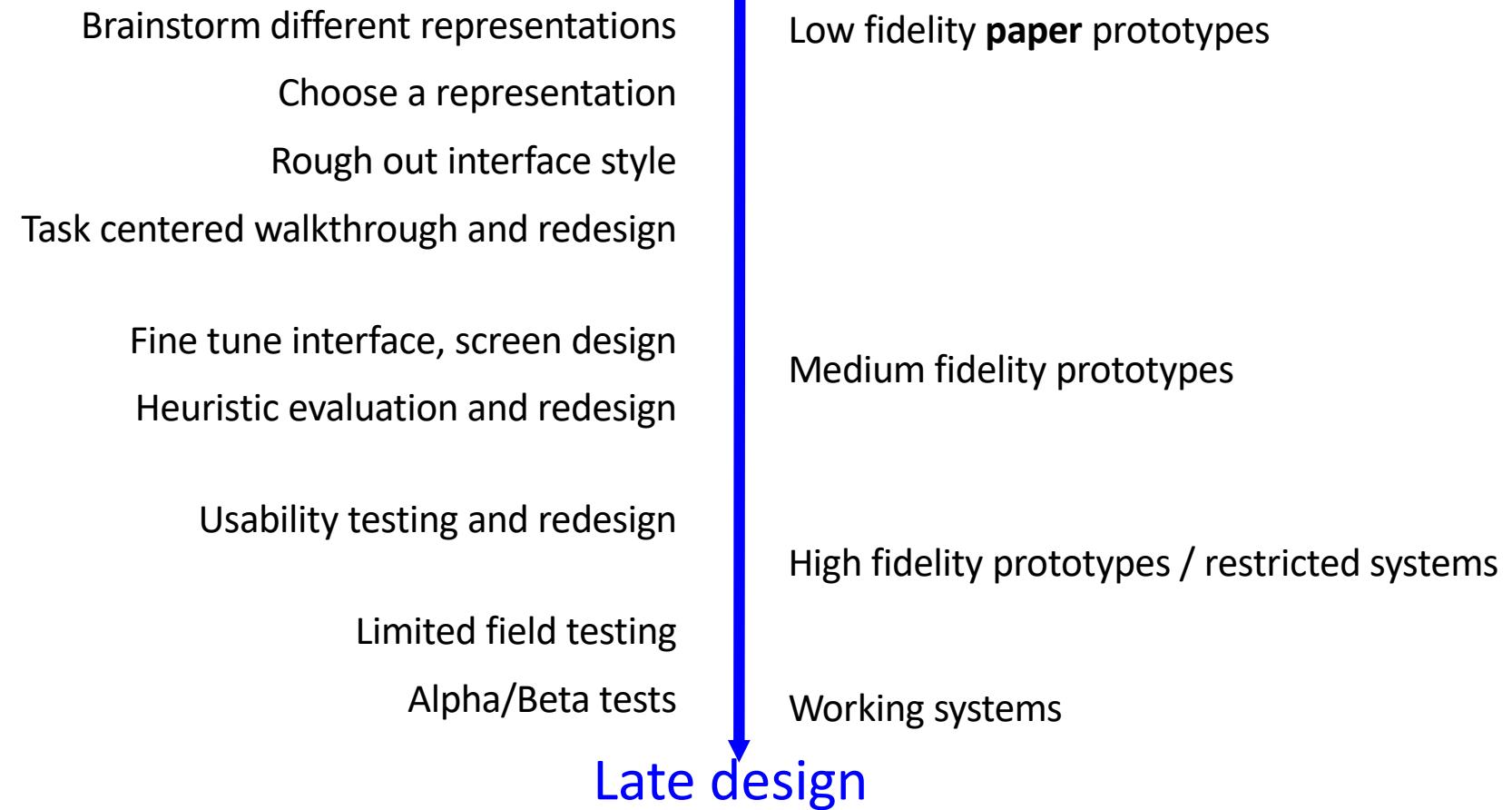
Iterative Design: Supporting *Rapid* Iterations

- Fudd's first law of creativity: to get a good idea, get lots of ideas
- But lots of ideas will take lots of time to build/test
- Time is precious...
- Requires rapid creation and evaluation
- Rapid prototyping



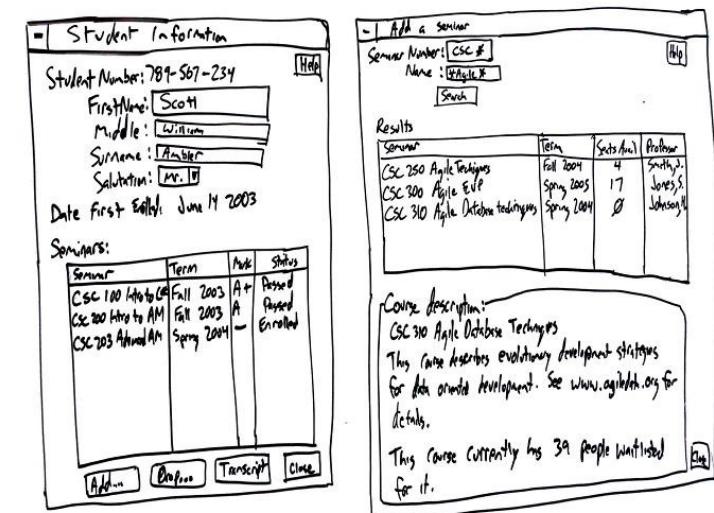
Prototyping

Early design



Low fidelity prototypes: sketches

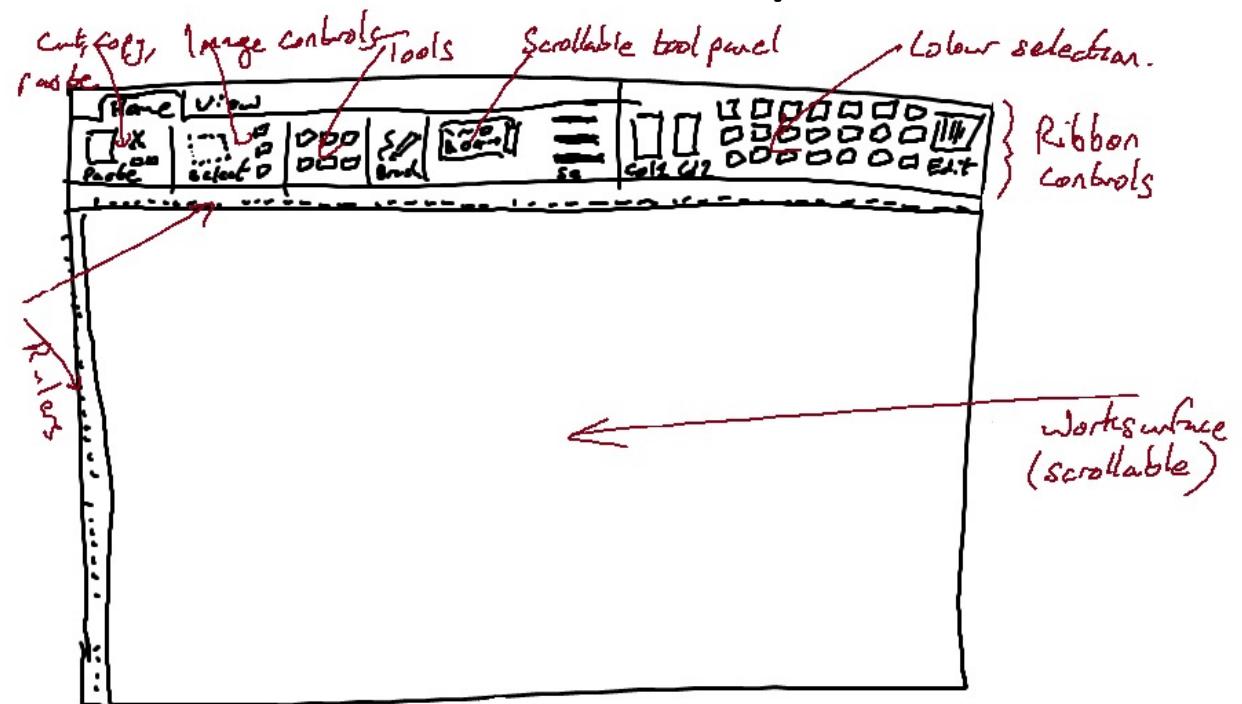
- Outward appearance & structure of intended design
- **Necessarily crude/scruffy**
 - Focus on high level concepts
 - Fast to develop
 - Fast to change
 - Low change resistance
 - Delays Commitment!
- Annotations/sequence can show UI progression



Source: agilemodeling.com

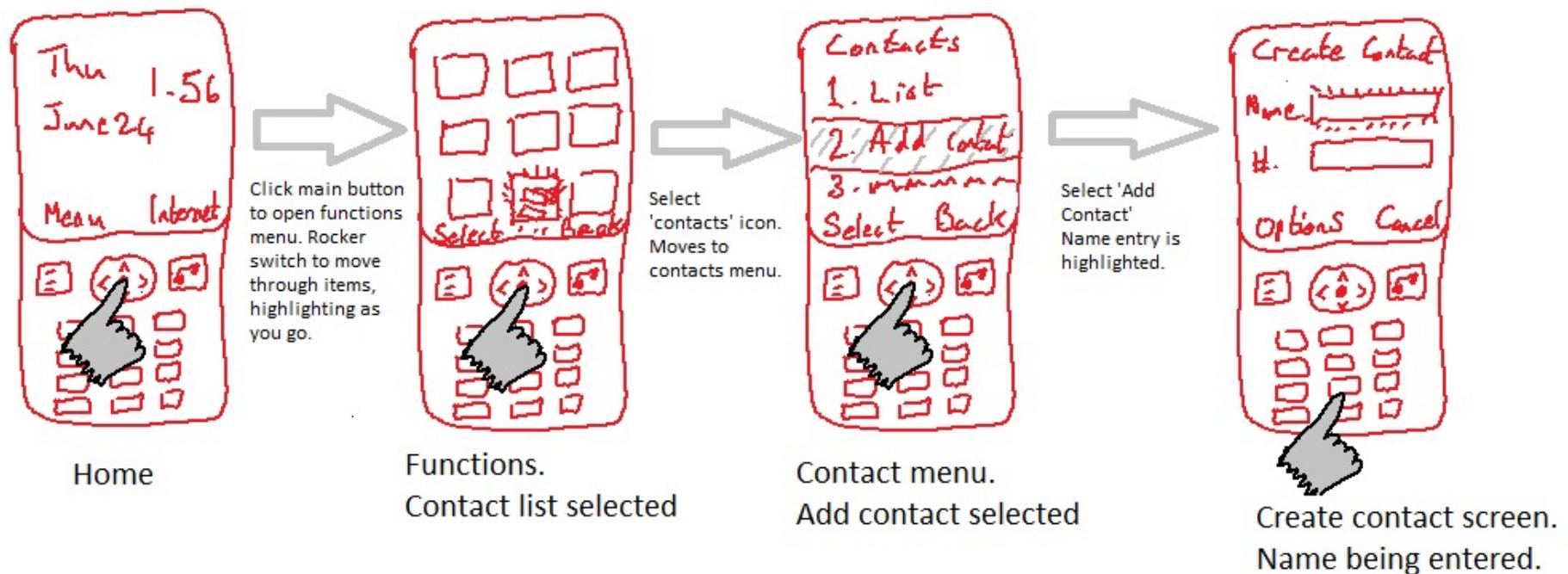
Low fidelity prototypes: sketches

- Use annotations/notes as necessary
- Cross reference to other zoomed in/out sketches



Low fidelity prototypes: sequential sketches /storyboards

- Show state transitions



Low fidelity prototypes: tutorials/manuals

- Write the tutorial/manual *before* the system
- Task-centred!
 - Users are not interested in what the system can do
 - They're interested in what they **need** to do
- Manual/tutorial serves as a UI specification

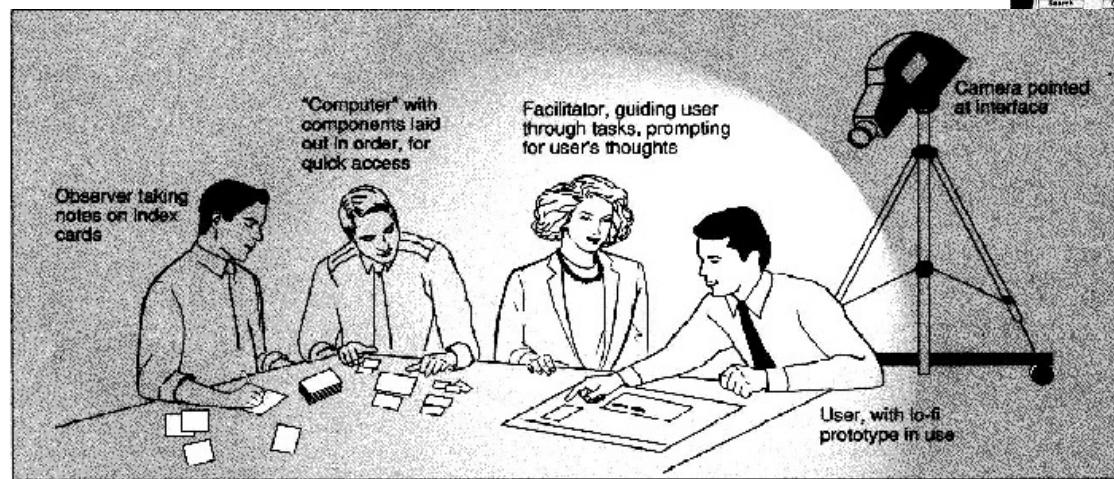
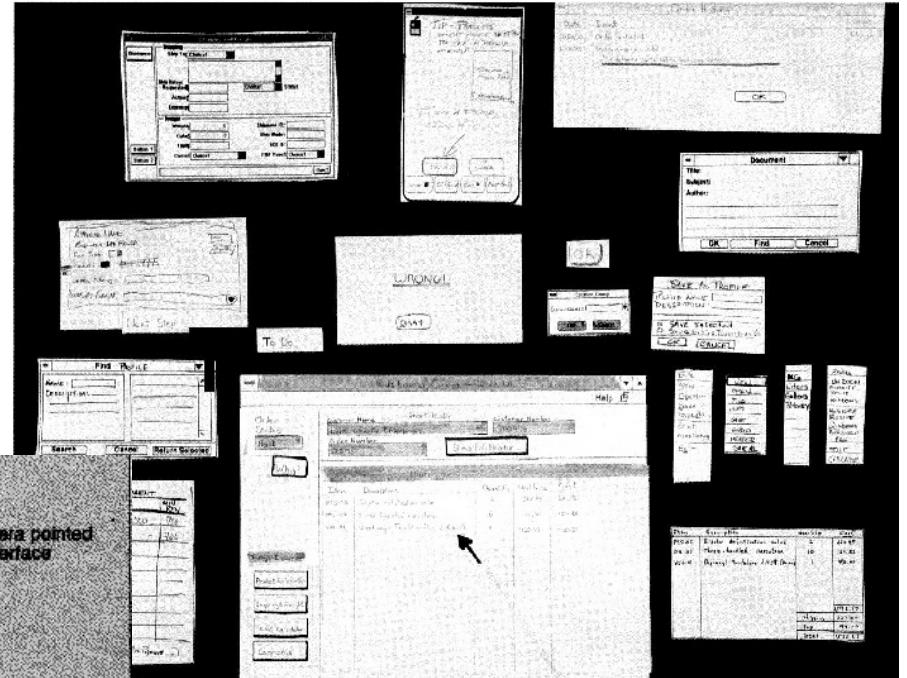
Medium fidelity prototypes: Wizard of Oz

- Functionality is mimicked by a person
- The wizard must know the algorithm (practice!)
- Good for complex/futuristic ideas



Medium fidelity prototypes: storyboards

- Series of key frames
- State progression is clear
- Walkthrough evaluation

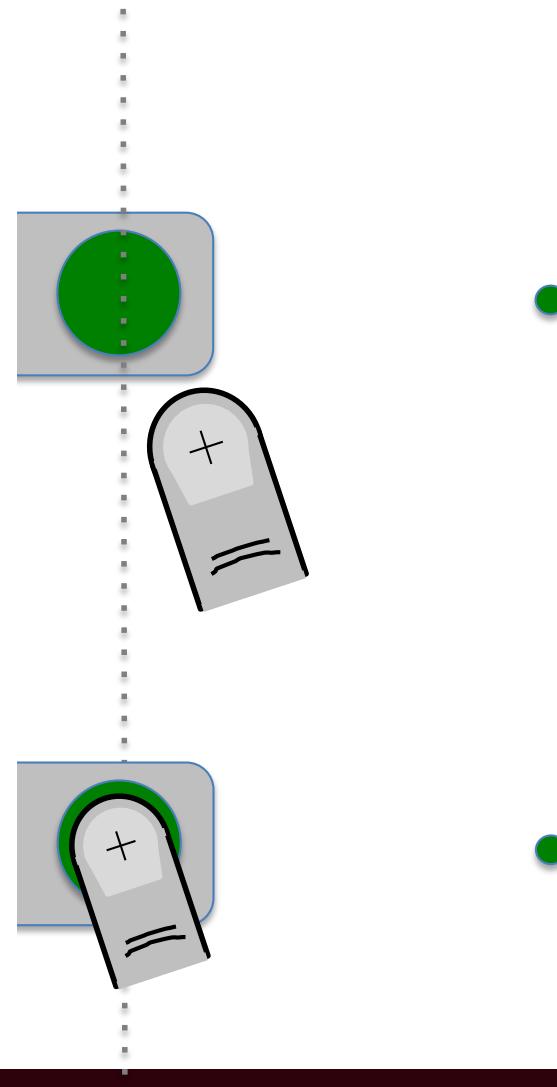


Source: Mark Rettig.
“Prototyping for tiny fingers”.
CACM v37(4). 1994.

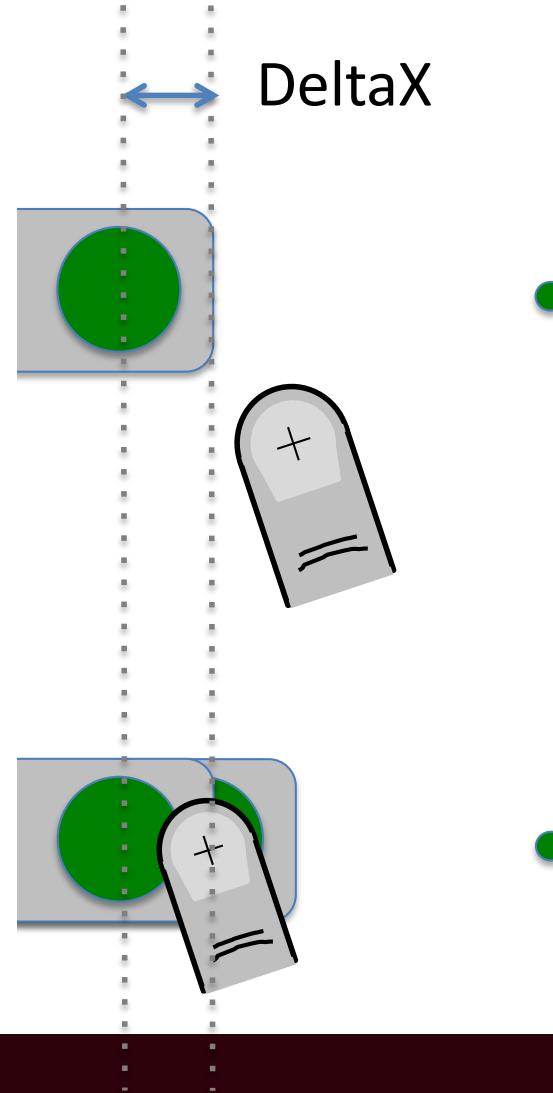
Medium fidelity prototypes: Refinement PowerPoint (for example)

- Facilitates motion paths
- Links between states, etc.
- Lots of “wireframing” tools
 - moqups.com
 - balsamiq.com
 - axure.com, ...

