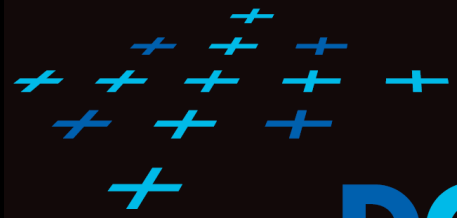


DCGI

DEPARTMENT OF COMPUTER GRAPHICS AND INTERACTION

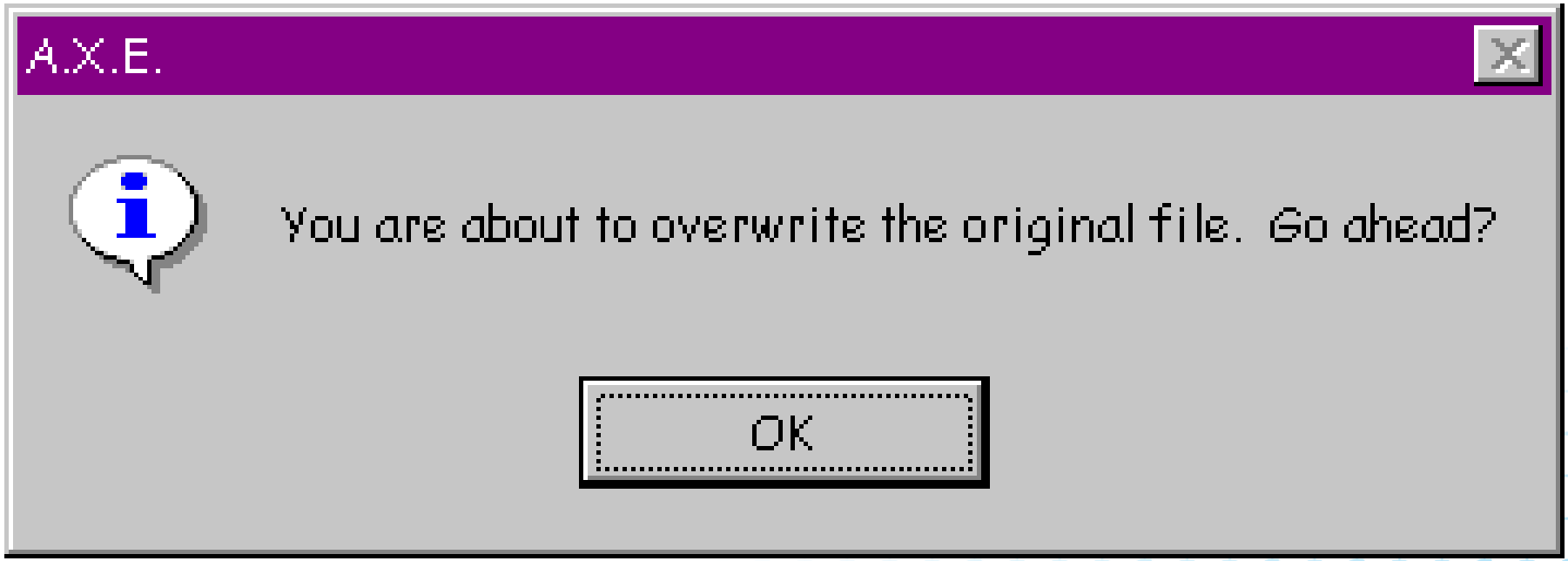
AST
LECTURE 6

User Interfaces (UIs)

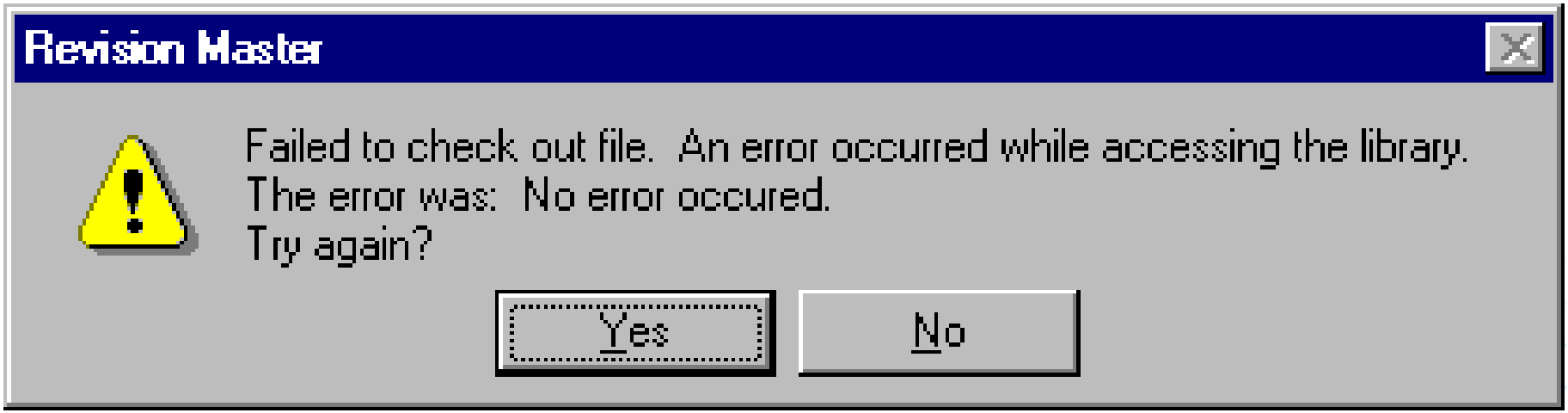
- The part of the technology, allowing people to:
  - Perform their own tasks
  - Interact with the technology
  - Both are indivisible

HCI is sometimes understood as the *design, prototyping, evaluation, and implementation* of the UIs for desktop computers.