Precise Medium Fidelity Prototype

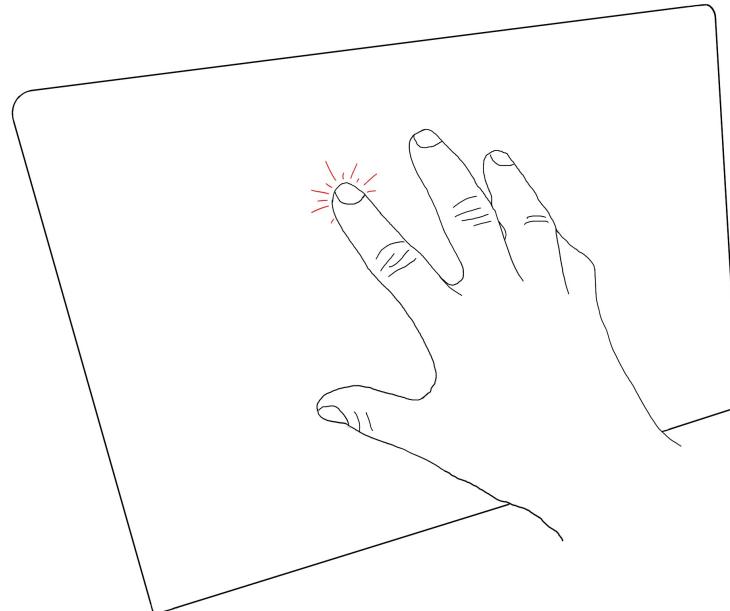
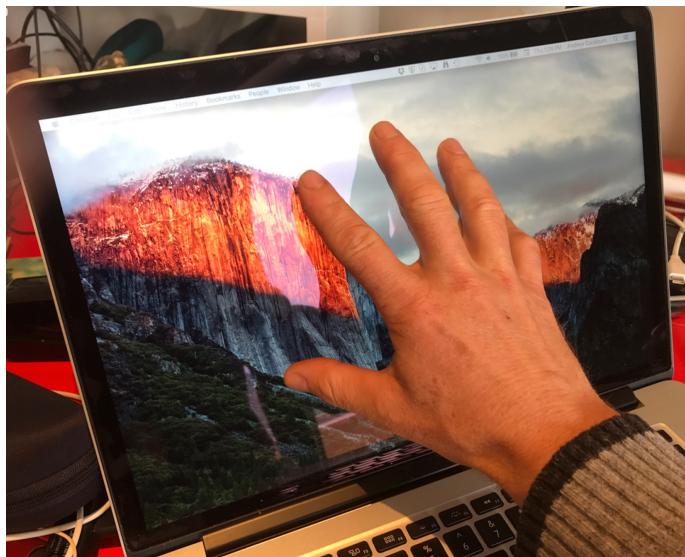


Precise Medium Fidelity Prototype



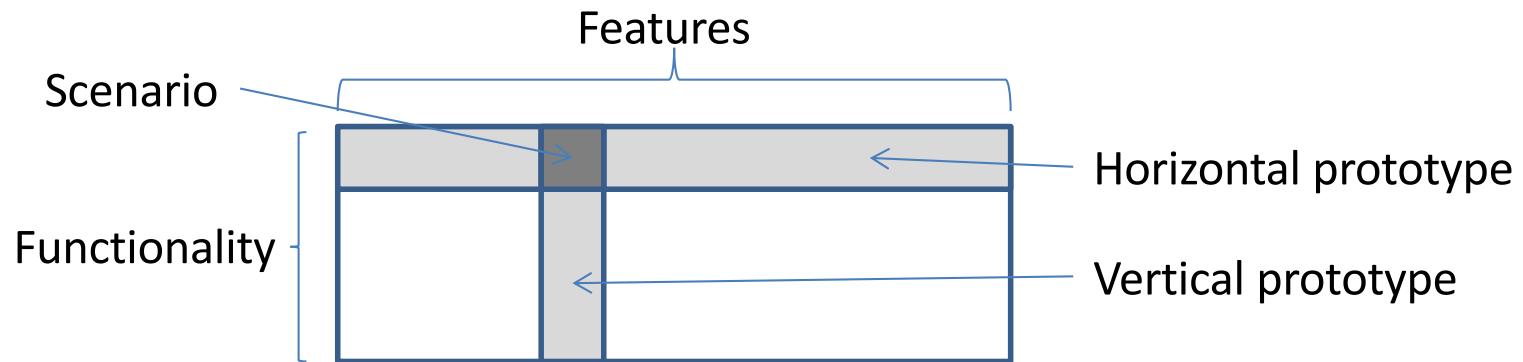
Medium fidelity prototypes: photo traces

- Overcome sketching inability
- Tidy capture of interaction essence, without exact representation



Medium fidelity prototypes: simulations and animations

- Work well for *second round* evaluation

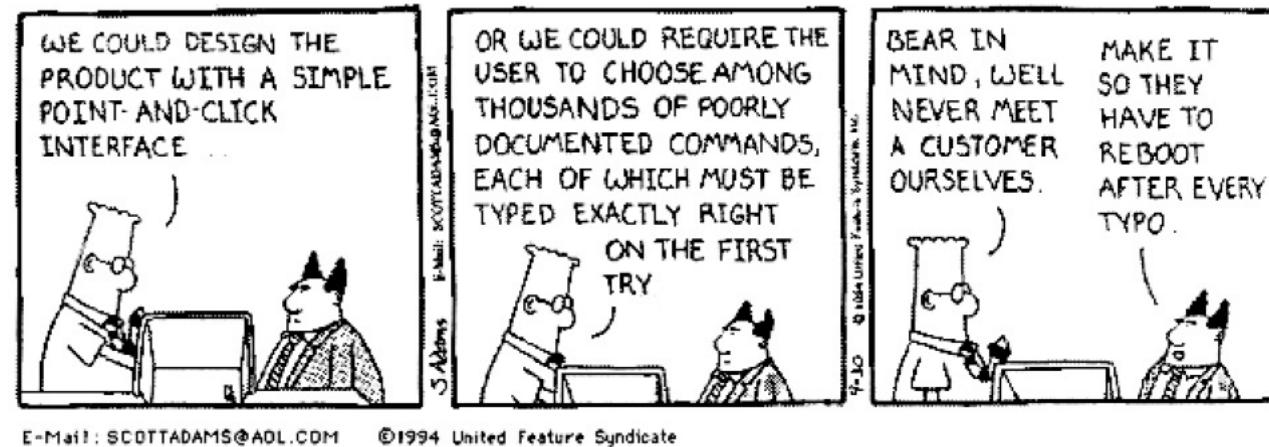


- Beware of:
 - Giving perception of ‘nearly completed’
 - Reluctance to change
 - Excessive focus on presentation rather than approach

Interface Design: Task-Centred System Design (TCSD)

System Centered System Design (How NOT to approach design)

- Focuses on the system's and designer's needs
- What can we easily build?
- What is possible/easy with the tools we have/know?
- What do I (the programmer) find interesting?



File Edit View Window Help



Cohort
Email
Letter
Notes
Process
Agenda
Multi Action

User Agenda Monitor - ajc168

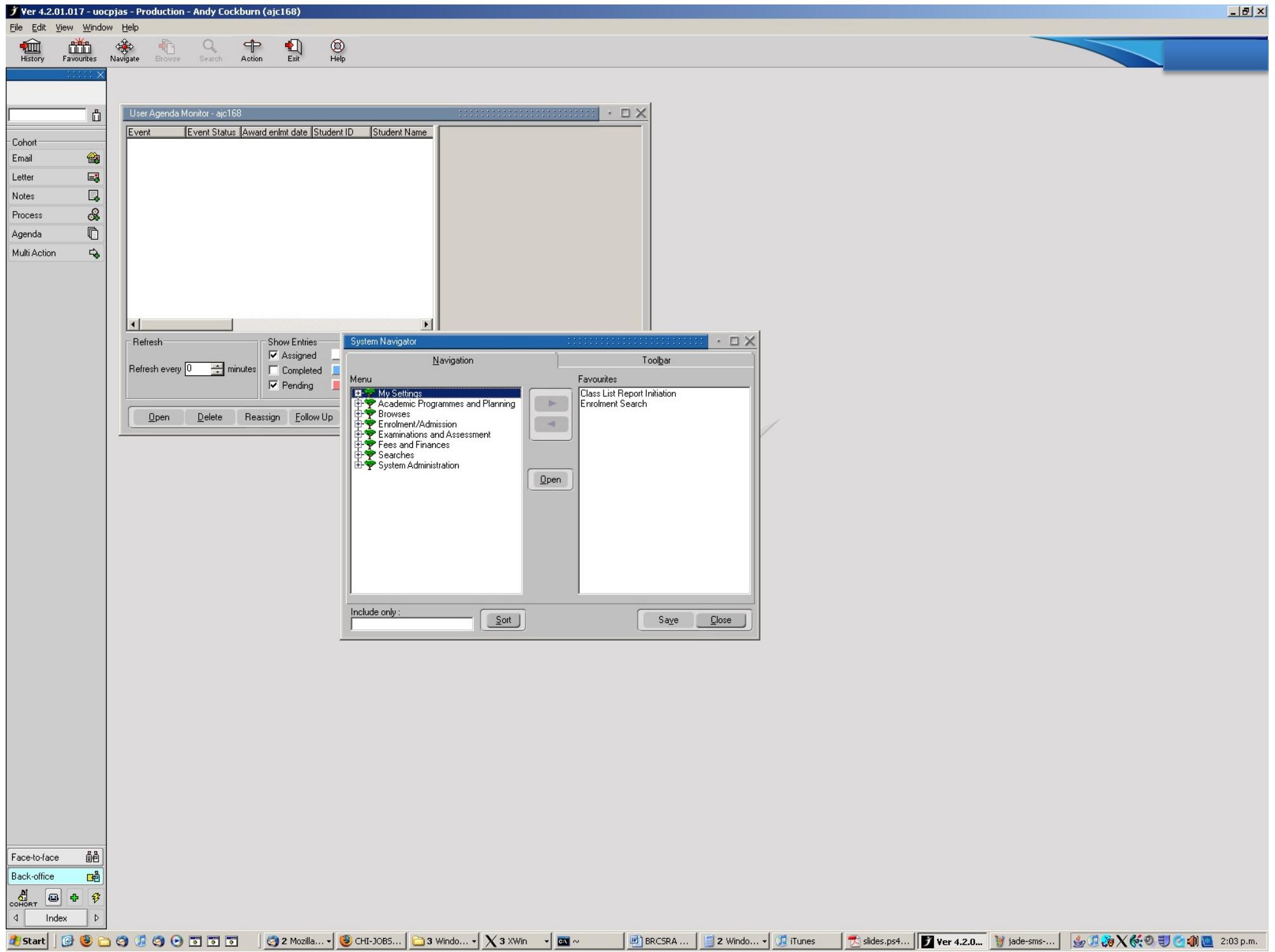
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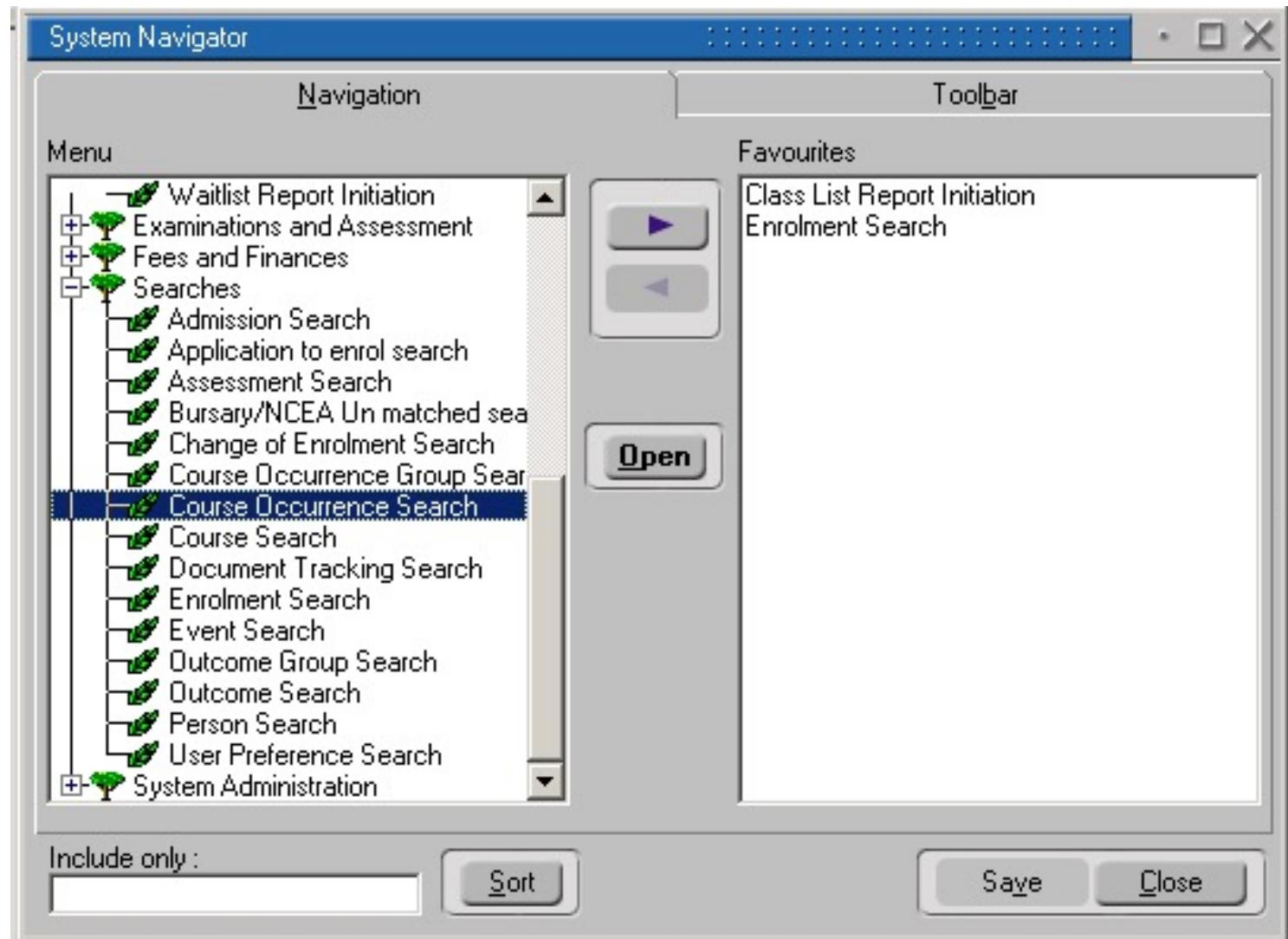
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Refresh every 0 minutes Assigned Follow Ups Show completed entries for last 7 Days
Completed Compl. Advices Hours
Pending Actions Expired Minutes

Open Delete Reassign Follow Up Refresh Cohort Close

Face-to-face
Back-office
COHORT
< Index >





Course Occurrence Search

Find Clear Cancel Hide

Dates

Advanced Criteria

Course code		College		<input checked="" type="radio"/> Owning <input type="radio"/> Delivering
Occurrence code		School		
Course title		Programme		<input type="radio"/> Owning <input checked="" type="radio"/> Linked
Status		Activity		
Substatus		Outcome		
Stand alone	<input type="checkbox"/>	Report		

Open New Copy Cohort Audits Print Extract Close

Course Occurrence Search

Search Criteria		Dates	Advanced Criteria	
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Occurrence code			School	
Course title			Programme	<input type="radio"/> Owning <input checked="" type="radio"/> Linked
Status			Activity	
Substatus			Outcome	
Stand alone	<input type="checkbox"/>		<input type="button" value="Report"/>	

Start Date	Finish Date	Occurrence Code	Course Code	Programme	Site
21/02/2005	2/07/2005	COSC225-05S1 (L)	COSC225	BSC	U
10/07/2006	12/11/2006	COSC225-06S2 (L)	COSC225	BSC	U
26/02/2007	1/07/2007	COSC225-07S1 (C)	COSC225	BSC	C
25/02/2008	6/07/2008	COSC225-08S1 (C)	COSC225	BSC	C

Code: COSC225
 Title: Human-Computer Interaction and Computer Graphics
 Course Type: Course
 Start date: 26/02/2007
 Finish date: 1/07/2007
 Status: Live
 Substatus: Running
 Description: A study of the design.

Course Occurrence Maintenance - COSC225-07S1 (C) (26/02/2007 - 1/07/2007)

Course code **COSC225**Occurrence Code **07S1 (C)**Start date **26/02/2007**Course title **Human-Computer Interaction and Computer Graphics**Finish date **1/07/2007**

- Follow Ups
- Compl. Adv.
- Actions Exp

Fees**Occurrence Groups****Distributions****Teaching Weeks****Composition****S+****Details****Org Unit Relationships****Enrolments****Entry Criteria****Dates****Activities Calendar****Activities Table**Linked programme **BSC**Gross length **19.0**Status **Live**Delivery mode **Int'Web Supported**Units **Weeks**Substatus **Running**Area **Christchurch**Contact hours **111.0**Course Type **Course**Site **C Christchurch**Other directed hours **0.0**Semester indicator **S1 : Semester One**Self-directed hours **0.0****Assessment Ratios**Start year/week **2007 / 8**Total learning hours **111.0**Assess./Exam Ratio **1 : 0**End year/week **2007 / 26**Self-paced Alternate Ratio **0 : 0**Funding classification **06 : Computer Science****Flexitime**Source of funding **EFTS based tuition su**Flexible hours **0**Cost category **B2 : Computing, Fine A**Maximum duration **0**Course factor **0.0917**Cancellation notice **0**

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Task-Centred System Design

Lewis and Rieman, 1993

- HCI equivalent of requirements analysis / use cases
- Exactly and specifically who are the users and what will they use the system for?
- Critical difference between:
 - “The User”: a pretend person who will adapt to the system
 - “Mary”: a real, busy person trying to do her job
- TCSD: a reality-based sanity check for designers

TCSD: 1. User Identification

- Identify categories of end-users, with specific exemplars: typical and extremes
- How: Talk to users!
 - If they won't talk to you, will they use your system?
 - If they really don't exist: worry & describe 'assumed users and tasks'
 - Learn about people in the task chain: who do inputs come from, where do outputs go?

TCSD: 2. Task Identification

1. Record what the user wants to do, but minimize description of how
 - No interface assumptions
 - Can be used to compare alternative designs
2. Record the complete task: input source, output destination
3. Identify users
 - Design success depends on what users know
 - Tested against specific individuals, so name names
4. Uniquely enumerate tasks for identification
5. Identified tasks are circulated for validation (omissions, corrections, clarifications)
6. Identify broad coverage of users and tasks

	Infreq	Freq
Not Important	X	✓
Important	✓	✓✓✓

TCSD: Phase 1&2 Outcomes

A report on Phase 1&2 would state:

1. User categories (& their priorities if necessary)
E.g., for UCSMS, undergrads, postgrads, academics, admin, ...
2. Specific personas exemplifying each category
E.g., “Tom is a first year undergrad entering university directly from school...”
3. Task categories and their priorities (perhaps, ‘must’, ‘should’, ‘could’, ...)
E.g., “Course/program enrollment”, “New course creation”, ...
4. Concrete representative task scenarios (with name of owner)
Enumerated, specific, used for UI validation
“CE42: Tom wants to enroll in COSC224, but to do so he needs a waiver of prerequisite based on his B grade pass in CCS124 at Waikato...”
5. Explicitly identify any groups or tasks that will not be supported (and why)

TCSD: Phase 3, Design

- Use the tasks categories & scenarios to generate and evaluate designs
- Strive for natural workflow (natural to the user)
- Consider task category and its scenarios:
 - For each design for each task scenario:
 - How would the user complete the task?

TCSD: Phase 4, Walk-through evaluation

Interface design debugging (one form of ‘cognitive walkthrough’)

1. Select a task scenario
2. For each step/action:
 - Given what the user knows, what would they do?
 - Is the story believable? ('credible stories')
 - If not, it's an interface bug
 - Once identified, record it, assume it's fixed, and move on to next step

TCSD Example Task Scenarios: UCSMS

Course Enrolment CE15: Mary Smith (id 66677788) wants to enroll in EMTH555 if that course will be sufficient for her to complete her degree requirements. If not, she will enroll in EMTH666 and EMTH777.

Course Enrolment CE43 & ID2: John Smith arrives at student services. He tried to enroll in COSC368 using the on-line system, but was refused 'due to lack of a prerequisite course'. He has a letter from the Head of Department saying that he can enroll in the course, but the letter also states that he must take MATH115 this year. He has been standing in line for the desk for 20 minutes and has forgotten his Canterbury card. He can't remember his student ID or usercode.

Cautions on TCSD

- Tasks and task scenarios often embody process
- Hard to record identified tasks and write task scenarios that are independent of interface or workflow prescription
- This may hinder identification of alternative (better) ways to achieve tasks
- Can be hard to find people ‘responsible’ for new tasks in a system (therefore hard to validate them)

User Centred System Design

- Golden rule of interface design:
“Know The User”
- Design should be based around user's needs, abilities, context, work, tasks
- Users continually involved in design: requirements analysis, storyboards, prototypes, ...

User Centred System Design

Participatory Design

- Problem:
 - Intuitions can be wrong
 - Interviews lack precision/context, and can mislead
 - Designers cannot know user's needs sufficiently well to answer all questions likely to arise during design
- Solution:
 - Designers need access to a pool of representative end users
 - Not managers, union-reps; real users
 - These users are full members of the design process

Participatory Design: Pros and Cons

- ✓ users are excellent at reacting to suggested system designs
 - designs must be concrete and visible
- ✓ users bring in important “folk” knowledge of work context
 - knowledge may be otherwise inaccessible to design team
- ✓ greater buy-in for the system often results

- ✗ hard to get a good pool of end users
 - expensive, reluctance ...
- ✗ users are not expert designers
 - don’t expect them to come up with design ideas from scratch
- ✗ the user is not always right
 - don’t expect them to know what they want

UCSD/Participative Design: Involving the user

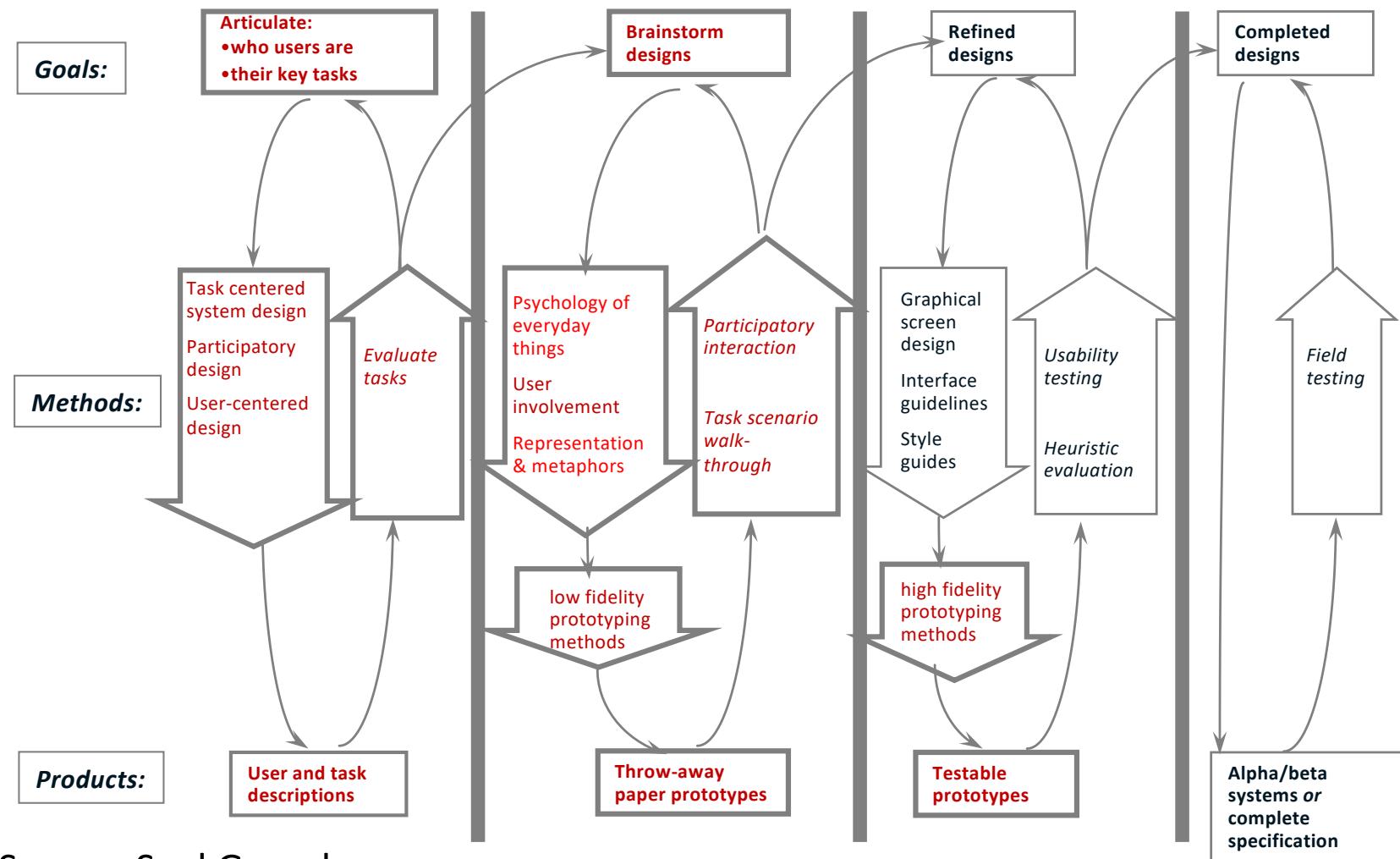
- Talk to users!
- Interviews
 - discover user's culture, requirements, expectations, etc.
 - contextual inquiry: interview *while* doing their job
- Explain designs
 - get input at all design stages
 - important to have visuals/demos: Prototypes
- Walk-throughs
 - No one knows better 'what the user would do'

Schedule (long)

Week	Beginning	LECTURES	LABS
1	19-July	Introduction to HCI	Lab 1: Python/TkInter refresher
2	26-July	Models of interaction	Lab 2: Python/TkInter: Keyboard GUI
3	2-Aug	The Human – senses	Lab 3: Python/TkInter: Canvas & Fitts law GUI
4	9-Aug	The Human – performance and phenomena	Lab 4: Fitts' law experiment and analysis
5	16-Aug	Interface Design – Iteration	Lab 5: Sketching Designs
6	23-Aug	Interface Design – Task Centred System Design	Assignment help
	30-Aug		
	6-Sept		
7	13-Sept	Interface Design – Heuristics	Lab 6: Visual search, decision, skill development
8	20-Sept	Interface Design – Heuristics II	Lab 7: Performance prediction
9	27-Sept	Interface Design – Graphical design	Lab 8: Heuristic evaluation
10	4-Oct	Interface Evaluation & Empirical Methods	Lab 9: Experimental data analysis
11	11-Oct	Interface Evaluation & Empirical Methods 2	Assignment help
12	18-Oct	Overflow and UI Intellectual Property	

✓

Design Process



Source: Saul Greenberg

Usability Heuristics

Usability Heuristics: (Principles, Guidelines, Styleguides, etc.)