Examples of Obviously Bad Design



Examples of Obviously Bad Design



Examples of Obviously Bad Design

USABILITY IS THE KEYWORD

Usability

- **Simplicity of learning to use the system**
  - To learn to use a similar system faster
- **Recall**
  - To remember the way from one situation to another
- **Efficiency**
  - To carry out the task quickly and efficiently
- **Minimum amount of errors**
  - If encountered, inform the users on the cause and an advice how to proceed
- **Satisfaction of the user**
  - The users is convinced that the task has been successfully achieved

DCGI


ATM
WESTERN UNION
ATM

State of art controllers …

… difficult for the elderly users

DCGI

More devices in household

This is how the users feel:

Why test?

- These examples were showing things that were obviously wrong.
  - The problems could be prevented at the design stage, if following good practices.
- But are problems always this obvious?
  - Sometimes even apparently good designs fail

When and why to test?

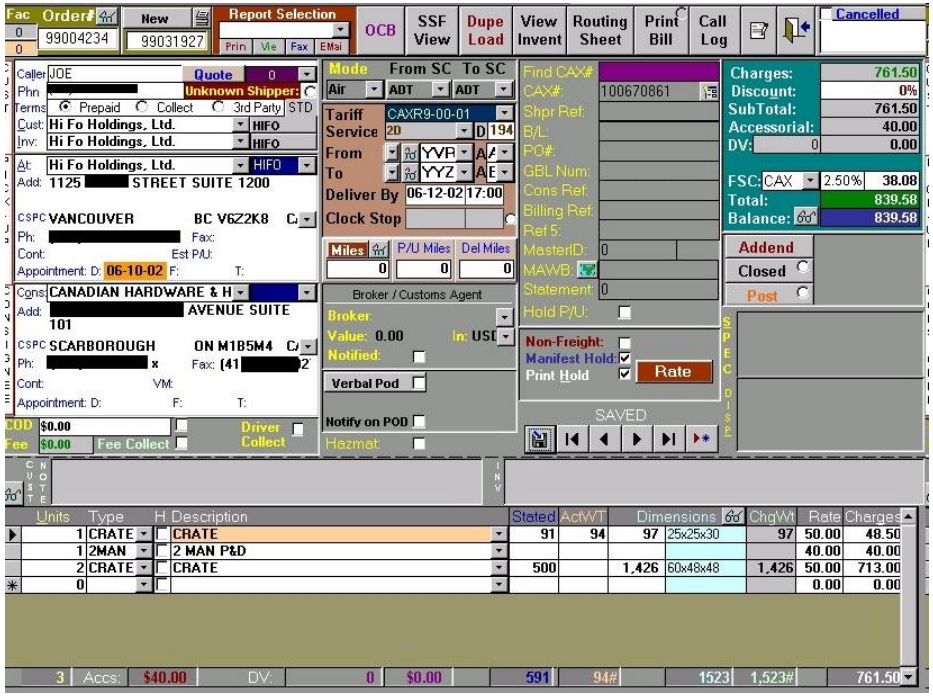
- Design
  - Testing in order to provide feedback to the designers and developers
  - Result: Feedback
- Comparison of products
  - Testing on order to determine
    - Whether a product fits the user needs
    - Product comparison
  - Result: “To buy or not to buy”

Usability Tests for Design

- Main purpose:
  - Improve the product *while* being developed
- What is done:
  - Detect usability problems
  - Provide feedback to the designers

Software products

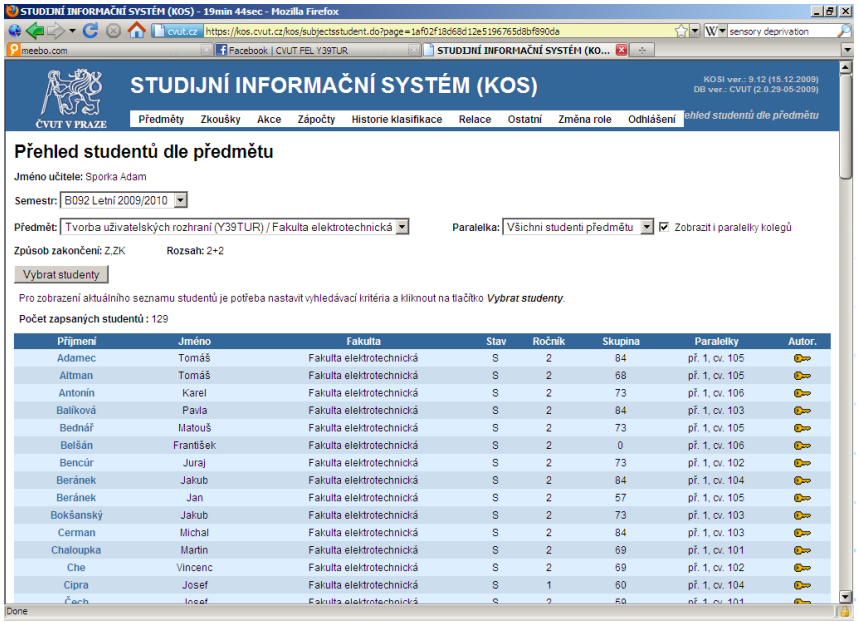
- “Is the software easy for the user to install?”
- “Is the software suitable for the task?”
- “Is the software easy to use?”
- “Does the software recover from errors?”
- “Does the user understand the underlying processes?”
- etc.