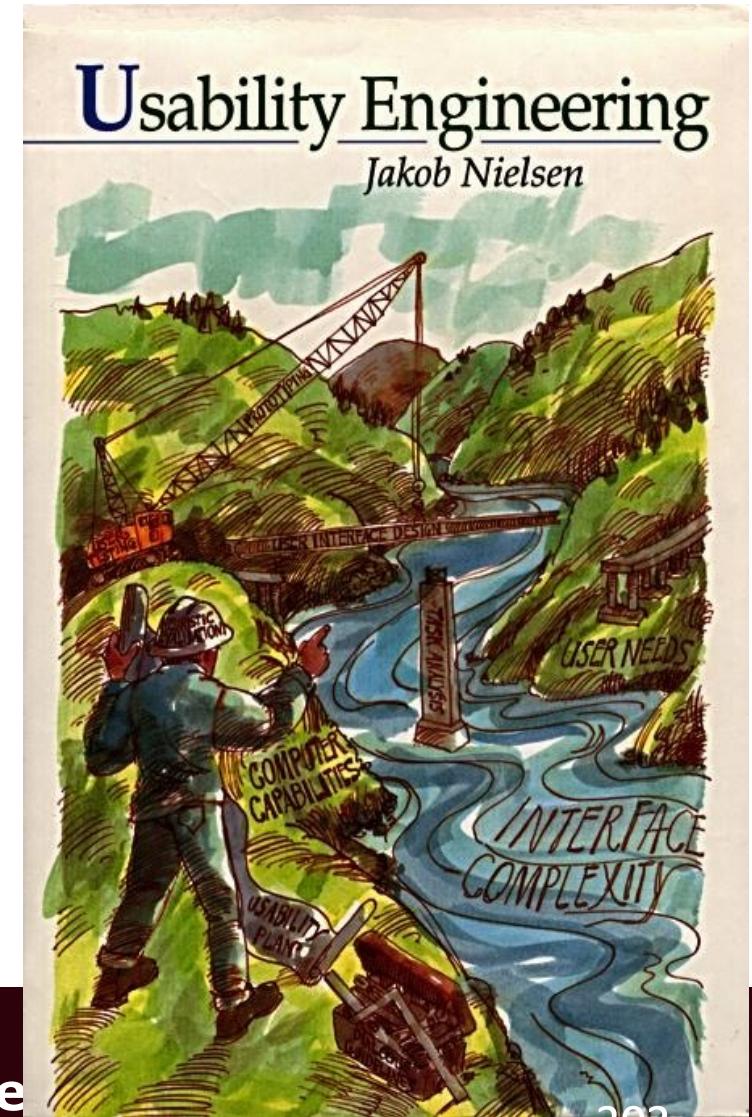
- Encapsulate best practice in ‘rules of thumb’
 - Identify common pitfalls
 - Simple, easy to use, ‘thinking hats’
-
- Formative: guide design decisions
 - Summative: evaluate systems
 - Extensively used

Usability Heuristics: (Principles, Guidelines, Styleguides, etc.)

- Advantages
 - Minimalist
 - A few guidelines cover most problems
 - Easily remembered and applied
 - Discount usability engineering
 - Cheap and fast
 - Can be done by experts and novices (e.g., end users)
- Disadvantages
 - Heuristics are very general ‘motherhoods’
 - There are subtleties in their application

E.g., Nielsen's Ten (original set)

1. Simple and natural dialogue
2. Speak the user's language
3. Minimise user memory load
4. Consistency
5. Feedback
6. Clearly marked exits
7. Shortcuts
8. Good error messages
9. Prevent errors
10. Help and documentation



1. Simple and Natural Dialogue

- Managing complexity: as simple as possible (but no simpler)
- Organisation of the interface:
 - Presentation: simple and natural?
 - Navigation: simple and natural?
- Graphic design
 - Organise, Economise, Communicate
 - Employ a graphic designer
- Use windows frugally
- Less is more

Course Occurrence Maintenance - COSC225-07S1 (C) (26/02/2007 - 1/07/2007)

Course code **COSC225**Occurrence Code **07S1 (C)**Start date **26/02/2007**Course title **Human-Computer Interaction and Computer Graphics**Finish date **1/07/2007**

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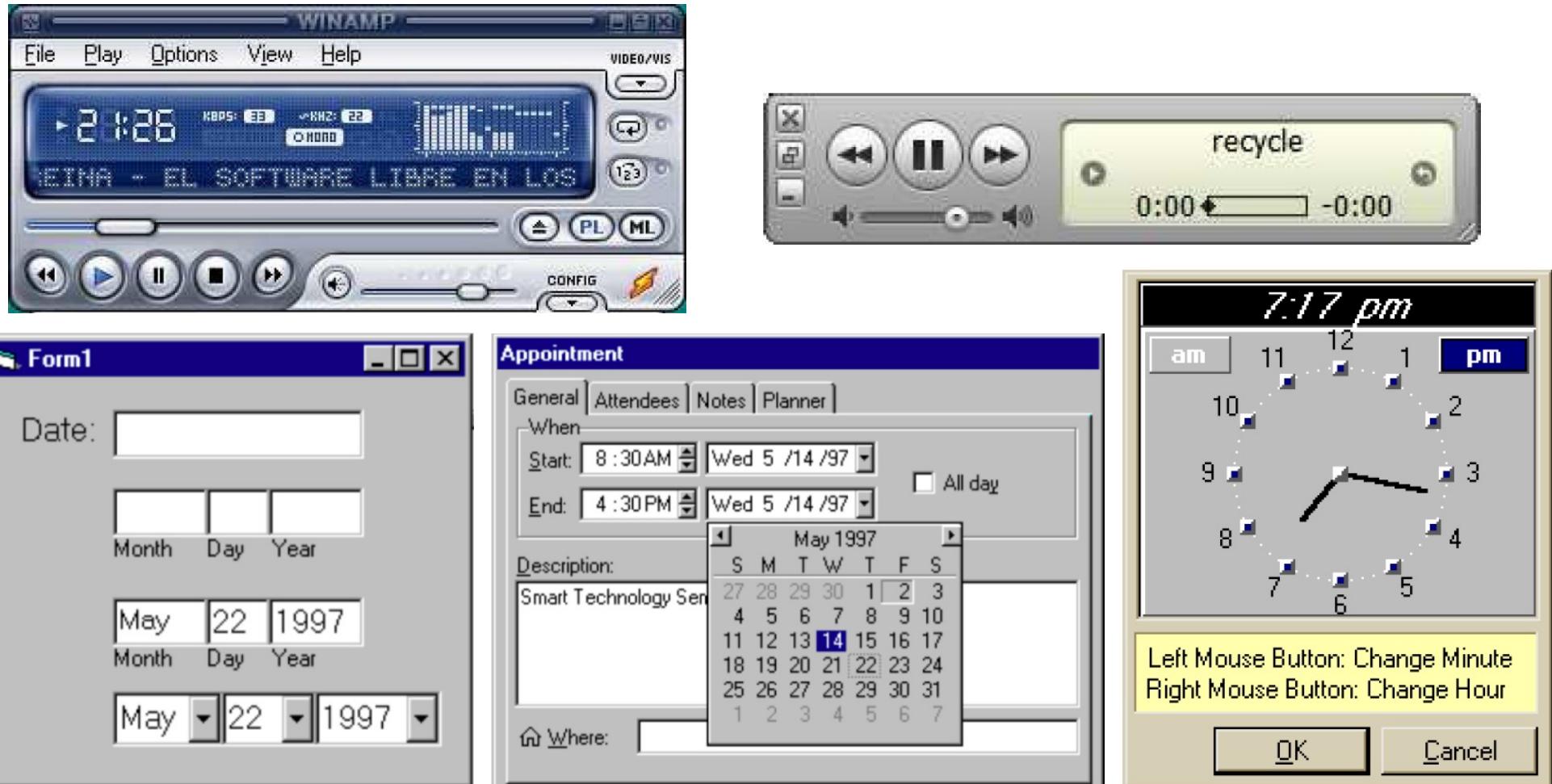
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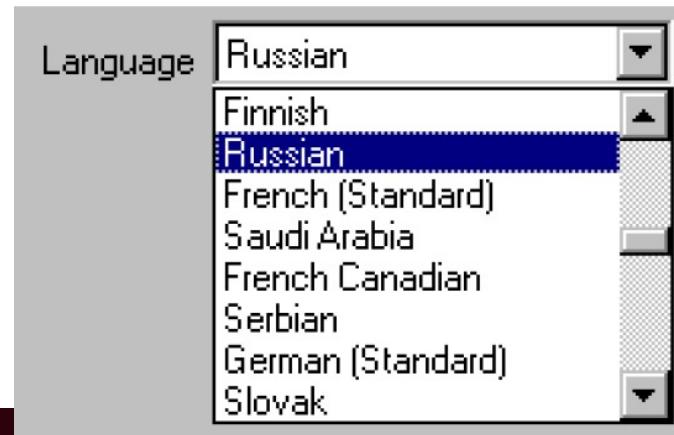
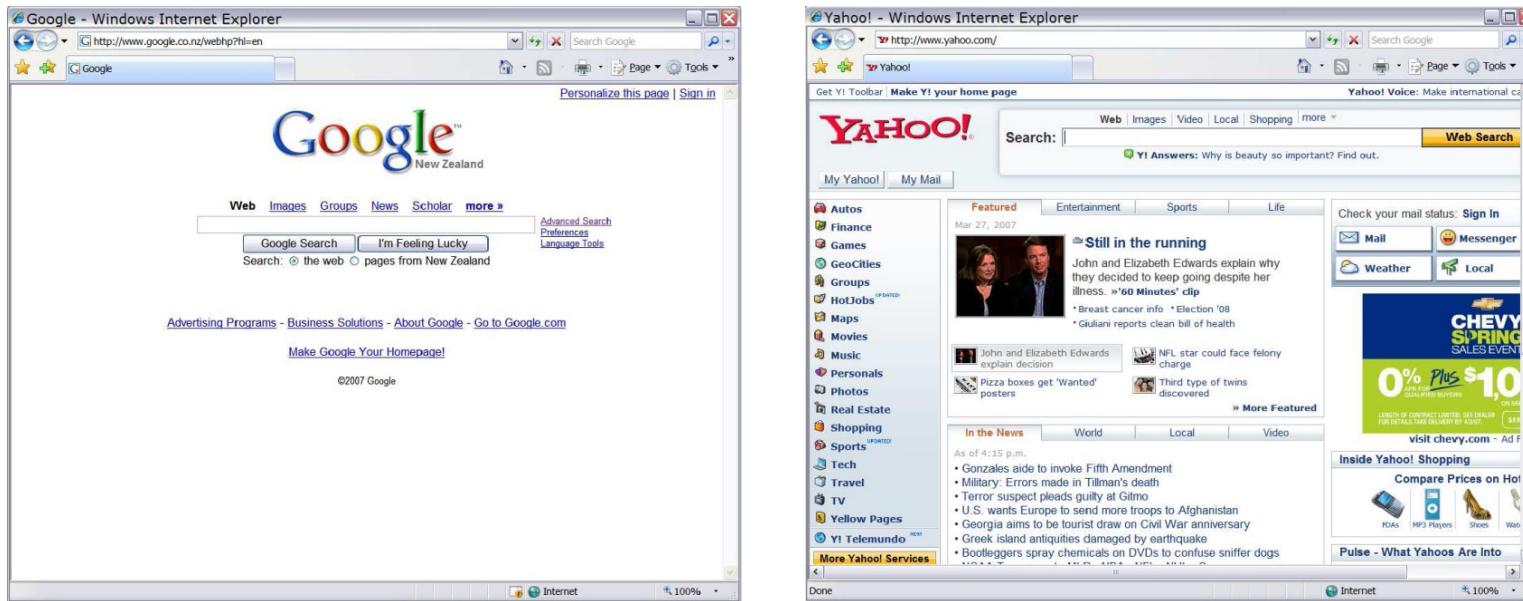
A study of the design,

Open**New****Copy****Cohort****Audits****Print****Extract****Close****New** **Edit****Criteria****Delivering****Linked****Report****Interaction and****ics**

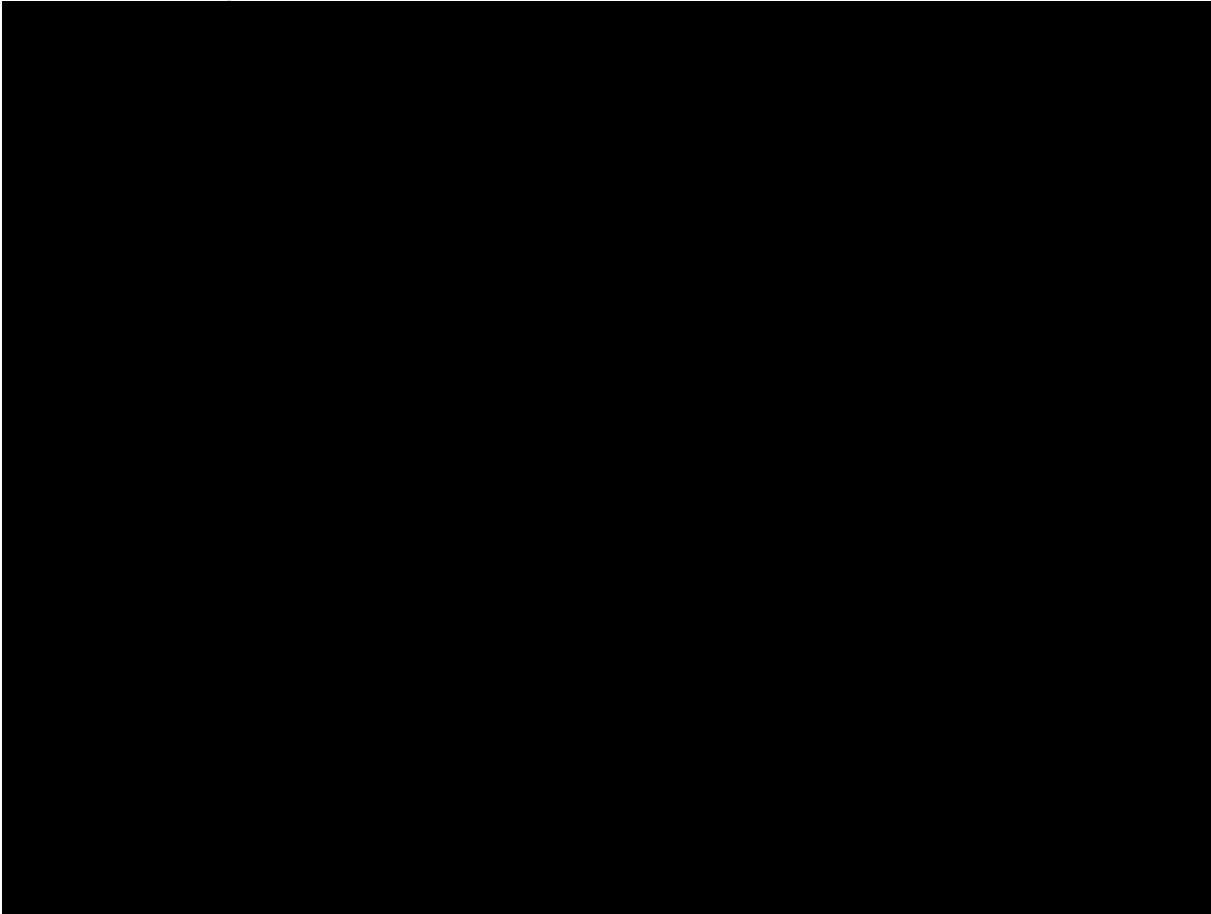
1. Simple and Natural Dialogue



1. Simple and Natural Dialogue



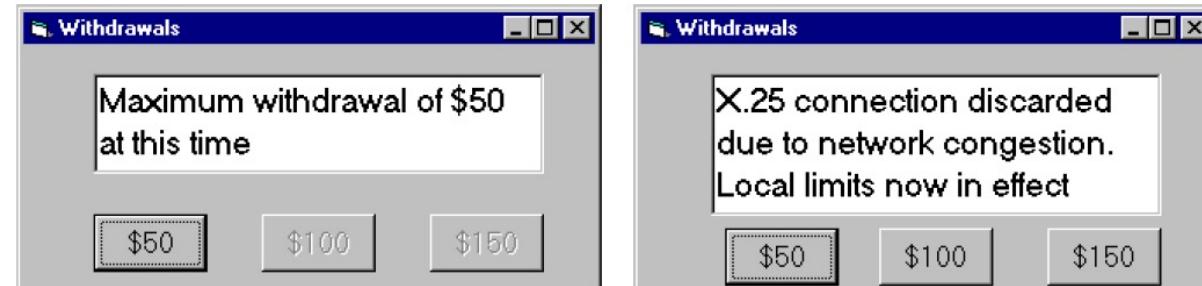
1. Simple and Natural Dialogue



Edward Tufte on the iPhone graphical design

2. Speak the users' language

- Affordance, mappings and metaphors
- Terminology should be based on user's task language

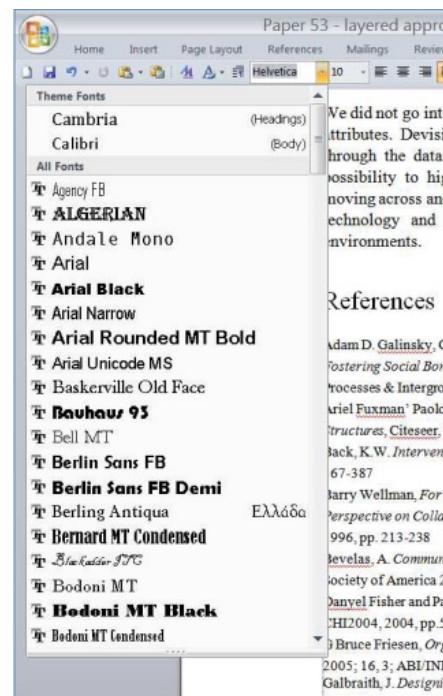


2. Speak the users' language

- “Language” is both textual and iconic
 - “Save” (natural language)
 - Ctrl-S (abbreviation)
 - Alt FS (mnemonic for menu action)
 -  (toolbar icon)
 - How about Ctrl-x-s (emacs)?