http://mike-austin.com/blog/uploaded_images/badui2-747337.jpg

Web pages

- “Will visitors understand what the web page contains?”
- “Are visitors able to navigate?”
- “Are visitors able to perform an on-line purchase?”
- etc.



Methods (usability testing)

- Non-user based (without users)
  - Expert review
  - Heuristic evaluations
  - Cognitive walkthrough

- User-based (with users)
  - User surveys
  - Ethnographic observations
  - Usability engineering

Methods with Users

- Observing users in their own environment
  - Their office, etc.
  - Natural and therefore realistic conditions
    - Environment plays very important role (ringing phones, traffic on the streets, …)
    - The user is accustomed to these conditions
  - Difficult to organize, time consuming
  - Results can not be generalized
- Experimental conditions
  - Controlled (laboratory) environment
  - Controlled conditions
    - Limited influence of external stimuli (distractions by other people, distractions by background software, …)
  - Repeatable
    - The same procedures will give the same results.

Logistics of the Test

- The usability test is a complex activity
  - Needs planning
  - Carried out according to certain rules

- Factors of the test:
  - Users
  - Design of tasks for the participants, relevant to the goal of the test
  - Data collection
  - Data analysis

The Participants of the Usability Test

- Ideal situation: Have all potential users test the system
  - Impossible ➔ Selection needed
- How many then?
  - In quantitative (e.g. performance tests) … as many as required by the tests for statistical significance for given hypothesis
- Selection of the participants
  - Screeners
  - Recruitment
- Reward

Task Scenarios

- Make the participants use the part of the system that needs testing
  - Design the task in the way that the tested part is used in a natural way
- Good scenario:
  - Realistic task
  - Short and unambiguous description of the task
  - Use the terminology of the user
  - Should not contain any hint of the right solution
  - It should be possible to accomplish the task in given time

The main ideas when testing

- You can design user interfaces that
  - Are pleasant and convenient for your users
  - Let them accomplish their goals
- The key: think about your users
  - Learn about them
  - Watch them work, in their workplace
  - Interview them, also in their workplace

Benefits of Usable User Interfaces

- Gaining a competitive edge
- Reducing development and maintenance costs
- Improving productivity
- Lowering support costs

Reducing development and maintenance costs

- Learn about users first, and you will avoid
  - Implementing features users don't want
  - Creating features that are annoying or inefficient
  - High cost of making changes late in the development cycle

Improving productivity

- Productivity means employees become more efficient because the system supports their tasks in an easy way.

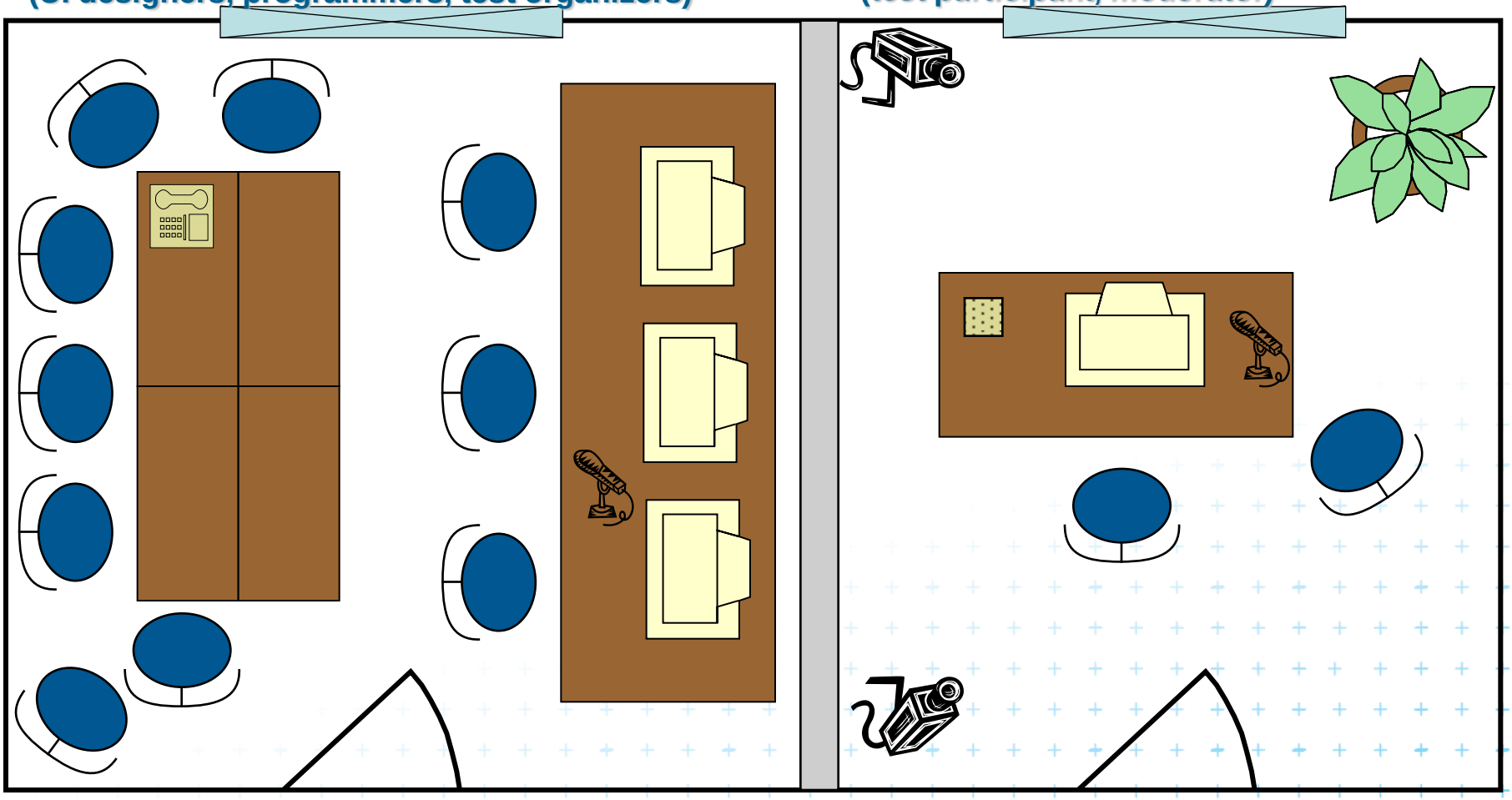
Lower support costs

- Calls to customer support are very expensive for the vendor: estimates range from €12 to €250 *per call*

Usability Lab – usability testing

Observer room
(UI designers, programmers, test organizers)

Participants room
(test participant, moderator)

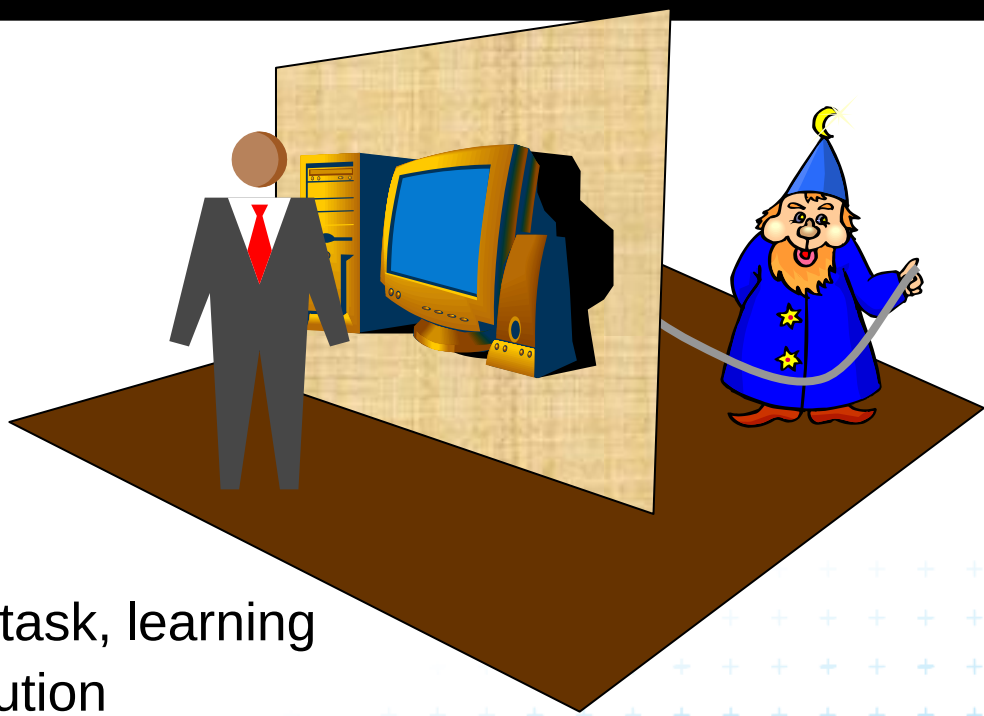


Usability testing

Developer watching videotape of usability test.

Prototyping and Evaluation

- *Wizard of Oz* Prototyping
  - Human `wizard' to simulate machine interaction
  - Faster prototyping
    - eliminates programming overhead



- Usability Studies
  - Task completion time, # errors / task, learning curve, function frequency distribution
  - User satisfaction and feedback
  - Physiological measurements?