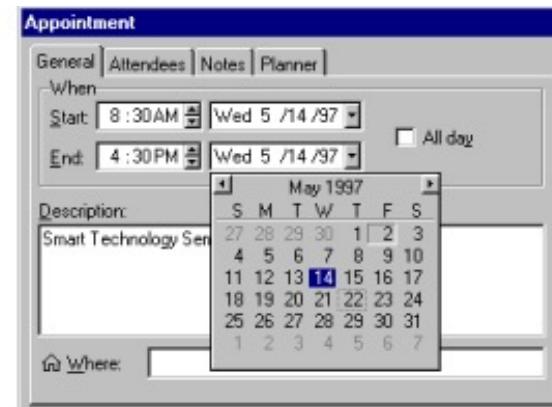
3. Minimise the user's memory load

- Promote recognition over recall



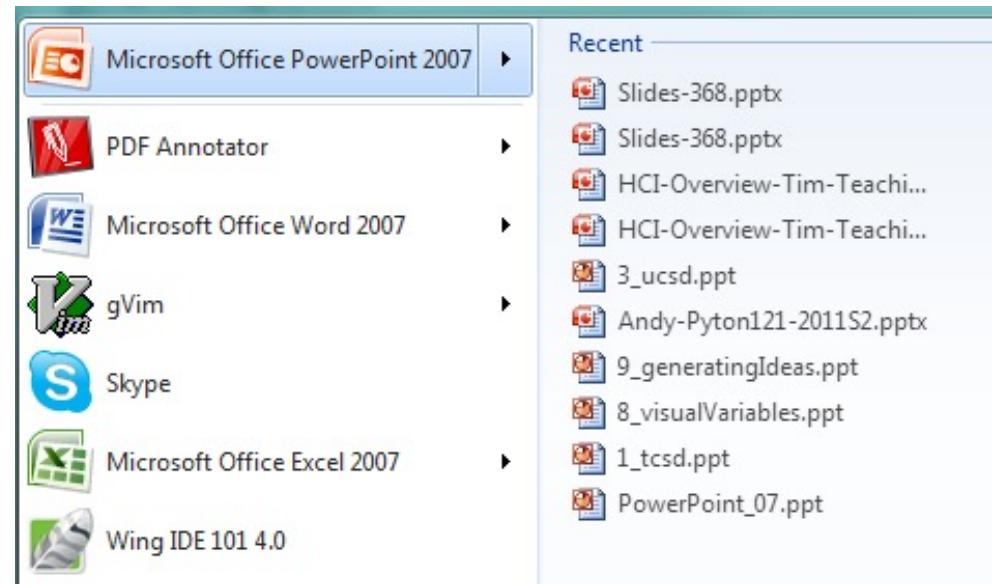
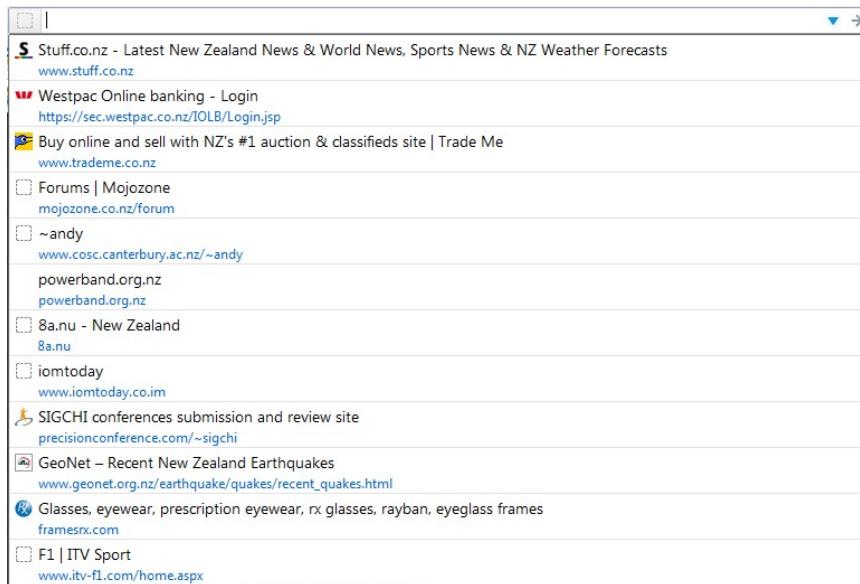
3. Minimise the user's memory load

- Show input formats and provide defaults



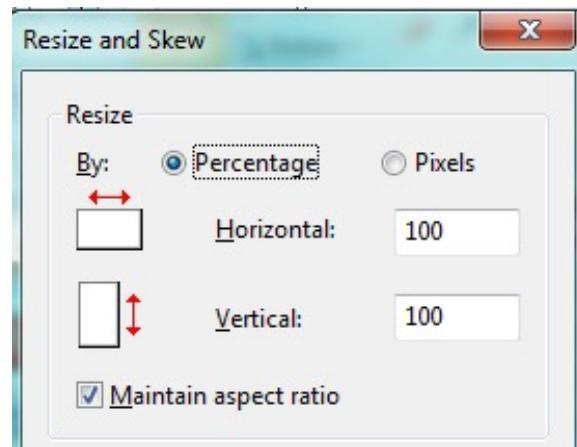
3. Minimise the user's memory load

- Support reuse and revisitation



3. Minimise the user's memory load

- Support exchange of units

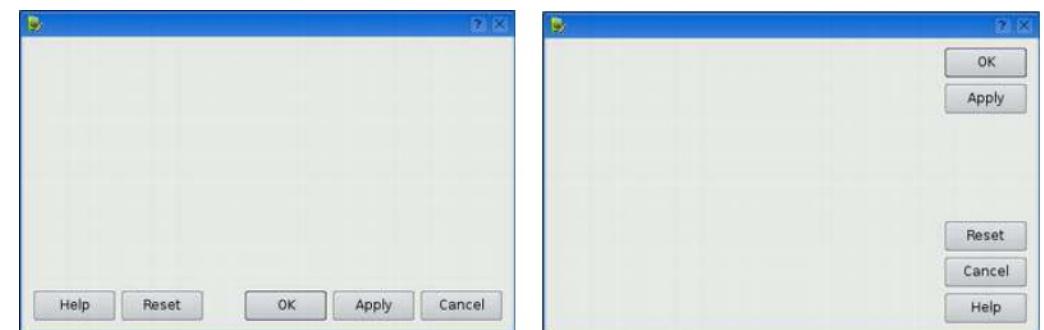
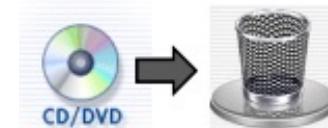
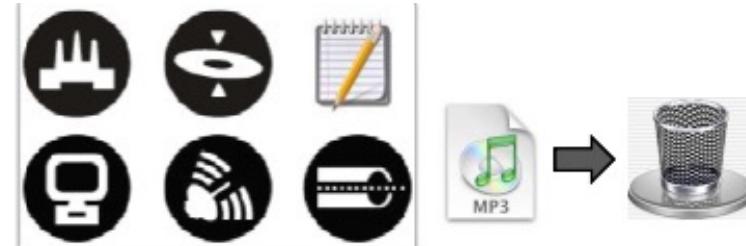


3. Minimise the user's memory load

- Support generalisation techniques
 - Same command can be applied to all objects (e.g., cut, copy, paste, drag, drop for characters, words, paragraphs, objects, files...)
 - Same method/modifier can be generalised (e.g., circle is a constrained ellipse; square is a constrained rectangle, etc.)

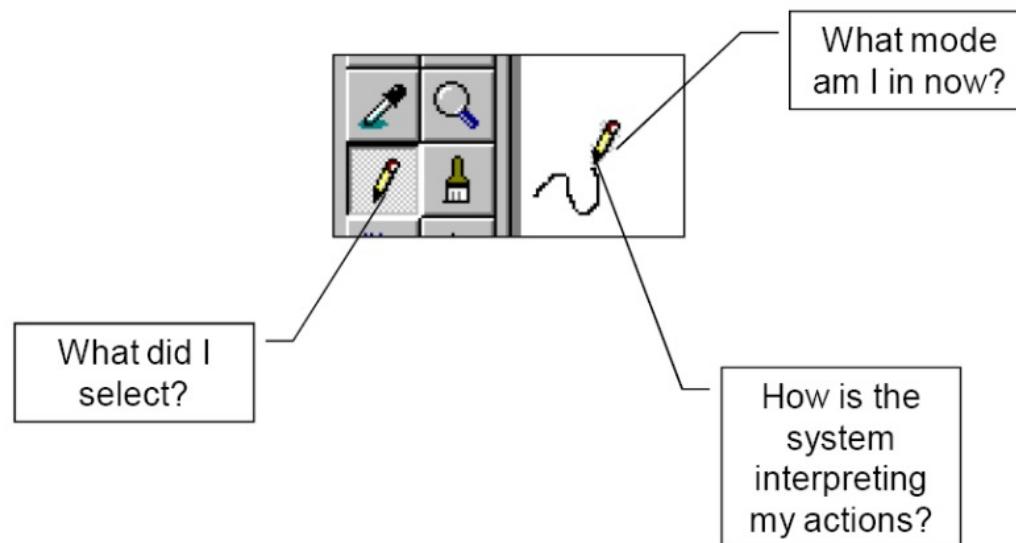
4. Be Consistent

- In graphic design
- In command structure
- In everything!
 - Internal consistency: within the application
 - External consistency: within the platform
 - Beyond computing



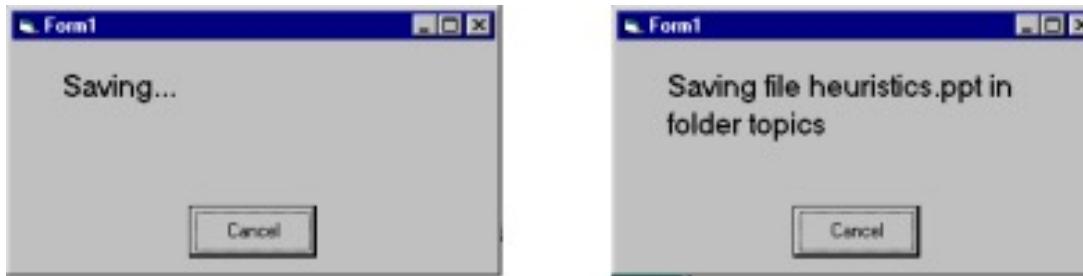
5. Provide Feedback

- Continually inform the user about:
 - What the system is doing
 - The system's interpretation of the input

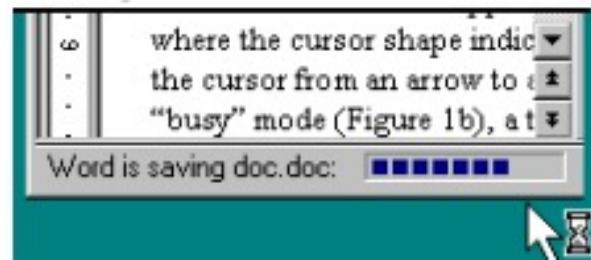


5. Provide Feedback

- Be specific, based on input

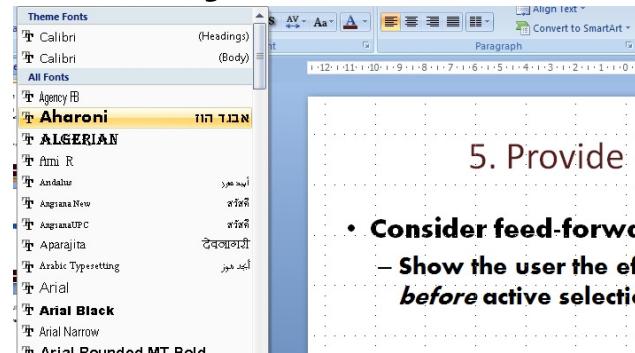


- Consider context of the action (don't disrupt)



5. Provide Feedback

- Consider feed-forward
 - Show effect of action *before* active selection



- Offer choices based on partial task completion



5. Provide Feedback

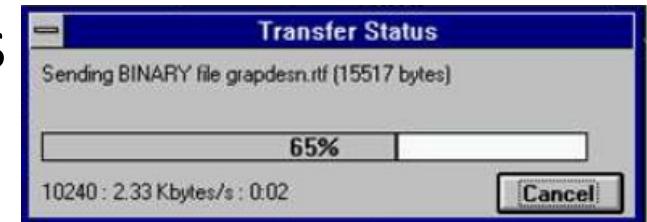
- Response times:
 - < 0.1s: perceived as ‘instantaneous’
 - < 1s: delay noticed, but flow of thought uninterrupted
 - 10s: limit for keeping attention on the dialogue
 - > 10s: user will want to perform other tasks
- Consider feedback persistence

5. Provide Feedback

- Feedback for delays
 - Cursors for short delays
 - Percentage done for longer delays



- “Working” dialogues for unknown delays



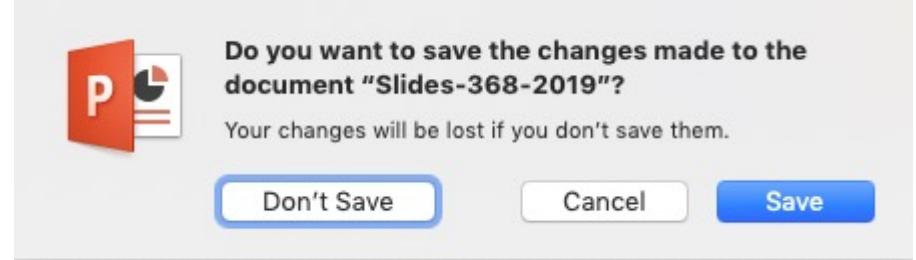
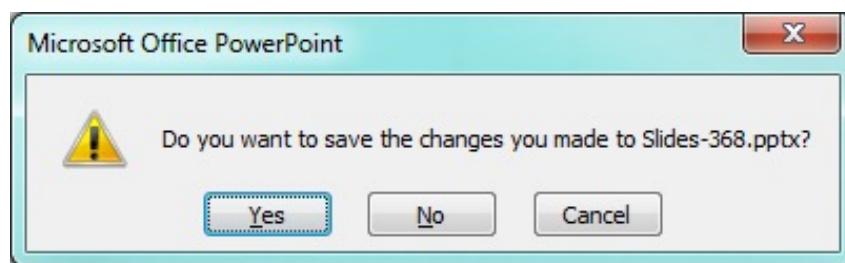
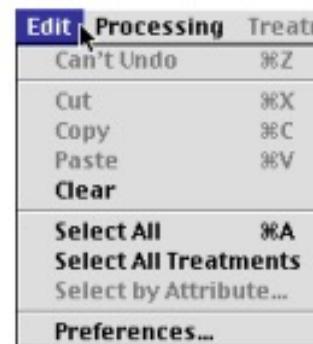
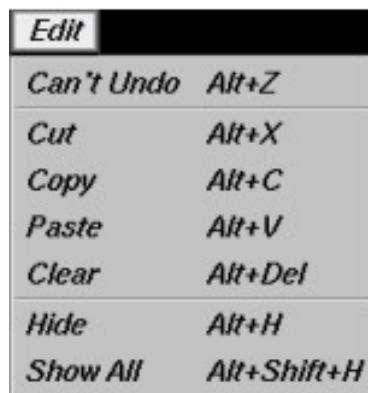
6. Provide clearly marked exits



6. Provide clearly marked exits

- Avoid ‘trapping’ the user: offer a way out when possible
- Strategies:
 - Cancel button
 - Universal undo (return to previous state)
 - Interrupt (especially for lengthy operations)
 - Higher precedence for more recent actions
 - Quit
 - Defaults (for restoring a property sheet)

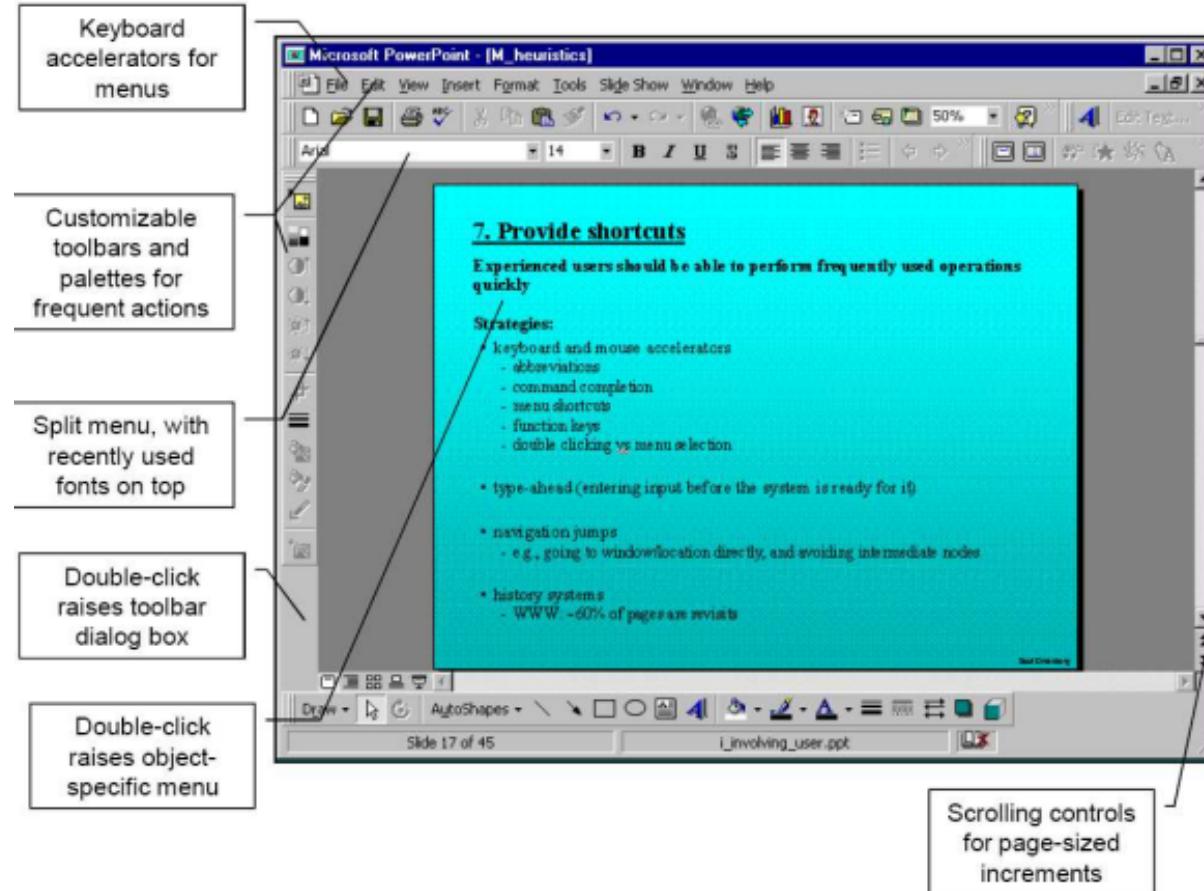
6. Provide clearly marked exits



7. Provide shortcuts

- Enable high performance by experienced users
 - Keyboard accelerators
 - Command completion
 - Function keys
 - Double clicking; context menus
 - Type-ahead (most likely prediction is offered)
 - Gestures
 - History

7. Provide shortcuts

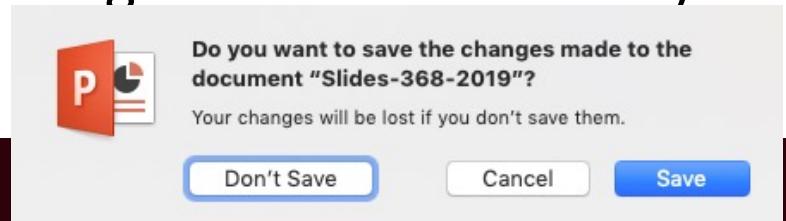


8. Prevent errors and avoid modes

- People will make errors:
 - Mistakes: conscious deliberation leads to incorrect action
 - Slips: unconscious behaviour that gets misdirected
- General rules:
 - Prevent slips before they occur (e.g., syntactic correctness)
 - Allow slips to be detected when they occur (via feedback)
 - Support easy correction (e.g., undo)
 - Commensurate effort (difficult states are hard to irreversibly leave)

8. Prevent errors and avoid modes

- Examples
 - Mode errors:
 - Have as few modes as possible (preferably none)
 - Assure modes are visible (or audible)
 - Spring-loaded modes: ongoing action maintains mode
 - Capture errors:
 - Instead of confirmation, make actions undoable
 - Allow reconsideration (e.g., opening trashcan to remove)
 - Context-sensitive confirmation



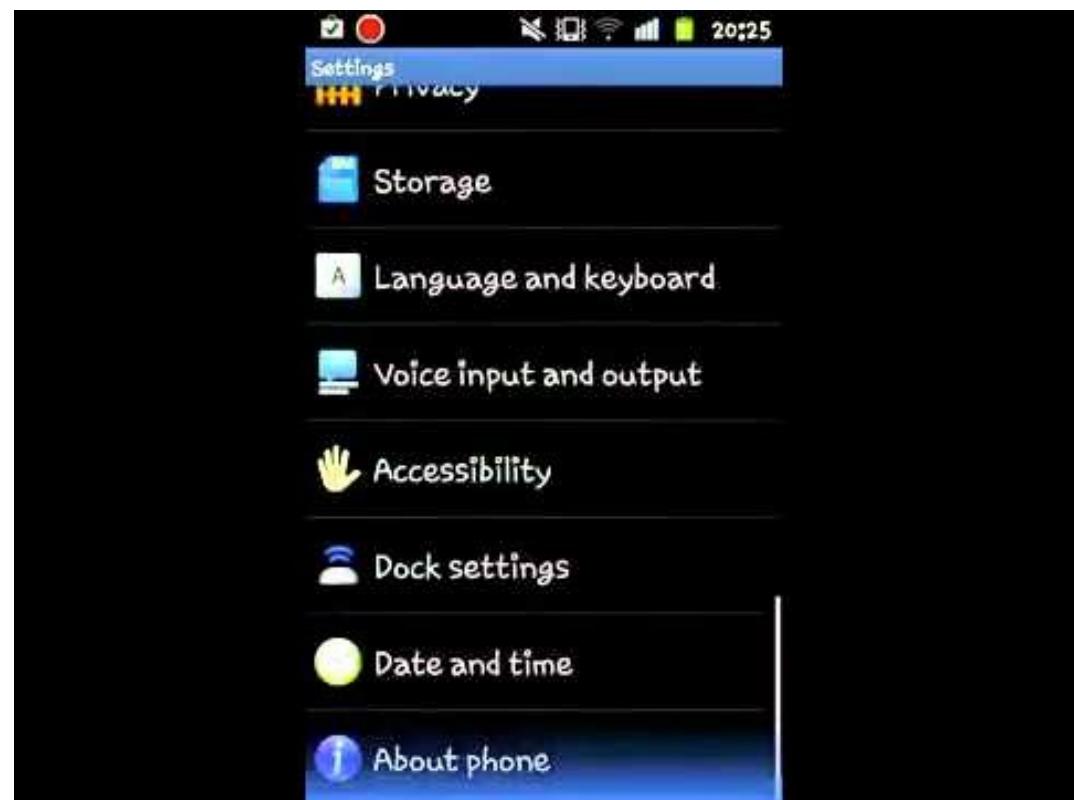
8. Prevent errors and avoid modes

- Forcing functions (e.g., syntactic correctness)
 - Prevent continuation of wrongful action
- Warnings
 - Irritating when overused
 - Can be ‘heavy’ (e.g., alertbox) or ‘light’ (beep)
- Do nothing
 - Illegal action ignored
 - User must infer what happened
 - E.g., ignoring letters typed into a number field

8. Prevent errors and avoid modes (iPhone ‘rubber banding’)

- Rubber-banding problem:
 - Potential for confusion/error over gesture scrolling direction – drag document (down for up); drag camera (down for down)
 - No scrollbars for cue (or minimal) or for control
 - Lack of feedback at terminus, confused for “crashed/broken”

8. Prevent errors and avoid modes (iPhone ‘rubber banding’)

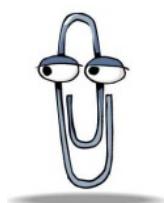


8. Prevent errors and avoid modes (iPhone ‘edge swipe’)

- Edge-swipe problem:
 - Users can swipe/drag between photos
 - Users can swipe/drag within a zoomed photo
 - Users accidentally swipe between photos when they hit the edge of a photo while exploring it
 - How do you prevent the error?

8. Prevent errors and avoid modes

- Self-correct:
 - System guesses action and does it
 - Problems of trust (and negativity bias)
- Let's talk about it:
 - System initiates a dialogue to solve problem
 - E.g., IDE shows syntax error in code or compile error
- Teach me (user instructs system):
 - System asks what was intended
 - Action becomes legal (e.g., dictionary addition)
- Teach you (system instructs user)
 - System guesses intention and instructs user on proper way
 - Clippy! (condescending, boring, tedious, wrong)



9. Deal with errors in a positive and helpful manner

- **Bad error message:**

Error 25

- **Clear language, not codes:**

Cannot open this document

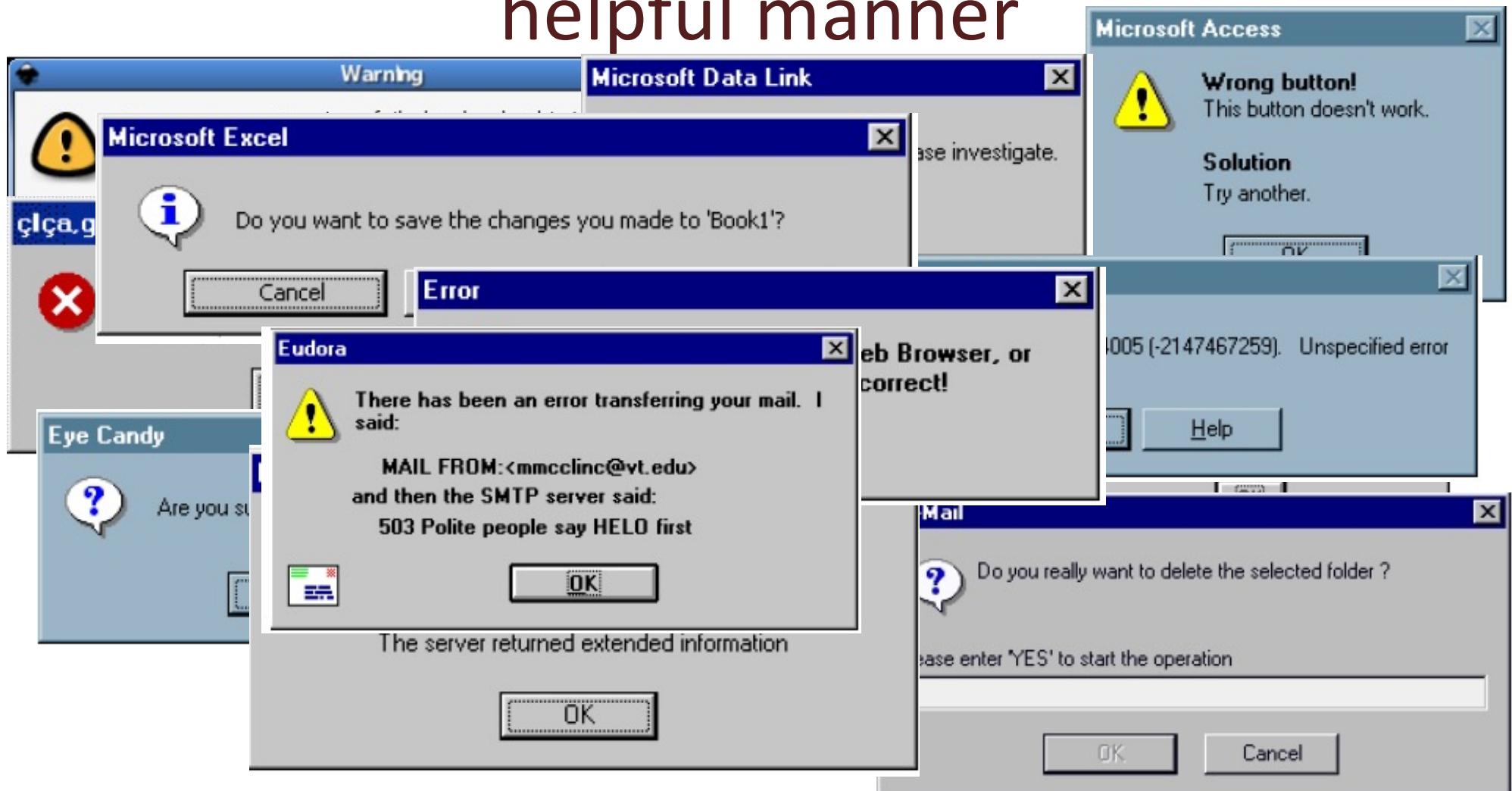
- **Precise, rephrasing user's input:**

Cannot open 'chapter5.doc' because the application Microsoft Word is not on your system

- **Constructive help:**

Cannot open 'chapter5.doc' because the application Microsoft Word is not on your system. Open with WordPad instead?

9. Deal with errors in a positive and helpful manner



10. Help and documentation

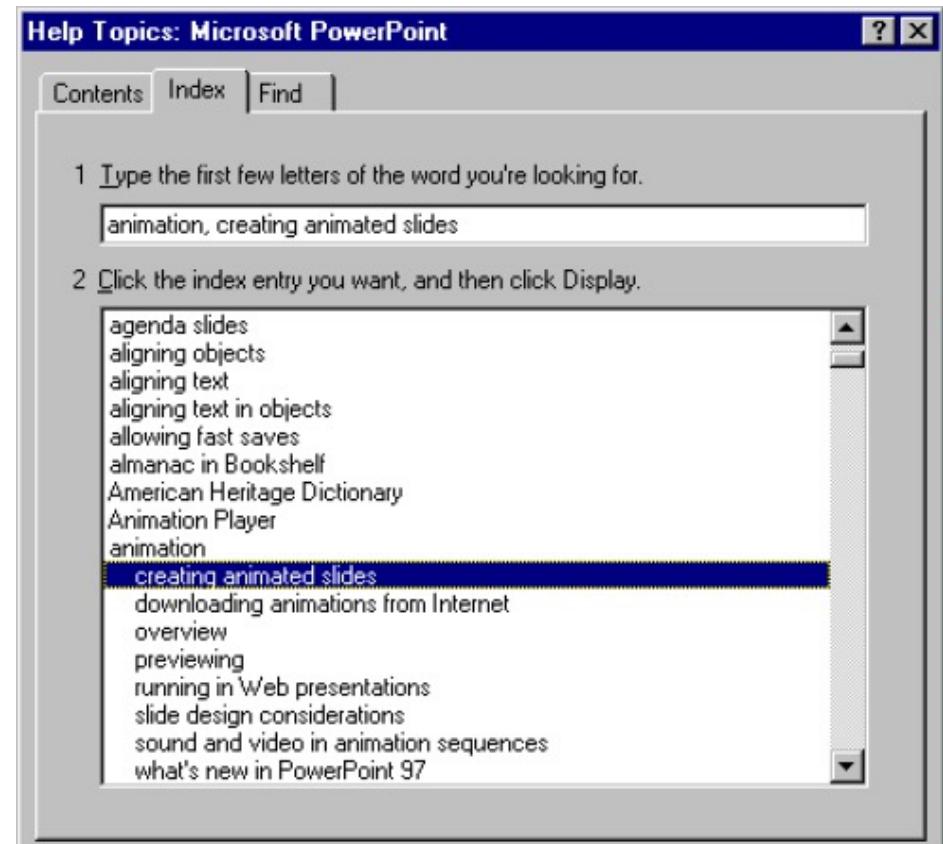
- Documentation is no excuse for interface hacks
- Write the manual before the system
- Task-centred manuals, particularly for beginners and for introduction to new system parts
- Quick reference cards for quick reference to aid novice to expert transition

10. Help and documentation

- Types of help:
 - Tutorials
 - Short introductory guides and overviews
 - Encourage exploration
 - Video walkthrough
 - Simple task walkthrough
 - Reference manuals
 - For lookup by expert (or those wanting to become so)
 - Thematically arranged

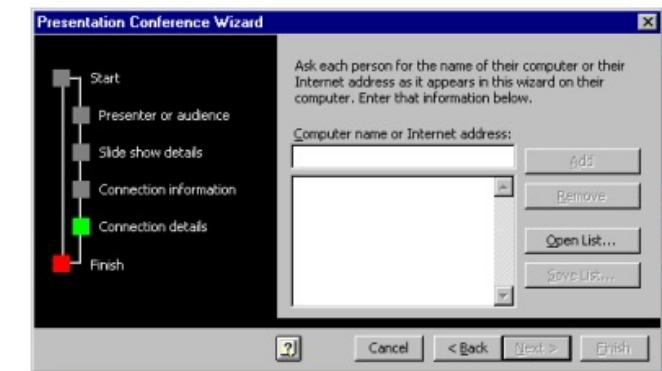
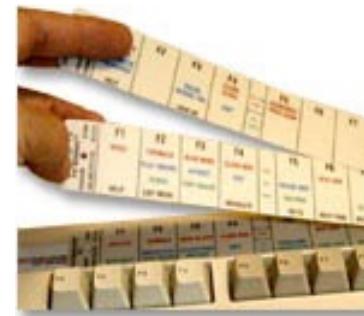
10. Help and documentation

- Types of help (cont.):
 - Online reference:
 - Search/find
 - Table of contents
 - Index



10. Help and documentation

- Types of help (cont.):
 - Reminders:
 - Short reference cards
 - Keyboard templates
 - Tooltips
 - Wizards:
 - Walk user through typical task
 - Dangerous if the user gets stuck
 - Tips
 - Tool for extending user capability
 - Risk that they become boring/tedious



Inspection methods

- Systematic inspection of a user interface
- Goal is to find usability problems
- Inspections typically use inspectors, not real users
- Works for systems at any stage:
 - Paper storyboards, prototypes
 - Working systems
- Heuristic evaluation
 - Most popular inspection technique
 - 3-5 evaluators inspect the interface

How to do a heuristic evaluation

- Each inspector works alone with the interface
- Evaluator traverses interface several times:
 - Has a scenario/task in mind
 - Inspects UI components and workflow
 - Compares them with the heuristics
 - Looks for noncompliance/problems
 - Notes and rates each problem
- Two pass approach
 - First pass: focus on specific UI elements
 - Second pass: focus on higher integration and flow

Course Occurrence Maintenance - COSC225-07S1 (C) (26/02/2007 - 1/07/2007)

Course code **COSC225**Occurrence Code **07S1 (C)**Start date **26/02/2007**Course title **Human-Computer Interaction and Computer Graphics**Finish date **1/07/2007**

- Follow Ups
- Compl. Adv.
- Actions Exp

Fees**Occurrence Groups****Distributions****Teaching Weeks****Composition****S+****Details****Org Unit Relationships****Enrolments****Entry Criteria****Dates****Activities Calendar****Activities Table**Linked programme **BSC**Gross length **19.0**Status **Live**Delivery mode **Int'Web Supported**Units **Weeks**Substatus **Running**Area **Christchurch**Contact hours **111.0**Course Type **Course**Site **C Christchurch**Other directed hours **0.0**Semester indicator **S1 : Semester One**Self-directed hours **0.0****Assessment Ratios**Start year/week **2007 / 8**Total learning hours **111.0**Assess./Exam Ratio **1 : 0**End year/week **2007 / 26**Self-paced Alternate Ratio **0 : 0**Funding classification **06 : Computer Science****Transfer to timetabling system****Flexitime**Source of funding **EFTS based tuition su****Last transferred to timetabling system**Flexible hours **0**Cost category **B2 : Computing, Fine A****Last updated from timetabling system**Maximum duration **0**Course factor **0.0917****Change...**Cancellation notice **0**Result status **No Result**Result status date **23/05/2006**Count Placements&Activities in VOS **Save****Delete****Save-Next****Close****Previous****Next****Index**

Finish date:

17/07/2007

Status:

Live

Substatus:

Running

Description:

A study of the design,

Open**New****Copy****Cohort****Audits****Print****Extract****Close**

Results synthesis

- Assess overlap in problems reported by inspectors
- Review and compare severity rankings
- Rank problems in order of importance

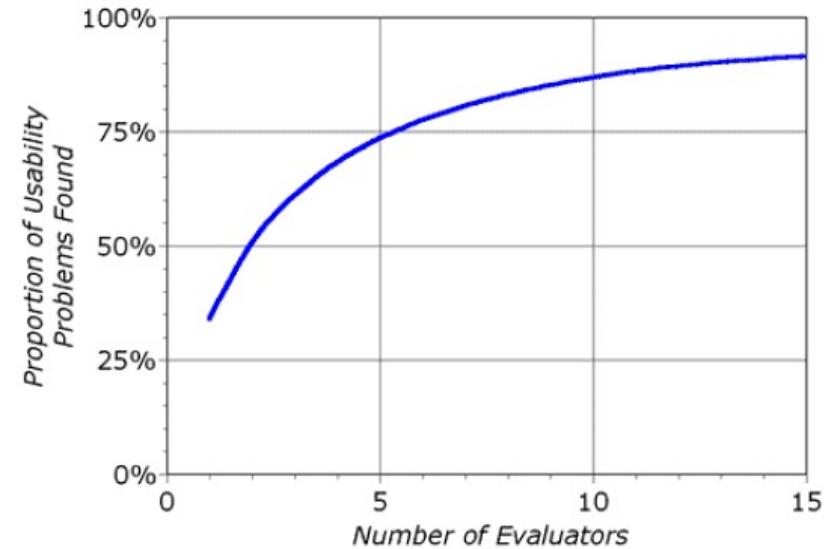
		Proportion of users experiencing the problem	
		Few	Many
Impact of the problem on those that encounter it	Small	Low severity	Medium severity
	Large	Medium severity	High severity

Who should evaluate?

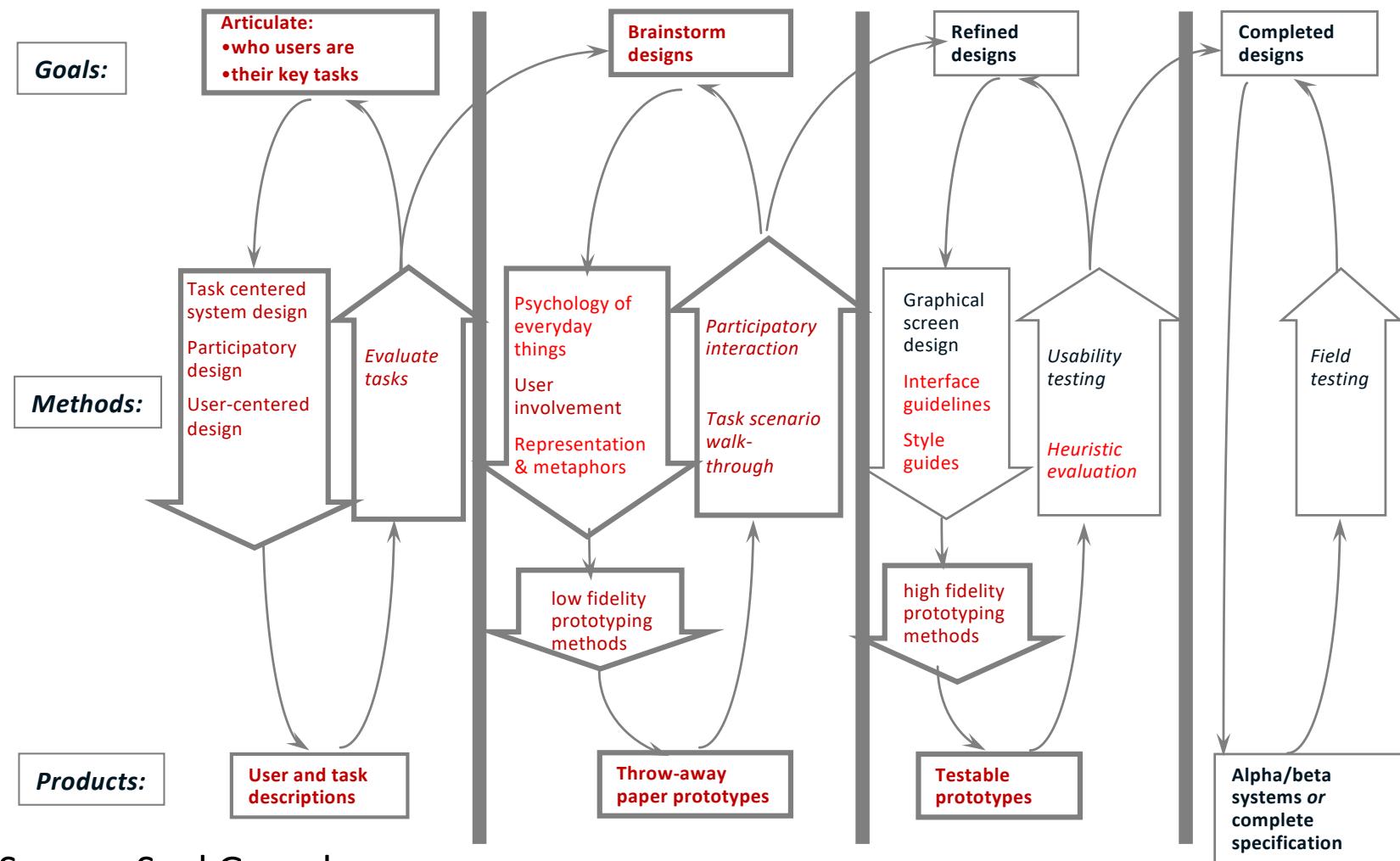
- Different perspectives will catch different problems
- A reasonable team:
 - Developer
 - Designer
 - Usability expert
 - Domain expert
 - User
- Must be trained in the technique

How many evaluators?

- Each inspector finds about 35% of problems
 - But they usually don't find the same ones
- 3 inspectors find $\approx 60\%$, 5 find $\approx 70\%$,



Design Process



Source: Saul Greenberg

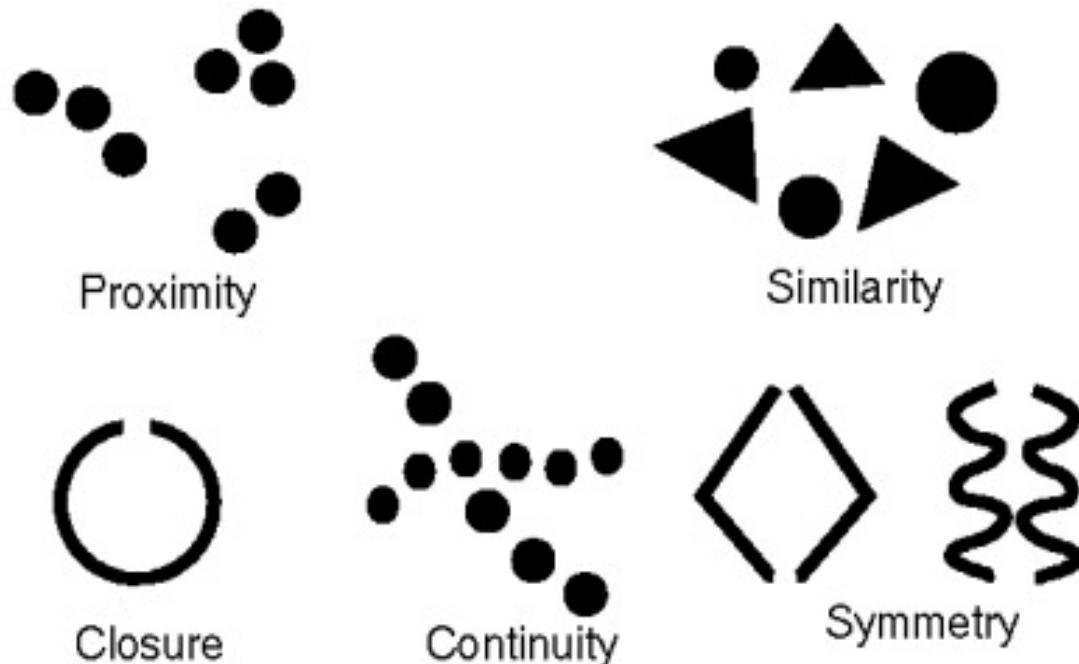
Graphical Screen Design

Good screen design draws on:

- Gestalt laws of perceptual organisation
- PARC principles: proximity, alignment, repetition, contrast
- Data representation
- Visual variables
- (Then information visualisation)

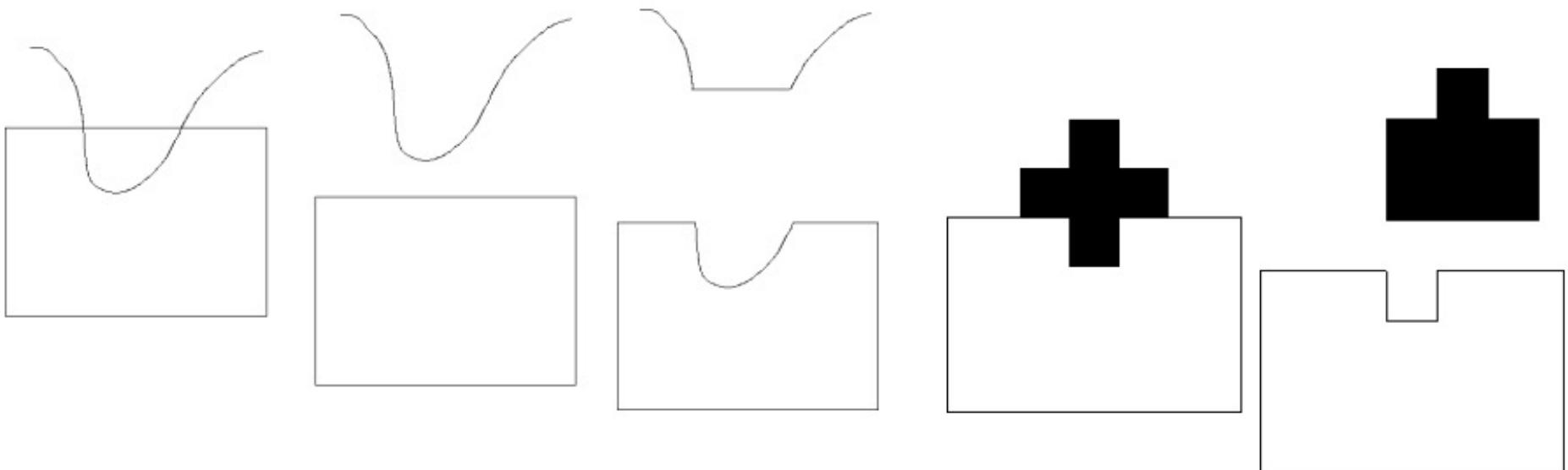
Gestalt Laws of Perceptual Organisation

- How do we see relationships/patterns
- Proximity
- Similarity
- Continuity
- Symmetry
- Closure



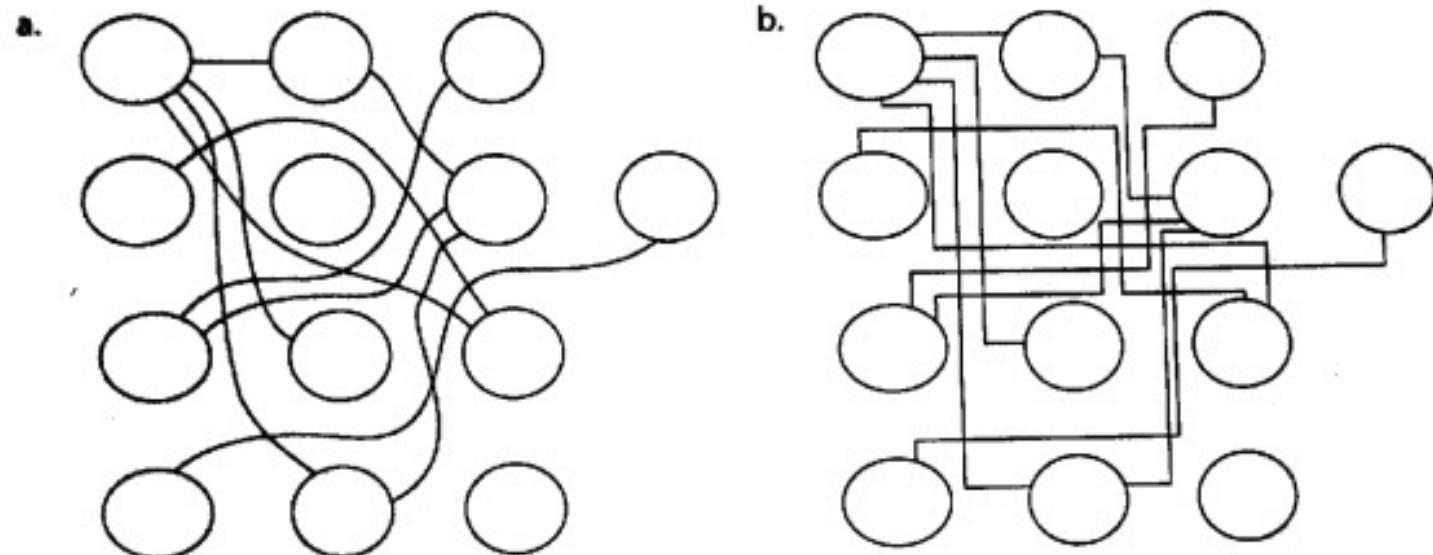
Gestalt Laws of Perceptual Organisation

- E.g., Continuity and symmetry



Gestalt Laws of Perceptual Organisation

- Smooth continuity eases perception (at cost of 'neatness')