Book about usability

Specific interactions

Multi-modal interaction

- **Sound important**
  - keeps us aware of surroundings
  - provides clues and cues to switch our attention
  - music - also auditory
    - convey and alter moods
    - conjure up visual images
    - evoke atmospheres
- **Touch**
  - tactile feedback to operate tools
  - hold and move tools, instruments, pens

Multi-modal interaction

- Taste and smell
  - less appreciated
  - check food if bad, detect early signs of fire, …

Multi-modal interaction

- Human-human everyday interaction multi-modal
- Each sense provides different information to make whole
- Want Human-computer interaction to be multi-modal
  - visual channel can get overloaded
  - provide richer interaction
  - provide redundancy for an equivalent experience to all

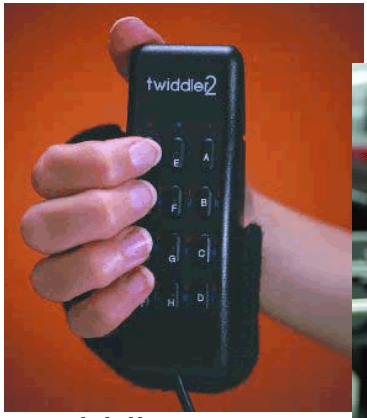
Design Guidelines

HCI Design Guidelines

- Reflexive (Motor-Sensory)
  - Minimize brain cycles needed to use the interface (“muscle memory”)
- Cognitive
  - Allows users to harness intuitive, problem-solving skills
- Social / Organizational
  - Meet requirements for multi-person interaction

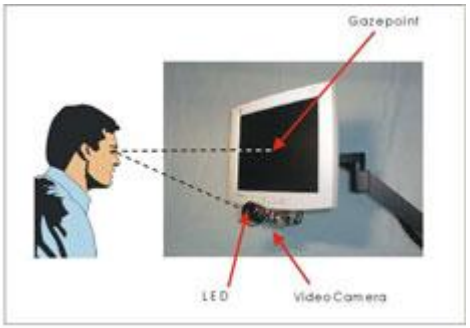
Reflexive Considerations

- Intuition versus learning
  - simplicity versus completeness / efficiency?
- Accuracy-speed tradeoff
  - ROC curve
- User feedback
  - visual, aural, tactile
- Motor-sensory channel separation
  - e.g. is gaze cursor control a good interface?
- Ergonomics
  - Minimize physical strain on users



Twiddler

HP Tablet PC



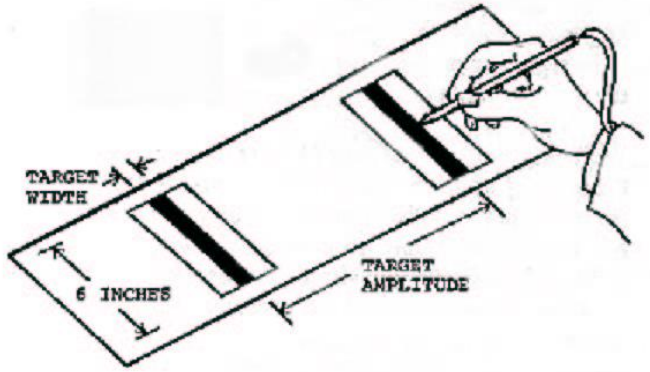
www.eyegaze.com

www.5dt.com

Reflexive Performance Studies: Evaluation and Modeling

- Evaluations are typically based on timing experiments

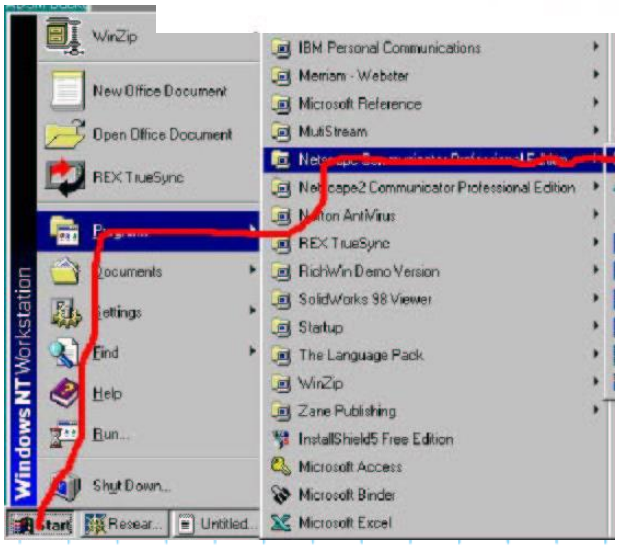
Images from Buxton 2003



- Keystroke-Level Model
  - Card, Moran & Newell 1980
  - Task time = Σ (unit tasks time)
  - Unit tasks: Keystroking, Pointing, Homing, Drawing, Mental, Response

- Modified Fitts' Law
  - Applicable to pointing tasks

$$\text{movement time} = a + b \log_2 \left(\frac{\text{distance}}{\text{target width}} + 1 \right)$$



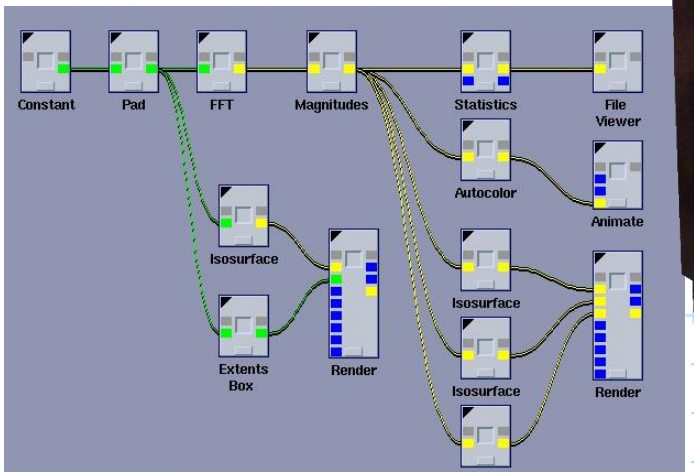
- Steering Law (*Accot & Zhai 1997*)
  - Navigation of menus