PARC Principles for Graphical Screen

Robin Williams: The non-designer's design book

- Proximity
 - Group related elements
 - Separate unrelated ones
- Alignment
 - Visually connect elements
 - Creates a visual flow
- Repetition
 - Repeat designs through the interface
 - Creates unity and consistency
- Contrast
 - Make different things look different
 - Bring out dominant elements, mute lesser ones

Worked example from Saul Greenberg

World Wide Web Info for Saul Greenberg - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address C:\Documents and Settings\Saul Greenberg\My Documents\My Webs\~saul\hci_topics\powerpoint_presentations2003\graphical_design\version

GroupLab
The University of Calgary

Saul Greenberg GroupLab Dept Computer Science University of Calgary



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Research

[GroupLab project](#) describes research by my group

[Publications](#) by our group; most available in HTML, PDF, and postscript

[Project snapshots](#) describes select projects done in GroupLab

[GroupLab software repository](#)

[GroupLab people](#)

Graduate Students

I have a few openings for MSc and PhD students who are interested in Human Computer Interaction and / or Computer Supported Cooperative Work. [Some research and project ideas](#) [honors and graduate students](#)

Courses offered this year

[CPSC 481](#): Foundations and Principles of Human Computer Inter

Original

253

Proximity

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[CPSC 601.13](#): Computer Supported Cooperative Work

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254

Alignment

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[CPSC 699](#): Research Methodology for Computer Science (old!)
[CPSC 601.48](#): Special Topics: Heuristic Evaluation


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Contrast

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[CPSC 601.56](#): Advanced Topics in HCI: Media Spaces and Casual Interaction
[SENG 609.05](#): Graphical User Interfaces: Design and Usability
[SENG 609.06](#): Special Topics in Human Computer Interaction
[Ego alert](#): My entry on U Calgary's 'Great Teachers' Web Site

Administration [Ethics Committee](#) for research with human subjects; I am the chair

Last updated: March 20, 1867

256

Repetition

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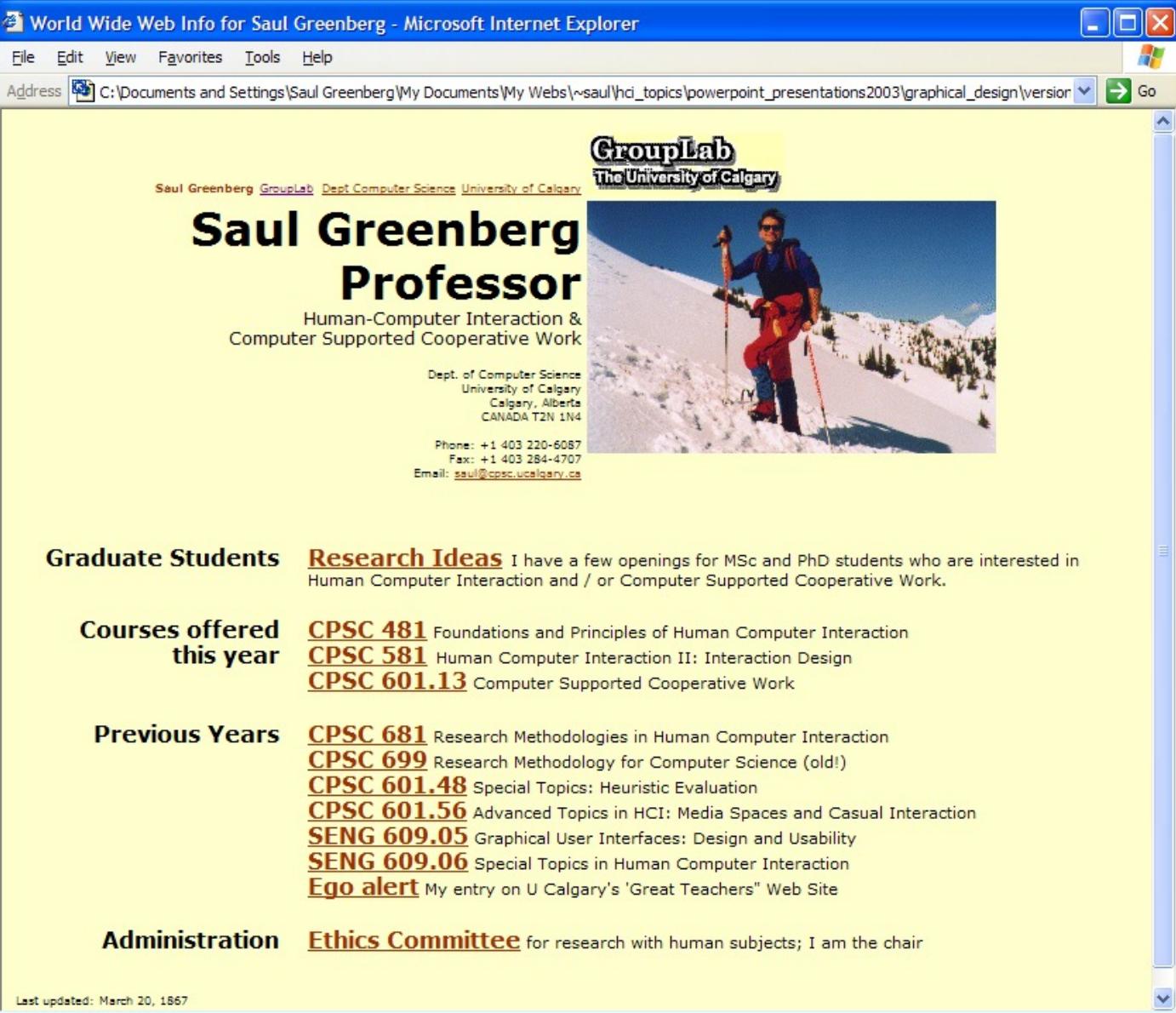
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257

Good Design Is As Easy as 1-2-3

1. Learn the principles.

They're simpler than you might think.

2. Recognize when you're not using them.

Put it into words – name the problem.

3. Apply the principles.

You'll be amazed.

Contrast
Repetition
Alignment
Proximity

Good design is as easy as...

1 Learn the principles.

They're simpler than you might think.

2 Recognize when you're not using them.

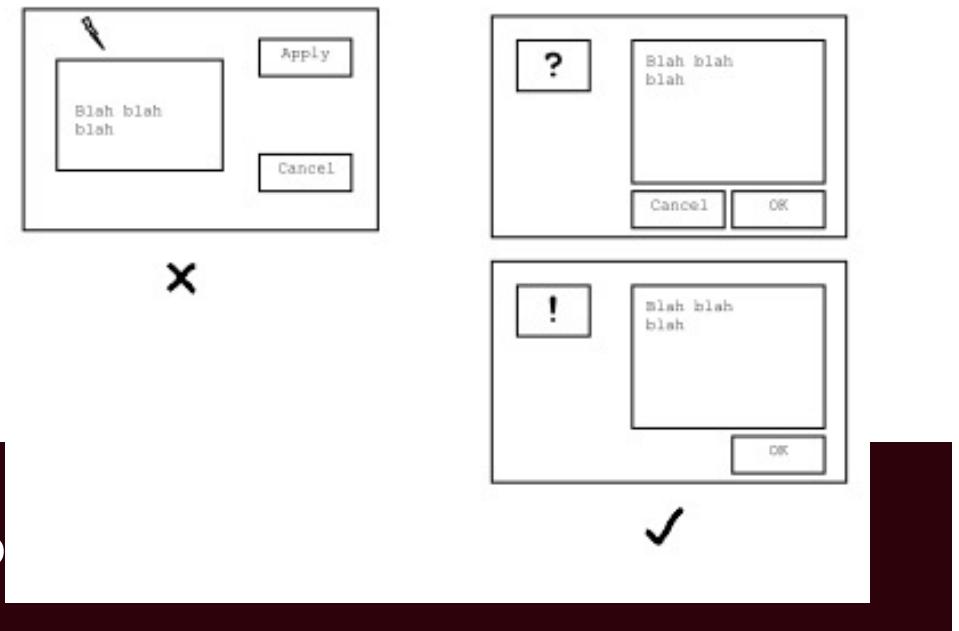
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3 Apply the principles.

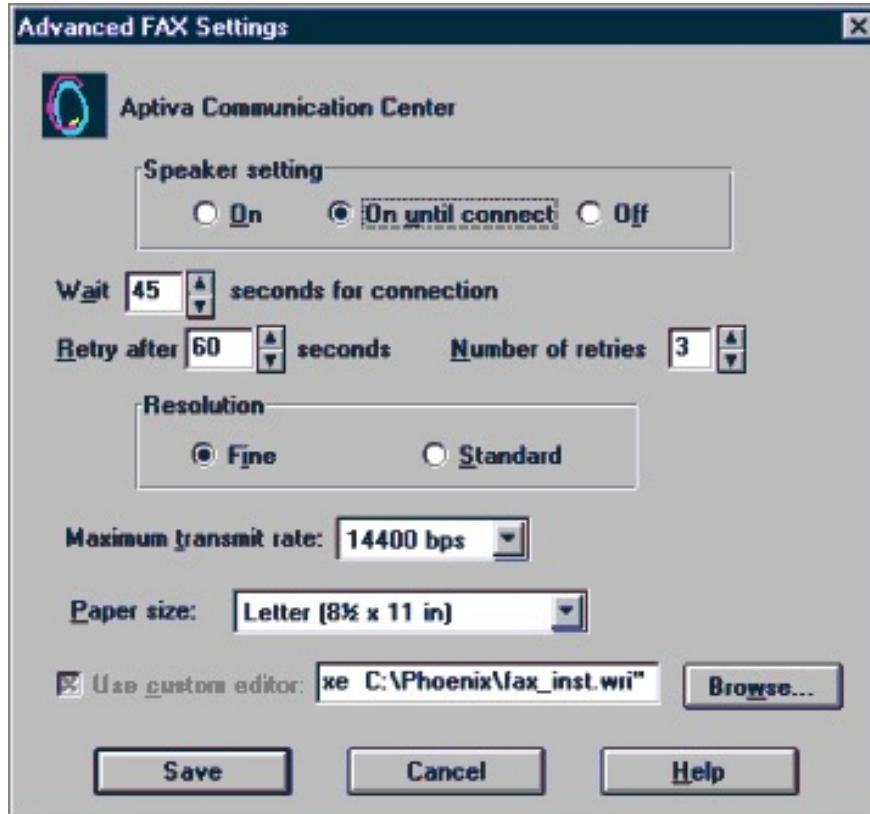
You'll be amazed.

Grids

- Horizontal and vertical alignment to group related components
- Proximity to group (and separate)
- Make light use of explicit structure (boxes and borders)



Grids



Weak use of grids. Scruffy



Excessive use of borders

Course Occurrence Maintenance - COSC225-07S1 (C) (26/02/2007 - 1/07/2007)

Course code **COSC225**Occurrence Code **07S1 (C)**Start date **26/02/2007**Course title **Human-Computer Interaction and Computer Graphics**Finish date **1/07/2007**

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- Compl. Adv.
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Grids (in document tables)

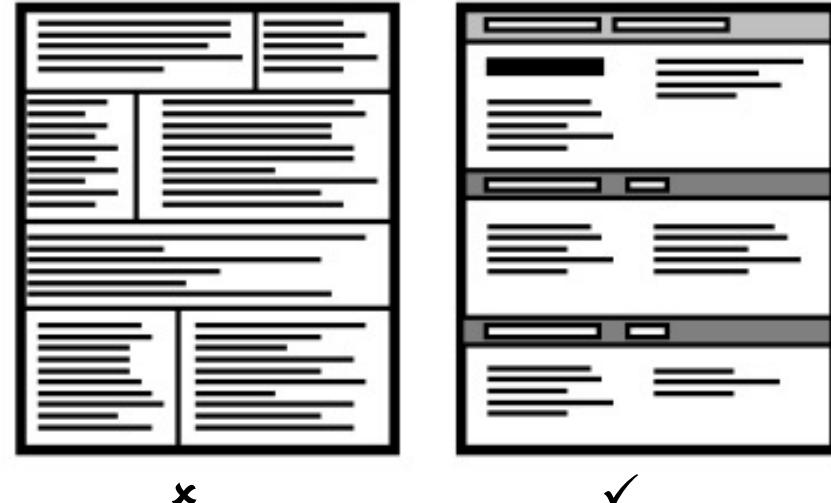
Subject	Initial Model	Task 1		Task 2	
		Correct?	Confidence	Correct?	Confidence
1	List	NO	weak	YES	v weak
2	List	YES	weak	YES	strong
3	Stack	YES	strong	YES	strong
4	List	NO	weak	NO	weak
5	List	NO	strong	YES	weak
6	Tree	NO	weak	YES	weak
7	List	NO	weak	YES	weak
8	List	NO	weak	NO	strong
9	Dequeue	YES	strong	NO	strong
10	List	NO	weak	NO	strong
11	List	NO	weak	NO	strong
Totals		3 of 11 Correct		6 of 11 Correct	
		8 of 11 Incorrect		5 of 11 Incorrect	

Grids (in document tables)

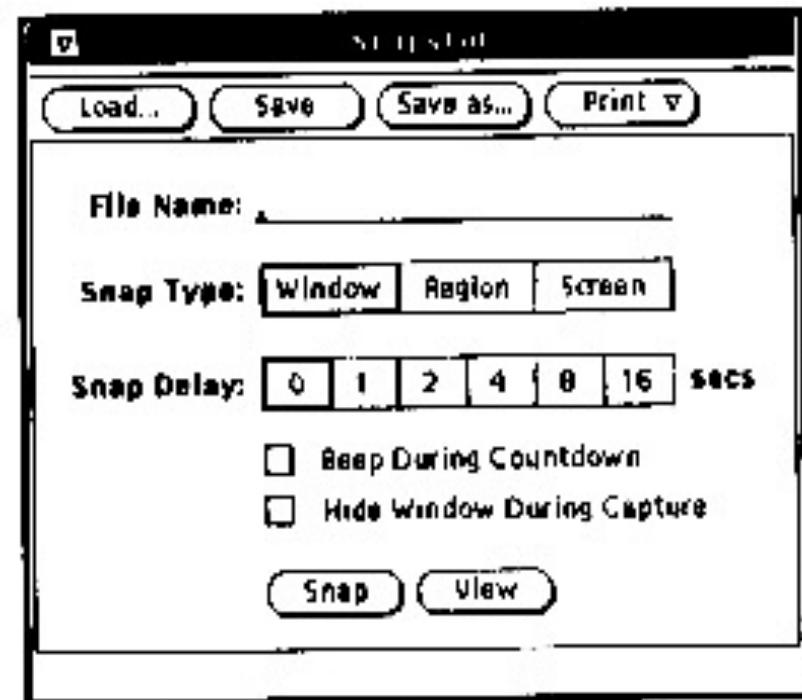
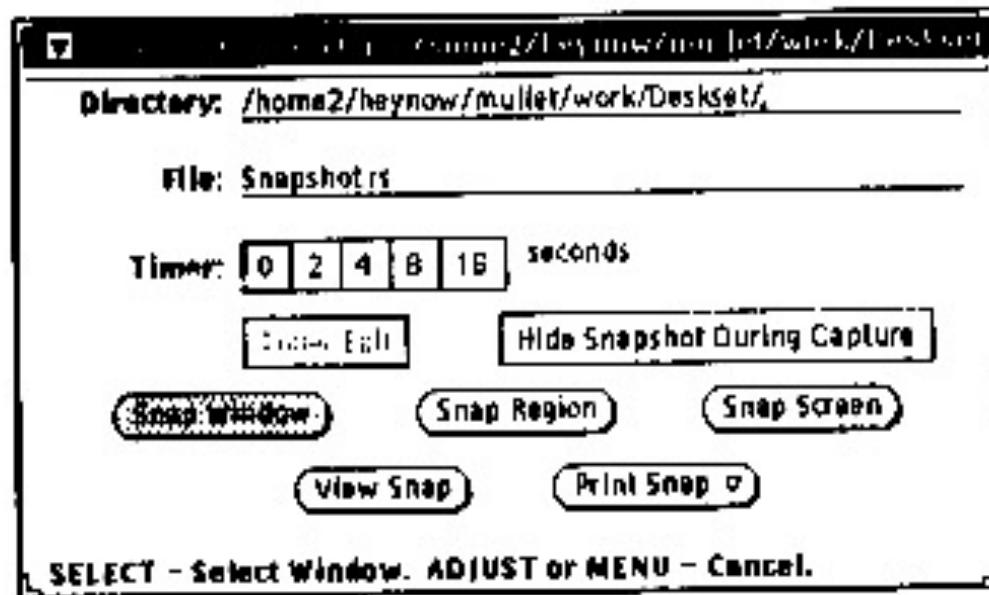
Subject	Initial Model	Task 1		Task 2	
		Correct?	Confidence	Correct?	Confidence
1	List	✗	weak	✓	v weak
2	List	✓	weak	✓	strong
3	Stack	✓	strong	✓	strong
4	List	✗	weak	✗	weak
5	List	✗	strong	✓	weak
6	Tree	✗	weak	✓	weak
7	List	✗	weak	✓	weak
8	List	✗	weak	✗	strong
9	Dequeue	✓	strong	✗	strong
10	List	✗	weak	✗	strong
11	List	✗	weak	✗	strong
Totals		3 Correct		6 Correct	
		8 Incorrect		5 Incorrect	

Navigational Cues

- Provide an initial focus (top left?)
- Group related items (quietly)
- Visual flow should follow logical flow



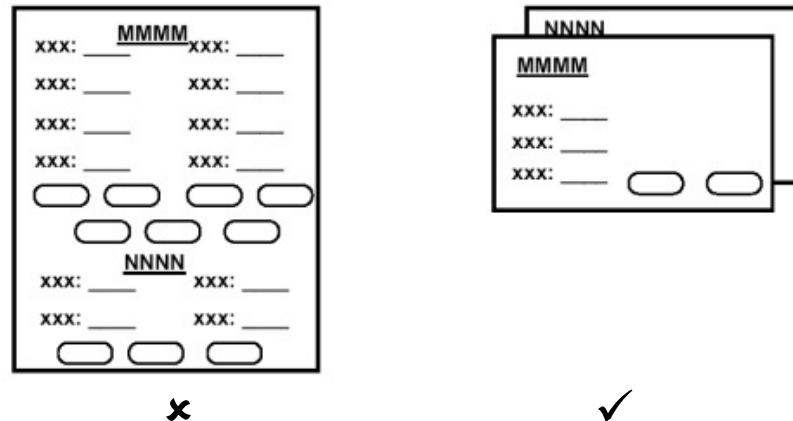
Navigational Cues



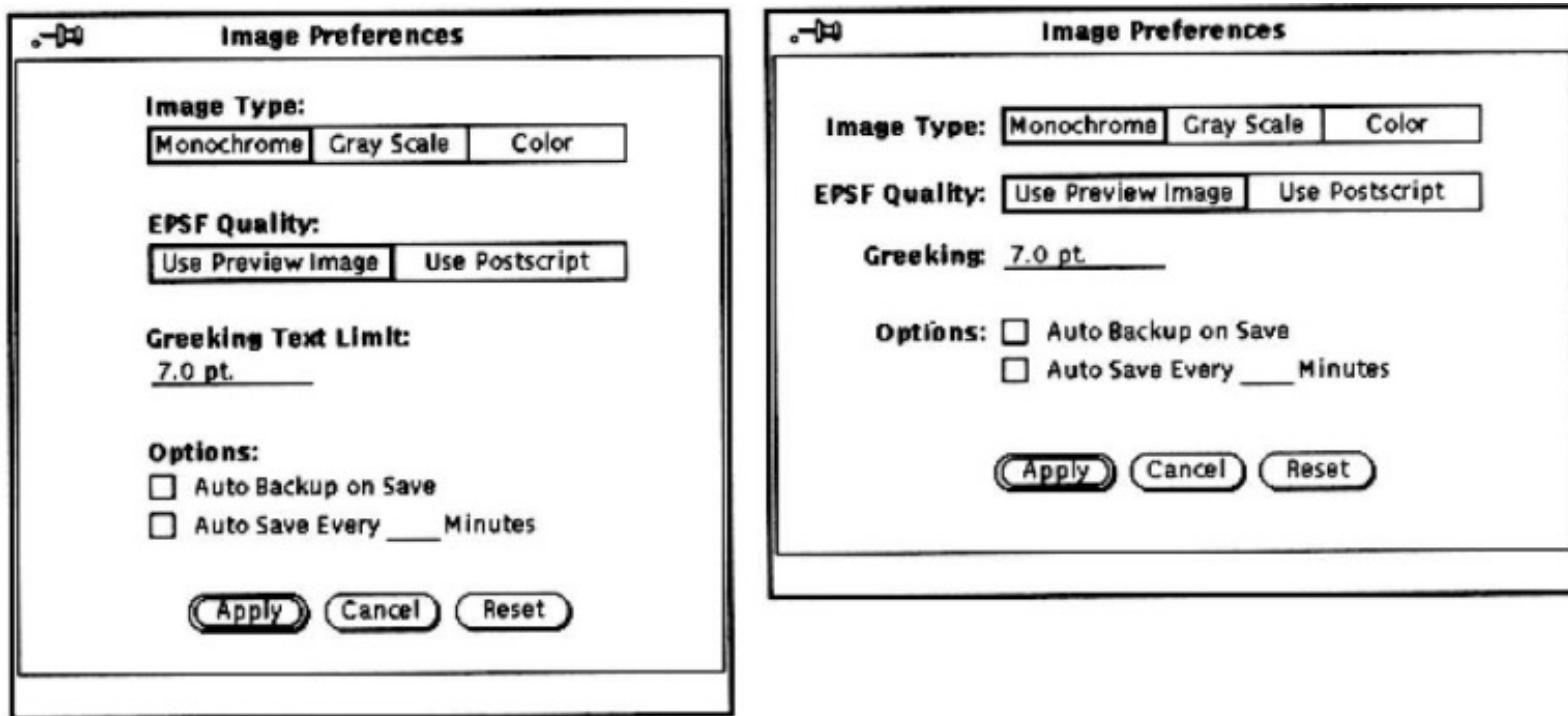
Redesign for navigational flow and alignment

Economy of visual elements

- Minimise the number of controls
- Include only those necessary (relegate others)
- Minimise clutter
- Experiment with white-space