Cognitive Considerations

- Metaphors
  - Info visualization
  - Visual programming
  - Anthropomorphism
- Cognitive load
  - Fatigue, stress of task
  - automation vs user choice
- Focus of attention
  - multi-tasking
    - how easy is it to return to a suspended task?
- User Modeling
  - Interfaces tailored to individuals

MSR data mountain

HP CRL – Smart Kiosk



Khoros – Cantata

User Interface Guidelines

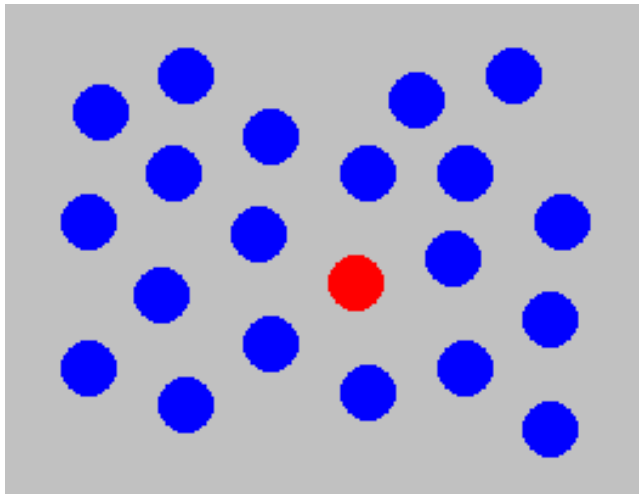
- Apple – 1986 (“industrial standard”)
- User Interface Guidelines – all company products should have compatible UI (e.g. all icons have the same meaning, the menu structure is the same etc…)
- These guidelines were inspiration for other companies that defined their own Usability guidelines (IBM, HP etc.…)

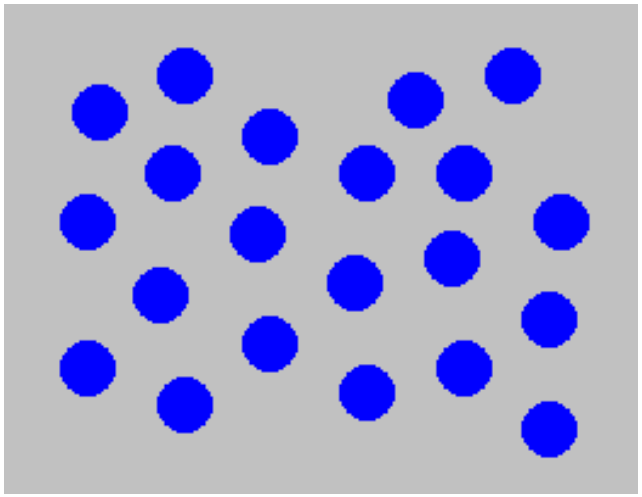
Perceptual Issues in UI Design

Pre-attentive Processing

- < 200 - 250ms qualifies as pre-attentive
  - eye movements take at least 200ms
  - yet certain processing can be done very quickly, implying low-level processing in parallel
- If a decision takes a fixed amount of time regardless of the number of distractors, it is considered to be pre-attentive.

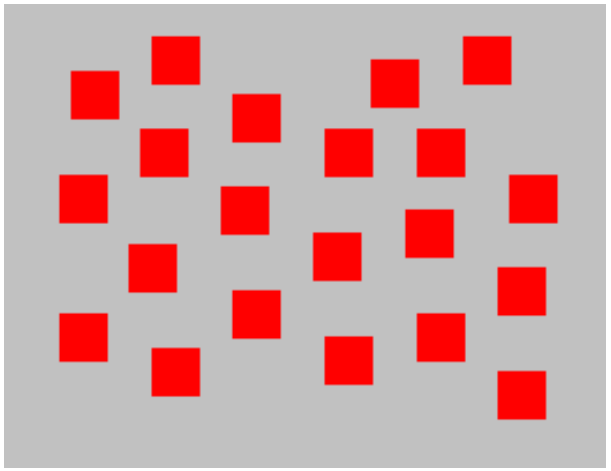
Example: Color Selection

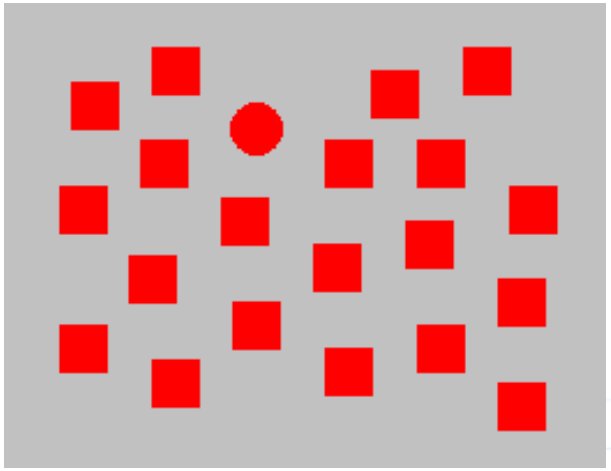




Viewer can rapidly and accurately determine whether the target (red circle) is present or absent. Difference detected in color.

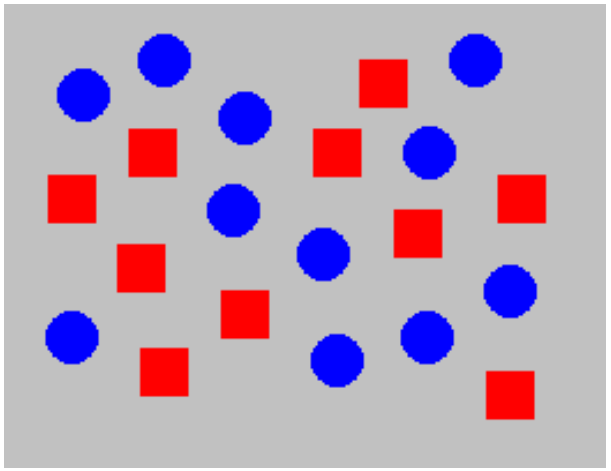
Example: Shape Selection

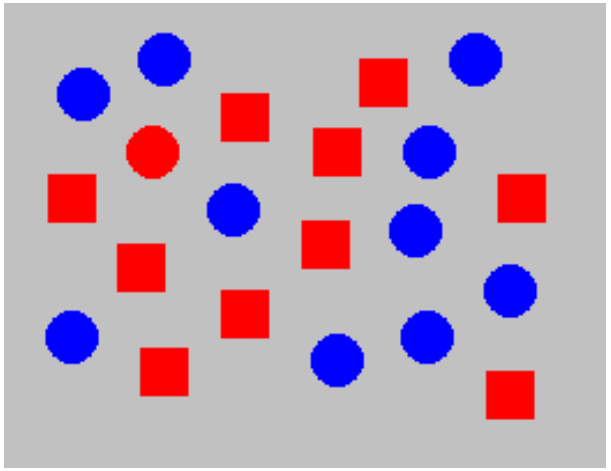




Viewer can rapidly and accurately determine whether the target (red circle) is present or absent. Difference detected in form (curvature)

Example: Conjunction of Features



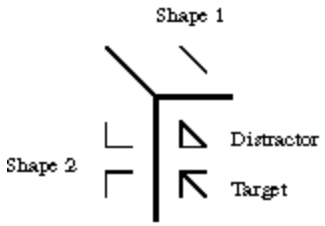


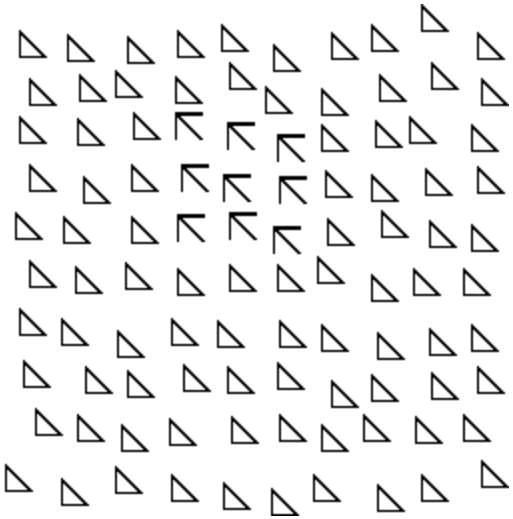
Viewer *cannot* rapidly and accurately determine whether the target (red circle) is present or absent when target has two or more features, each of which are present in the distractors. Viewer must search sequentially.

All Preattentive Processing figures from Healey 97

http://www.csc.ncsu.edu/faculty/healey/PP/PP.html

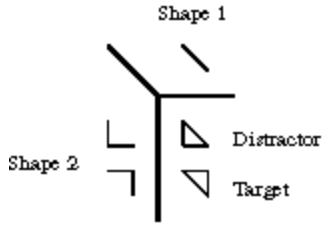
Example: Emergent Features

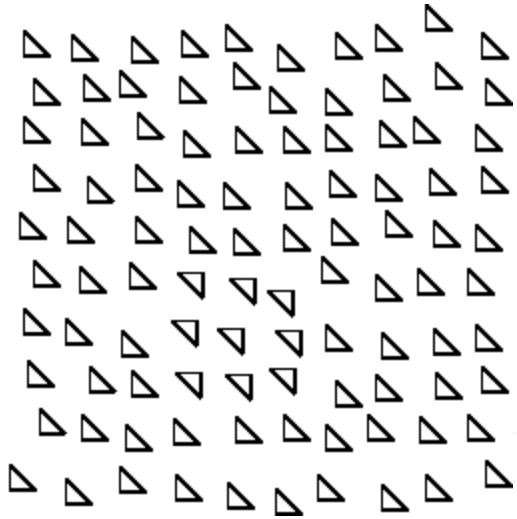




Target has a unique feature with respect to distractors (open sides) and so the group can be detected preattentively.