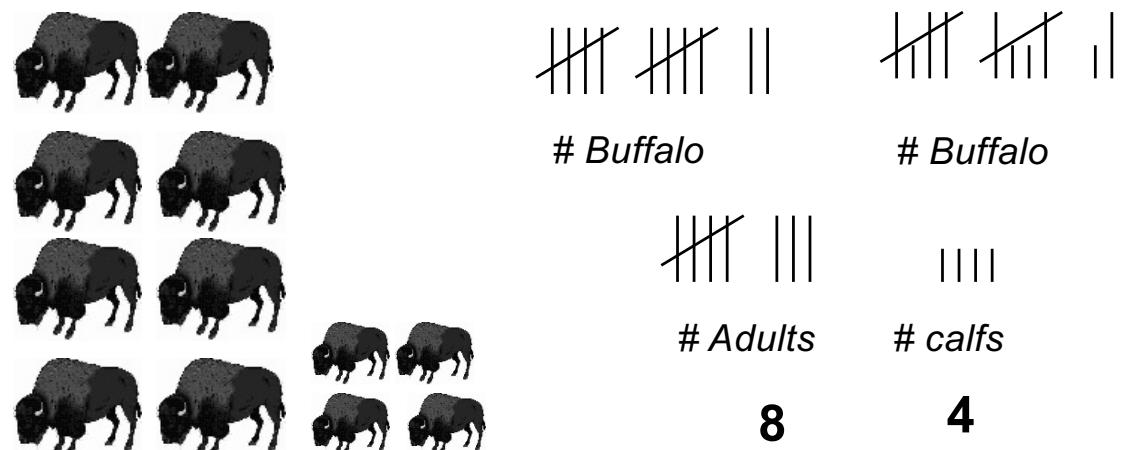
Economy of visual elements



White space experimentation

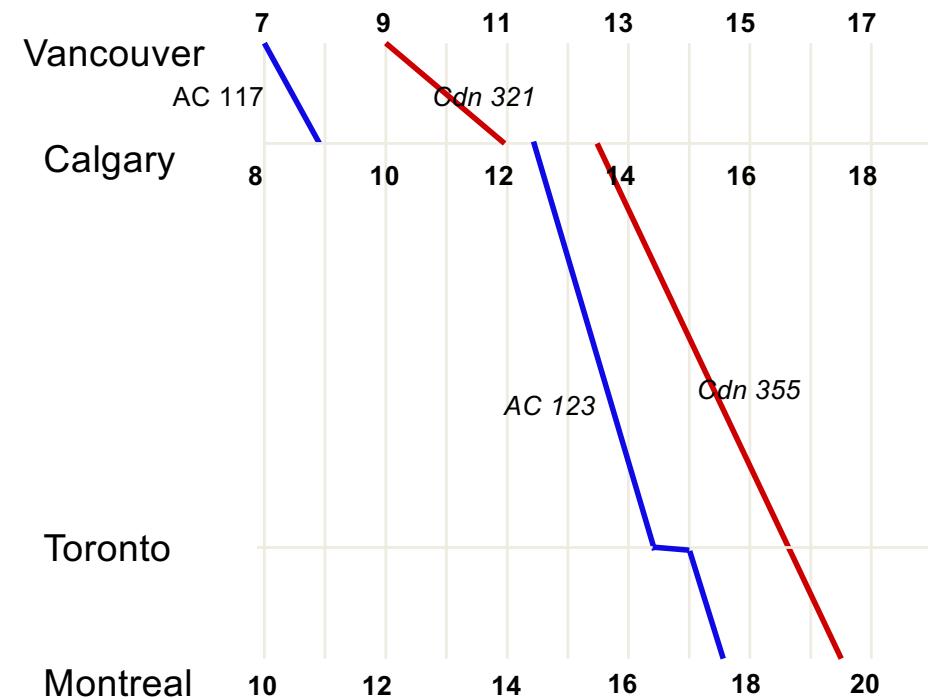
Data representation

- ‘Solving a problem simply means representing it so as to make the solution transparent’
(Simon, 1981)
- Different representations afford different views



Data representation

		<i>depart</i>	<i>arrive</i>
AC 117	Vancouver - Calgary	7:00	9:00
Cdn 321	Vancouver - Calgary	9:00	12:00
Cdn 355	Calgary - Montreal	13:30	19:30
AC 123	Calgary - Toronto	12:30	16:30
AC 123	Toronto - Montreal	16:45	17:30



Data representation

When do I take my pills?

10 - 30% error rate in taking pills

- | | | |
|----------|---|---------------------------------------|
| Inderal | - | 1 tablet 3 times a day |
| Lanoxin | - | 1 tablet every a.m. |
| Carafate | - | 1 tablet before meals and at bedtime |
| Zantac | - | 1 tablet every 12 hours (twice a day) |
| Quinag | - | 1 tablet 4 times a day |
| Couma | - | 1 tablet a day |

	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O			
Inderal	O	O	O	O
Quinag	O	O	O	O
Carafate	O	O	O	O
Zantac		O		O
Couma				O

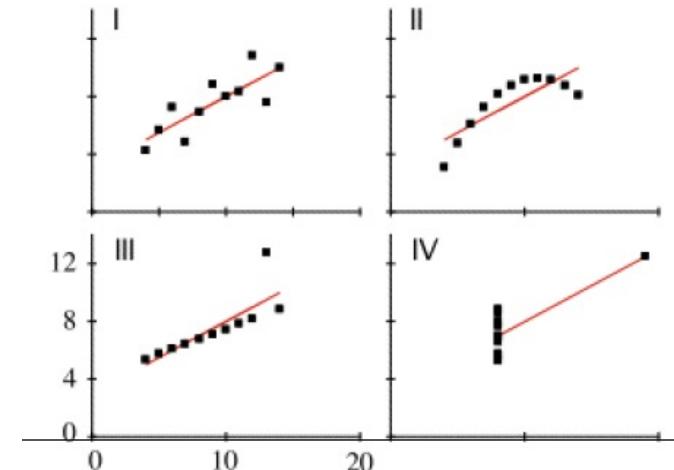
	Breakfast	Lunch	Dinner	Bedtime
Lanoxin				
Inderal			Inderal	Inderal
Quinag		Quinag	Quinag	Quinag
Carafate	Carafate	Carafate	Carafate	Carafate
Zantac			Zantac	Zantac
Couma				Couma

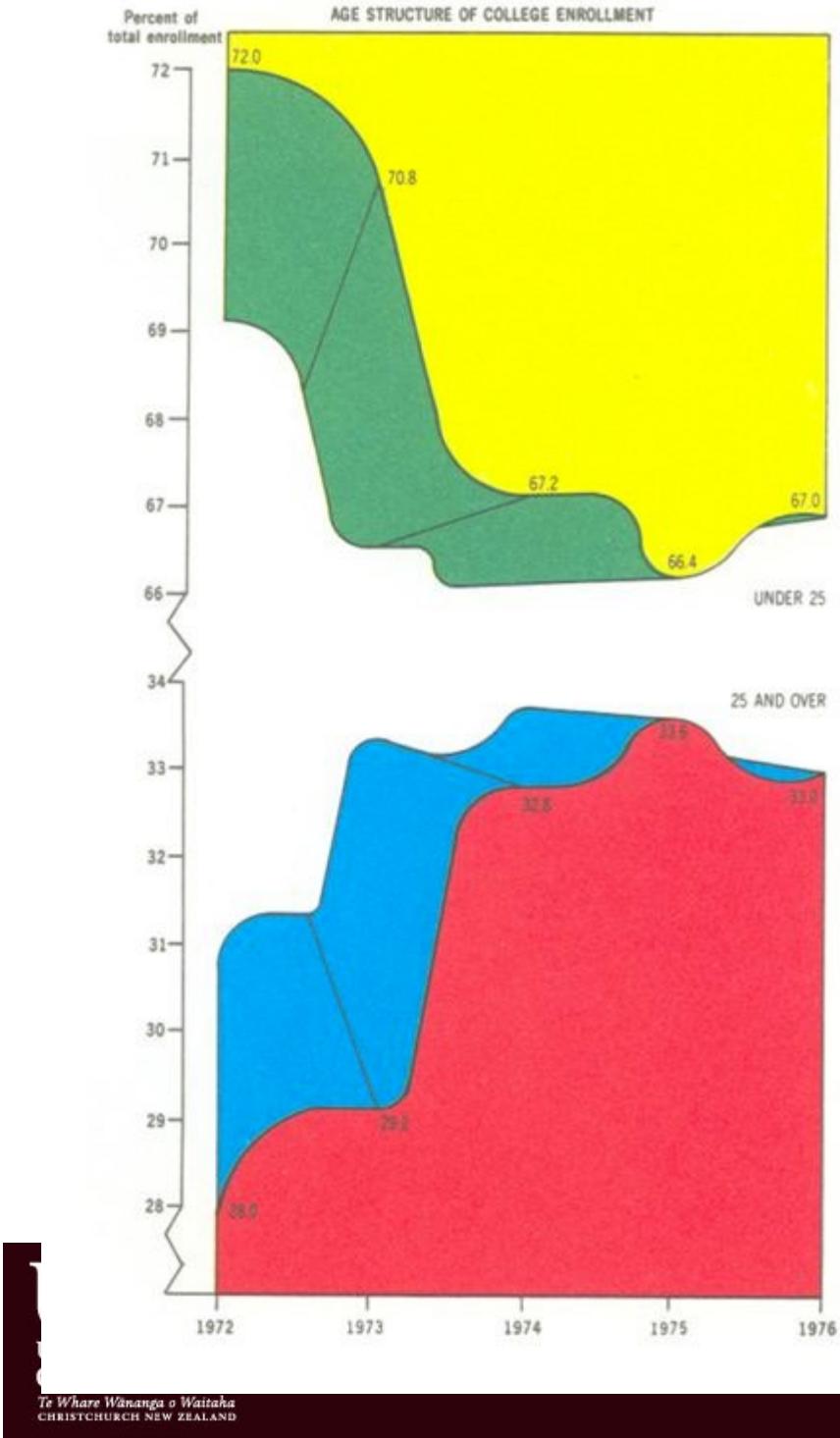
Principles of graphical communication

Edward Tufte: Visual Display of Quantitative Information

- Think: Revelation of the complex
- Show the data
- Suppress the media
- Enhance the information
- Avoid distortions
- Minimise space, time, ink
- Make large data-sets coherent
- Encourage comparisons
- Reveal multiple levels of detail
- Serve a clear purpose

I		II		III		IV	
x	y	x	y	x	y	x	y
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.10	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.10	4	5.39	19	12.50
12	10.84	12	9.13	12	8.15	8	5.56
7	4.82	7	7.26	7	6.42	8	7.91
5	5.68	5	4.74	5	5.73	8	6.89





Age structure of college enrollment

Tufte: "this may well be the worst graphic ever to find its way into print"

American Education magazine, 1970s

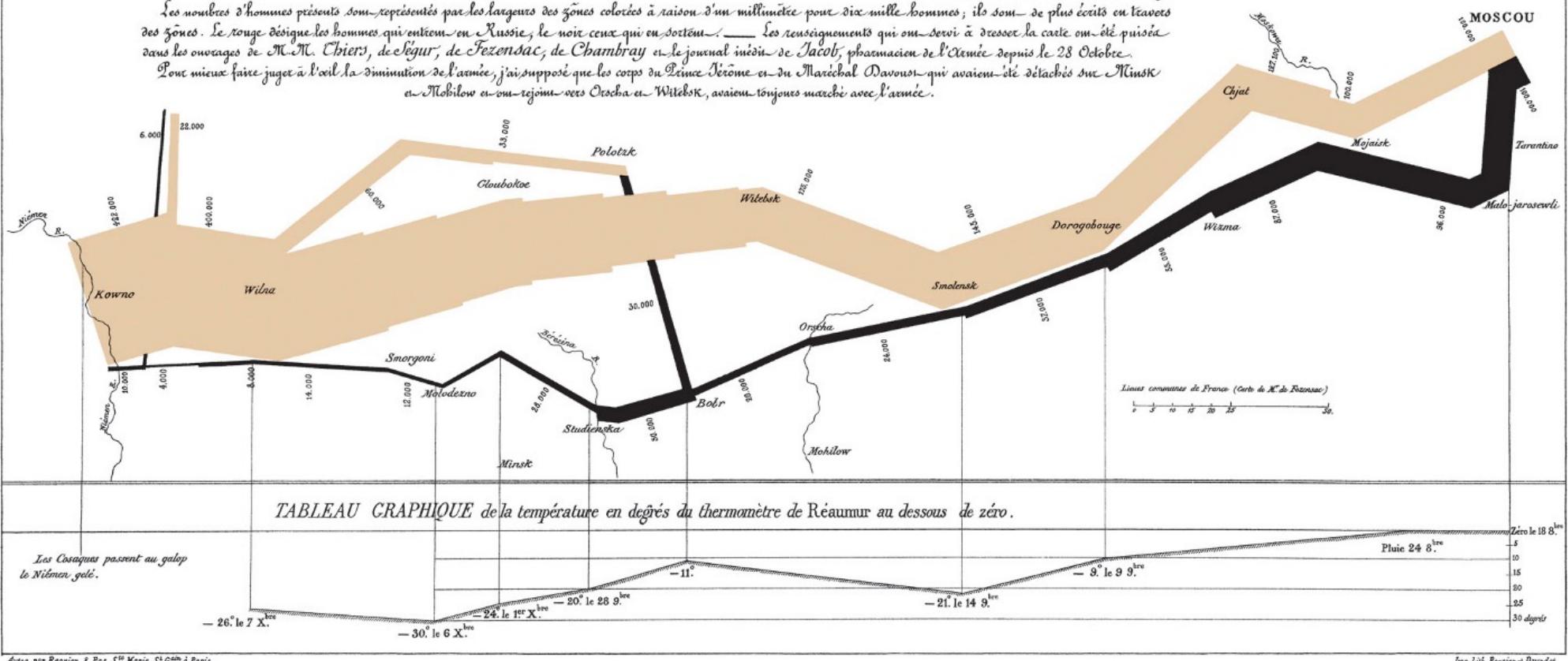
Tufte (2001) *The visual display of quantitative information*, p. 118

Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812-1813.
Dessinée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite

Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. Chiers, de Séguir, de Tézenac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Nérome et du Maréchal Davout, qui avaient été détachés sur Minsk et Mohilow en route vers Orsha et Witebsk, avaient toujours marché avec l'armée.



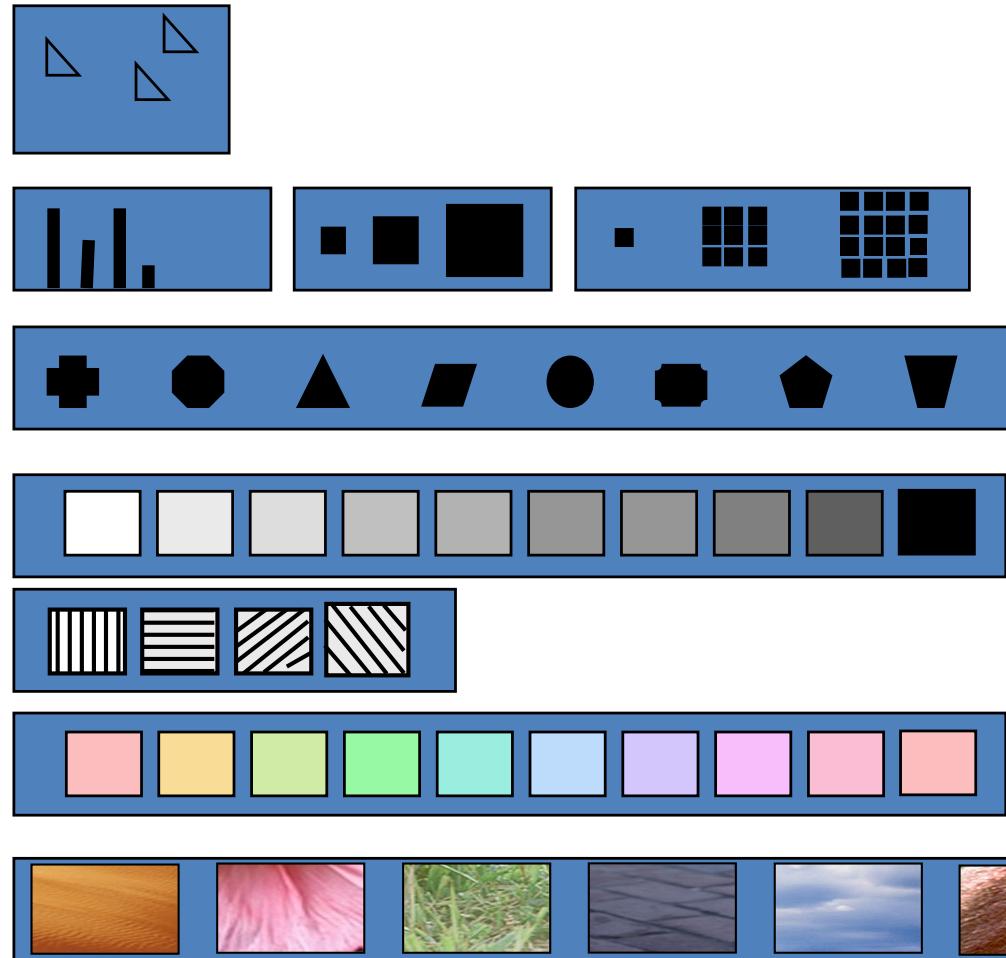
Autog. par Reginier, 8. Rue S^e Marie S^e G^eme à Paris.

Imp. L. L. Regnier et Bourdet.

Visual Variables – Attributes

Jacques Bertin via Sheelagh Carpendale

- **Position:** changes in the x, y (z) location
- **Size:** change in length, area or repetition
- **Shape:** infinite number of shapes
- **Value:** changes from light to dark
- **Orientation:** changes in alignment
- **Colour:** changes in hue at a given value
- **Texture:** variation in pattern
- **Motion**



Visual Variables – Characteristics

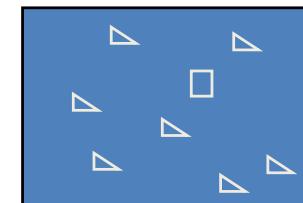
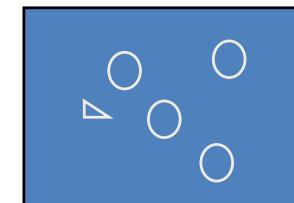
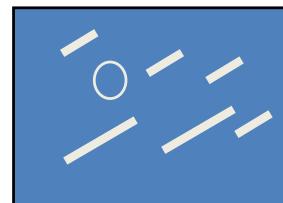
Jacques Bertin via Sheelagh Carpendale

- Different variable attributes may be:
 - **Selective**: supports selection from a group
 - **Associative**: supports perception of groups
 - **Quantitative**: supports numerical extraction
 - **Order**: supports order interpretation
 - **Length**: how many changes are perceptible

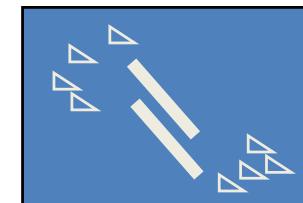
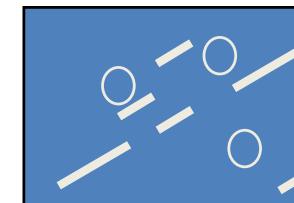
Visual Variables – Shape Example

Jacques Bertin via Sheelagh Carpendale

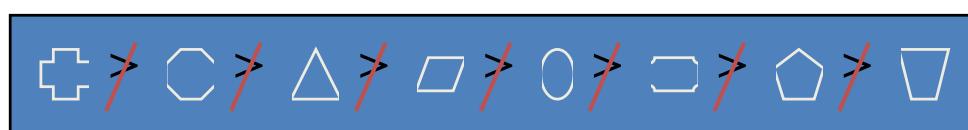
≈ selective



≈ associative



✗ quantitative



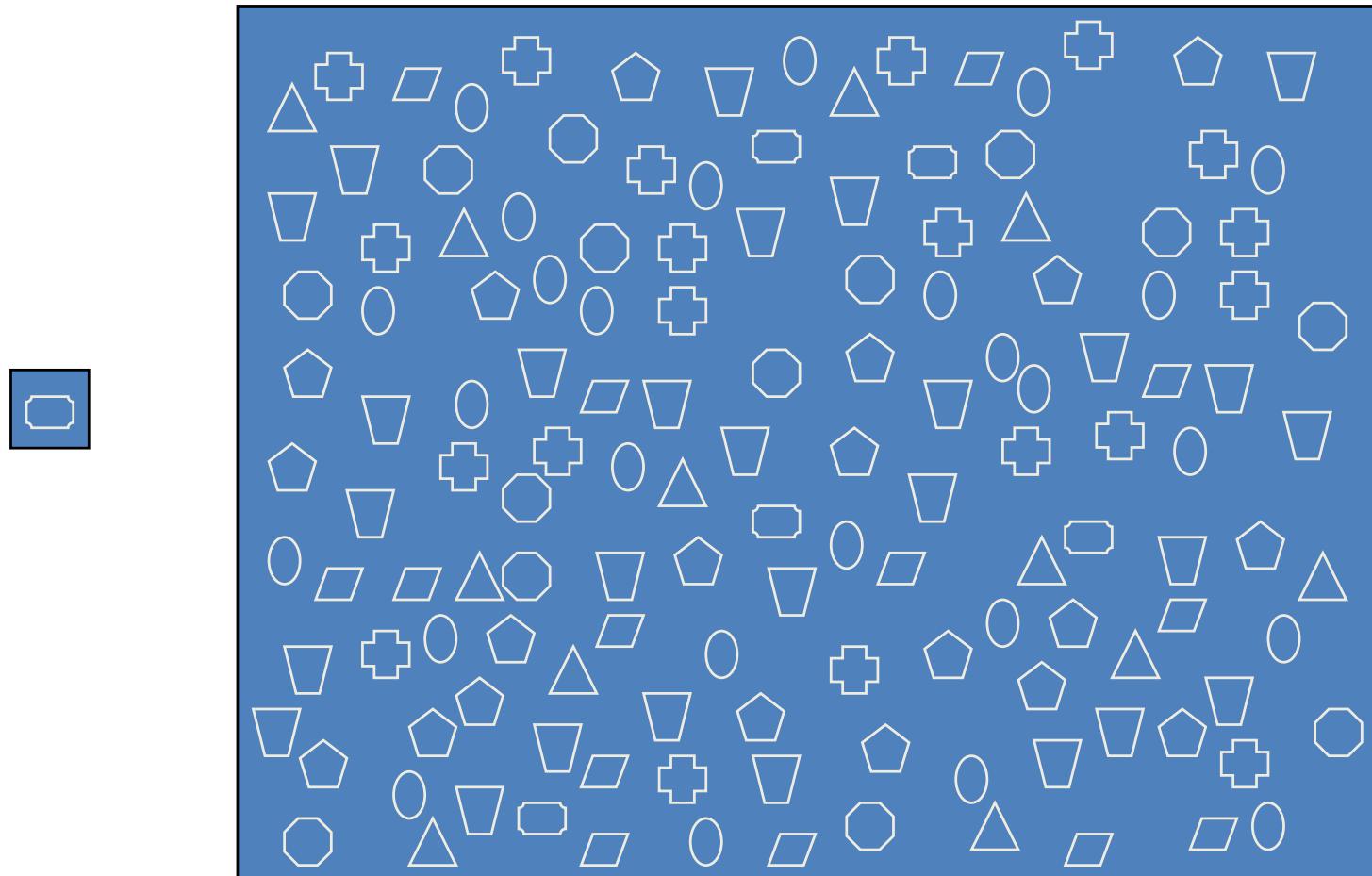
✗ order



✓ length – infinite variation

Visual Variables – Shape Selection Example

Jacques Bertin via Sheelagh Carpendale



Visual Variables

Jacques Bertin via Sheelagh Carpendale

	Selective	Associative	Quantitative	Order	Length
Position	✓	✓	✓	✓	✓
Size	✓	✓	≈	✓	✓
Shape	≈	≈	✗	✗	✓
Value	✓	✓	✗	✓	✓
Orientation	✓	✓	✗	✗	✓
Colour	✓	✓	✗	✗	✓
Texture	✓	✓	✗	✗	✓
Motion	✓	✓	✗	✗	✓

Emotional Effects (briefly)

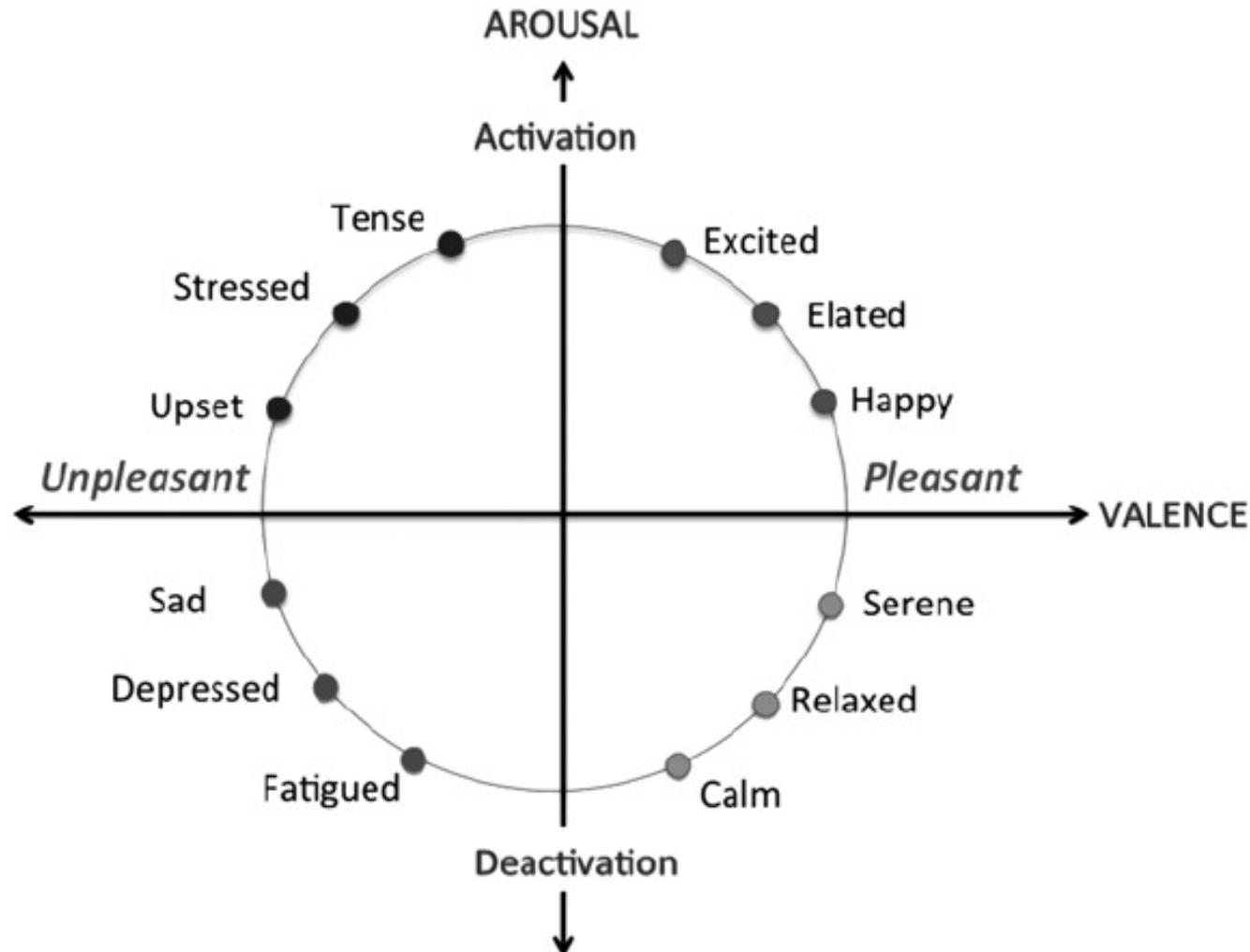
- Shape, colour, texture, and motion can be used for emotional effects

<http://mrl.nyu.edu/~perlin/experiments/polly/track.html>



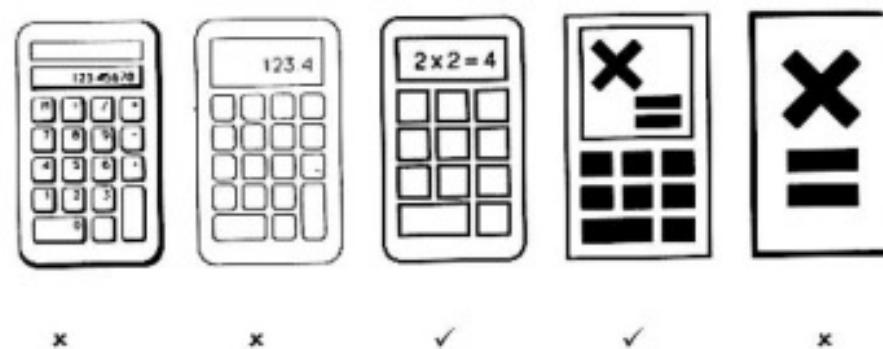
Aside

Emotion: Valence-Arousal Classification



Imagery (in two slides)

- Consider balance between concrete and abstract representation



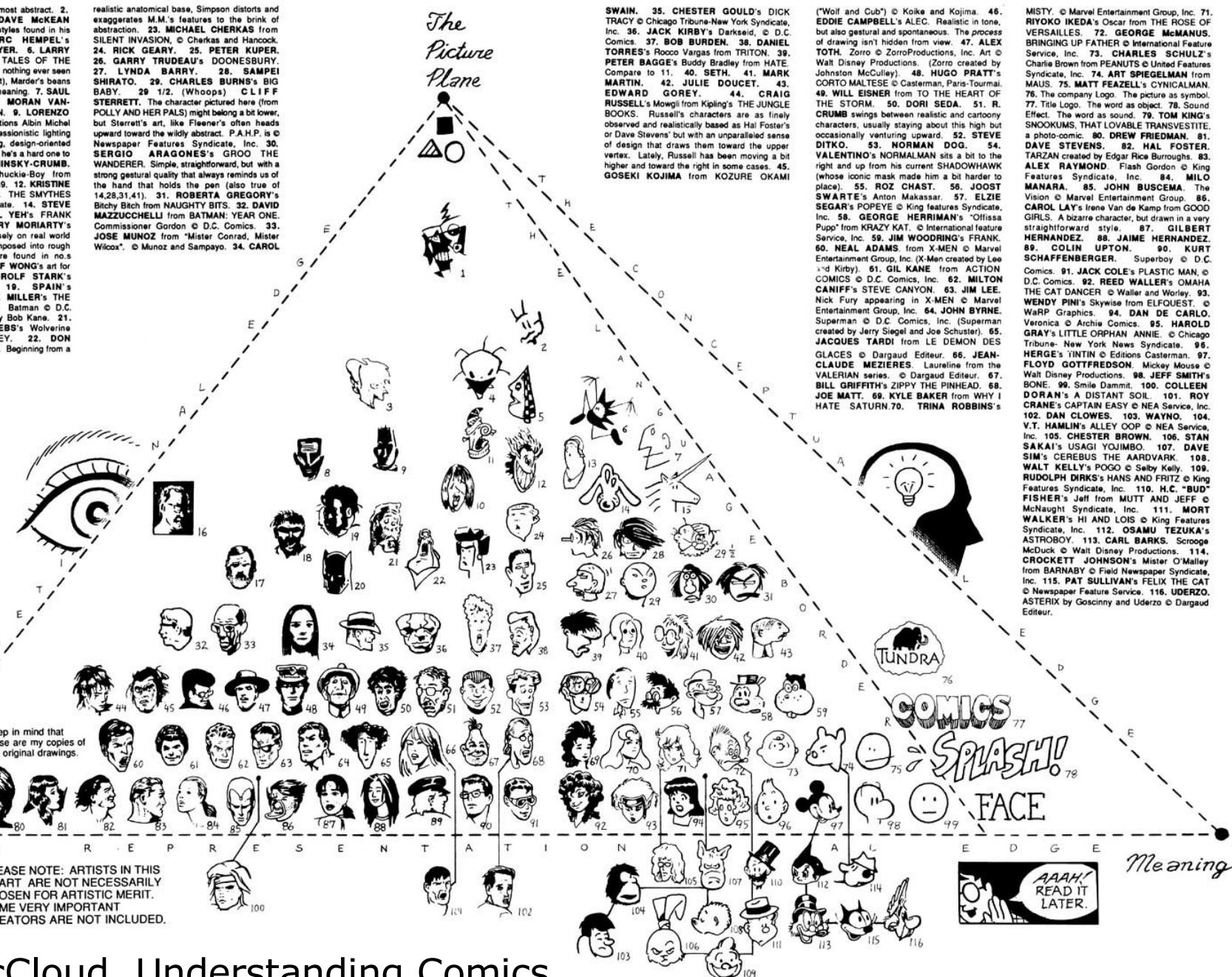
1. MARY FLEENER at her most abstract. 2. MARISCAL's Piker. 3. DAVE McKEAN employing one of the many styles found in his series CAGES. 4. MARC HEMPEL's GREGORY. 5. MARK BEYER. 6. LARRY MARDER's Beanies from TALES OF THE BEANWORLD. "Resembling" nothing ever seen (hence all the way to the right), Marder's beans walk the line from design to meaning. 7. SAUL STIENBERG. 8. PENNY MORAN VANDHORN from THE LIBRARIAN. 9. LORENZO MATTOTTI in FIRES (© Editions Albin Michel S.A.) combines deeply impressionistic lighting with iconic forms and strong, design-oriented compositions. In other words, he's a hard one to place. 10. ALINE KOMINSKY-CRUMB. 11. PETER BAGGE's Chuckie-Boy from NEAT STUFF. Compare to 39. 12. KRISTINE KRYTTRE. 13. REA IRVIN. THE SMYTHES © Field Newspaper Syndicate. 14. STEVE WILLIS's Morty. 15. PHIL YEH's FRANK THE UNICORN. 16. JERRY MORIARTY's "Jack Survives". Based closely on real world light and shadow, but decomposed into rough shapes. Similar effects are found in nos. 8,18,19,20 and 34. 17. JEFF WONG's art for Scott Russo's JIZZ. 18. ROLF STARK's expressionistic RAIN. 19. SPAIN's TRASHMAN. 20. FRANK MILLER's THE DARK KNIGHT RETURNS. Batman © D.C. Comics. Batman created by Bob Kane. 21. WILLIAM MESSNER-LOEBS's Wolverine MacAlister from JOURNEY. 22. DON SIMPSON's MEGATON MAN. Beginning from a

realistic anatomical base, Simpson distorts and exaggerates M.M.'s features to the brink of abstraction. 23. MICHAEL CHERKAS from SILENT INVASION, © Cherkas and Hancock. 24. RICK GEARY. 25. PETER KUPER. 26. GARRY TRUDEAU's DOONESBURY. 27. LYNDY BARRY. 28. SAMPEI SHIRATO. 29. CHARLES BURNS'S BIG BABY. 29 1/2. (Whoops) CLIFF STERRETT. The character pictured here (from POLLY AND HER PALS) might belong a bit lower, but Sterrett's art, like Fleener's often heads upward toward the wildly abstract. P.A.H.P. is © Newspaper Features Syndicate, Inc. 30. SERGIO ARAGONÉS's GROO, THE WANDERER. Simple, straightforward, but with a strong gestural quality that always reminds us of the hand that holds the pen (also true of 14,28,31,41). 31. ROBERTA GREGORY's Bitchy Bitch from NAUGHTY BITS. 32. DAVID MAZZUCHELLI from BATMAN: YEAR ONE. Commissioner Gordon © D.C. Comics. 33. JOSE MUÑOZ from "Mister Conrad, Mister Wilcox". © Muñoz and Sampayo. 34. CAROL

SWAIN. 35. CHESTER GOULD's DICK TRACY © Chicago Tribune-New York Syndicate, Inc. 36. JACK KIRBY's Darkseid, © D.C. Comics. 37. BOB BURDEN. 38. DANIEL TORRES's Rocco Vargas from TRITON. 39. PETER BAGGETT Buddy Bradley from HATE. Compare to 11. 40. SETH. 41. MARK MARTIN. 42. JULIE DOUCET. 43. EDWARD GOREY. 44. CRAIG RUSSELL's Mowgli from Kipling's THE JUNGLE BOOKS. Russell's characters are as finely observed and realistically based as Hal Foster's or Dave Stevens' but with an unparalleled sense of design that draws them toward the upper vertex. Lately, Russell has been moving a bit higher and toward the right in some cases. 45. GOSEKI KOJIMA from KOZURE OKAMI

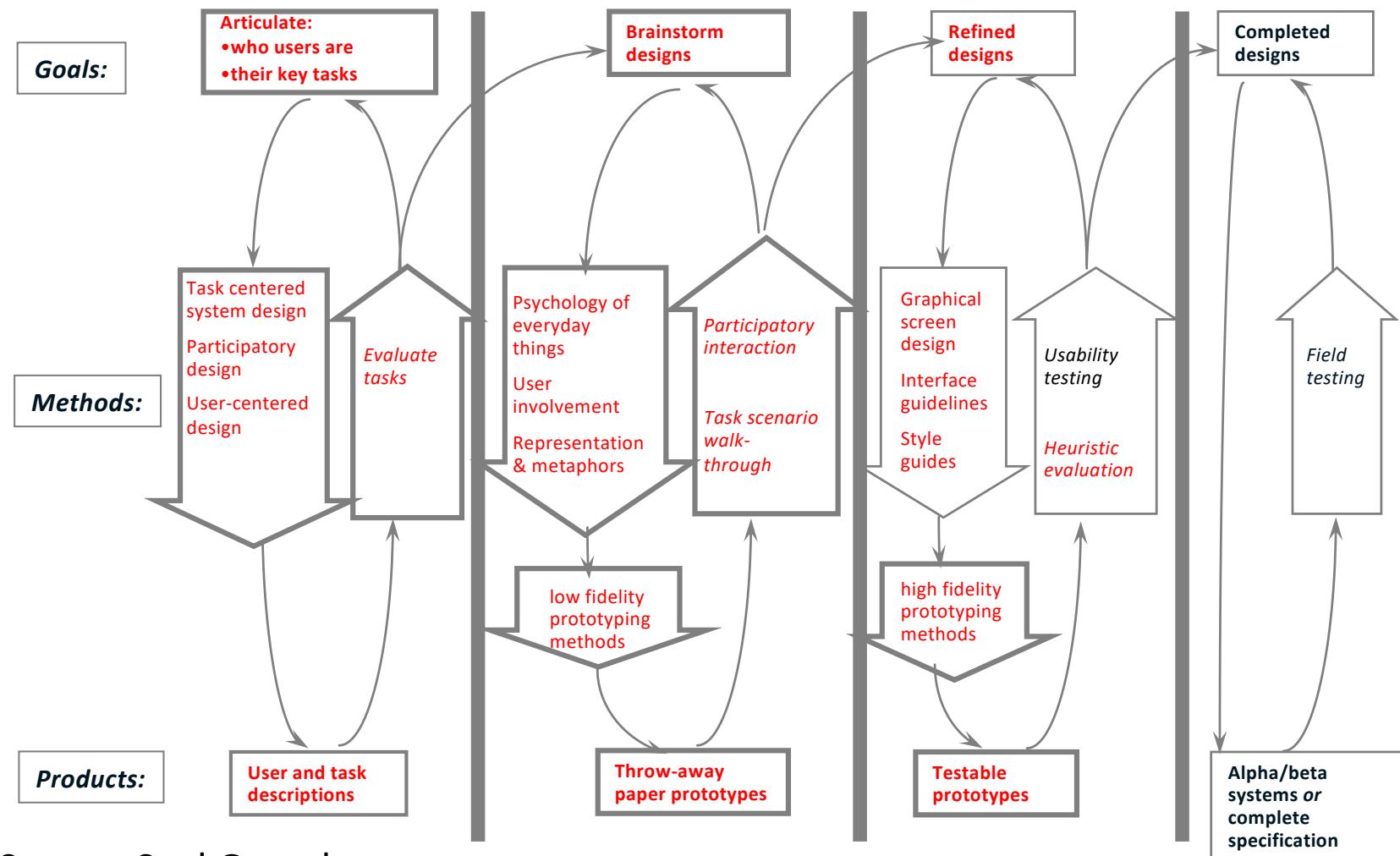
("Wolf and Cub") © Koike and Kojima. 46. EDDIE CAMPBELL's ALEC. Realistic in tone, but also gestural and spontaneous. The process of drawing isn't hidden from view. 47. ALEX TOTH. Zorro © Zorro Productions, Inc. Art © Walt Disney Productions. (Zorro created by Johnston McCulley). 48. HUGO PRATT's CORTO MALTESE © Casterman, Paris-Tourmai. 49. WILL EISNER from TO THE HEART OF THE STORM. 50. DORI SEDA. 51. R. CRUMB swings between realistic and cartoonish characters, usually staying about this high but occasionally venturing upward. 52. STEVE DITKO. 53. NORMAN DOG. 54. VALENTINO'S NORMALMAN sits a bit to the right and up from his current SHADOWERHAWK (whose iconic mask made him a bit harder to place). 55. ROZ CHAST. 56. JOOST SWARTE's Anton Makassar. 57. ELZIE SEGAR's POPEYE © King features Syndicate, Inc. 58. GEORGE HERRIMAN's "Offissa Puppo" from KRAZY KAT. © International feature Service, Inc. 59. JIM WOODRING's FRANK. 60. NEAL ADAMS from X-MEN © Marvel Entertainment Group, Inc. (X-Men created by Lee and Kirby). 61. GIL KANE from ACTION COMICS © D.C. Comics, Inc. 62. MILTON CANIFF'S STEVE CANYON. 63. JIM LEE. Nick Fury appearing in X-MEN © Marvel Entertainment Group, Inc. 64. JOHN BYRNE. Superman © D.C. Comics, Inc. (Superman created by Jerry Siegel and Joe Shuster). 65. JACQUES TARDI from LE DEMON DES GLACES © Dargaud Editore. 66. JEAN-CLAUDE MEZIERES. Laureline from the VALERIAN series. © Dargaud Editore. 67. BILL GRIFFITH'S ZIPPI THE PINHEAD. 68. JOE MATT. 69. KYLE BAKER from WHY I HATE SATURN. 70. TRINA ROBBINS's

MISTY. © Marvel Entertainment Group, Inc. 71. RIVOKO IKEDA's Oscar from THE ROSE OF VERSAILLES. 72. GEORGE McMANUS. BRINGING UP FATHER © International Feature Service, Inc. 73. CHARLES SCHULZ's Charlie Brown from PEANUTS © United Features Syndicate, Inc. 74. ART SPIEGELMAN from MAUS. 75. MATT FEAZELL'S CYNICALMAN. 76. The company Logo. The picture as symbol. 77. Title Logo. The word as object. 78. Sound Effect. The word as sound. 79. TOM KING's SNOKUMS, THAT LOVABLE TRANVESTITE, a photo-comic. 80. DREW FRIEDMAN. 81. DAVE STEVENS. 82. HAL FOSTER. TARZAN created by Edgar Rice Burroughs. 83. ALEX RAYMOND. Flash Gordon © King Features Syndicate, Inc. 84. MILO MANARA. 85. JOHN BUSCEMA. The Vision © Marvel Entertainment Group. 86. CAROL LAY's Irene Van Kamp from GOOD GIRLS. A bizarre character, but drawn in a very straightforward style. 87. GILBERT HERNANDEZ. 88. JAIME HERNANDEZ. 89. COLIN UPTON. 90. KURT SCHAFFENBERGER. Superboy © D.C. Comics. 91. JACK COLE'S PLASTIC MAN. © D.C. Comics. 92. REED WALLER'S OMAHA THE CAT DANCER © Waller and Worley. 93. WENDY PINI's Skywise from ELFQUEST © Warp Graphics. 94. DAN DE CARLO. Veronica © Archie Comics. 95. HAROLD GRAY'S LITTLE ORPHAN ANNIE. © Chicago Tribune - New York News Syndicate. 96. HERGE's TINTIN © Editions Casterman. 97. FLOYD GOTTFREDSON. Mickey Mouse © Walt Disney Productions. 98. JEFF SMITH's BONE. 99. Smile Dammit. 100. COLLEEN DORAN'S A DISTANT SOIL. 101. ROY CRANE'S CAPTAIN EASY © NEA Service, Inc. 102. DAN CLOWES. 103. WAYNO. 104. V.T. HAMLIN'S ALLEY © NEA Service, Inc. 105. CHESTER BROWN. 106. STAN SAKAI'S USAGI YOJIMBO. 107. DAVE SIM'S CEREBUS THE AARDVARK. 108. WALT KELLY'S POGO © Selby Kelly. 109. RUDOLPH DIRK'S HANS AND FRITZ © King Features Syndicate, Inc. 110. H.C. "BUD" FISHER's Jeff from MUTT AND JEFF © McNaught Syndicate, Inc. 111. MORT WALKER'S HI AND LO © King Features Syndicate, Inc. 112. OSAMU TEZUKA'S ASTROBOY. 113. CARL BARKS. Scrooge McDuck © Walt Disney Productions. 114. CROCKETT JOHNSON's Mister O'Malley from BARNABY © Field Newspaper Syndicate, Inc. 115. PAT SULLIVAN'S FELIX THE CAT © Newspaper Feature Service. 116. UDERZO. ASTERIX by Goscinny and Uderzo © Dargaud Editore.



Scott McCloud. Understanding Comics

Design Process



Source: Saul Greenberg