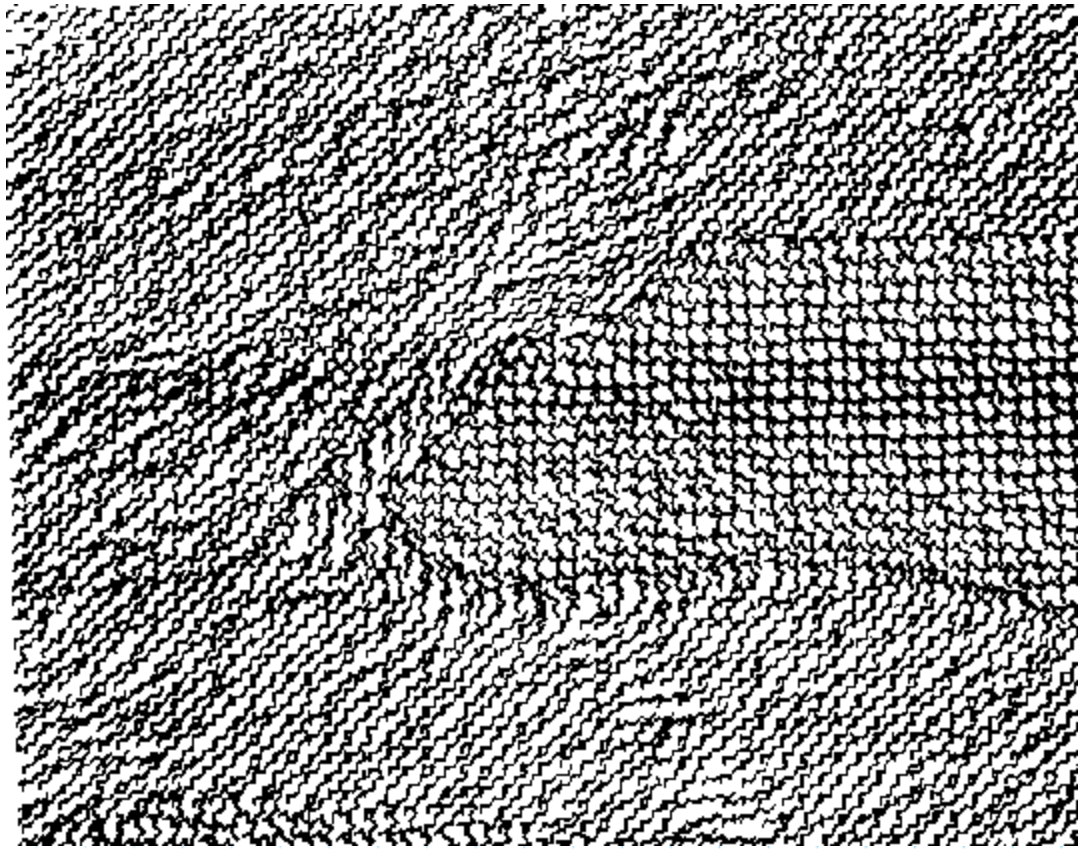
Example: Emergent Features





Target does not have a unique feature with respect to distractors and so the group cannot be detected preattentively.

Use Grouping of Well-Chosen Shapes for Displaying Multivariate Data



SUBJECT PUNCHED QUICKLY OXIDIZED TCEJBUS DEHCNUP YLKCIUQ DEZIDIXO
CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
SCIENCE ENGLISH RECORDS COLUMNS ECNEICS HSILGNE SDROCER SNMULOC
GOVERNS PRECISE EXAMPLE MERCURY SNREVOG ESICERP ELPMAXE YRUCREM
CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
GOVERNS PRECISE EXAMPLE MERCURY SNREVOG ESICERP ELPMAXE YRUCREM
SCIENCE ENGLISH RECORDS COLUMNS ECNEICS HSILGNE SDROCER SNMULOC
SUBJECT PUNCHED QUICKLY OXIDIZED TCEJBUS DEHCNUP YLKCIUQ DEZIDIXO
CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
SCIENCE ENGLISH RECORDS COLUMNS ECNEICS HSILGNE SDROCER SNMULOC

Text NOT Preattentive

SUBJECT PUNCHED QUICKLY OXIDIZED TCEJBUS DEHCNUP YLKCIUQ DEZIDIXO
CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
SCIENCE ENGLISH RECORDS COLUMNS ECNEICS HSILGNE SDROCER SNMULOC
GOVERNS PRECISE EXAMPLE MERCURY SNREVOG ESICERP ELPMAXE YRUCREM
CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
GOVERNS PRECISE EXAMPLE MERCURY SNREVOG ESICERP ELPMAXE YRUCREM
SCIENCE ENGLISH RECORDS COLUMNS ECNEICS HSILGNE SDROCER SNMULOC
SUBJECT PUNCHED QUICKLY OXIDIZED TCEJBUS DEHCNUP YLKCIUQ DEZIDIXO
CERTAIN QUICKLY PUNCHED METHODS NIATREC YLKCIUQ DEHCNUP SDOHTEM
SCIENCE ENGLISH RECORDS COLUMNS ECNEICS HSILGNE SDROCER SNMULOC

Cognitive issues - scrambled words

Aoccdrnig to a rscheearch at an Elingsh uinervtisy, it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoetnt tihng is taht frist and lsat ltteer is at the rghit pclae. The rset can be a toatl mses and you can sitll raed it wouthit porbelm. Tihs is bcuseae we do not raed ervey lteter by it slef but the wrod as a wlohe

This is because we do not read every letter by itself but the word as a whole

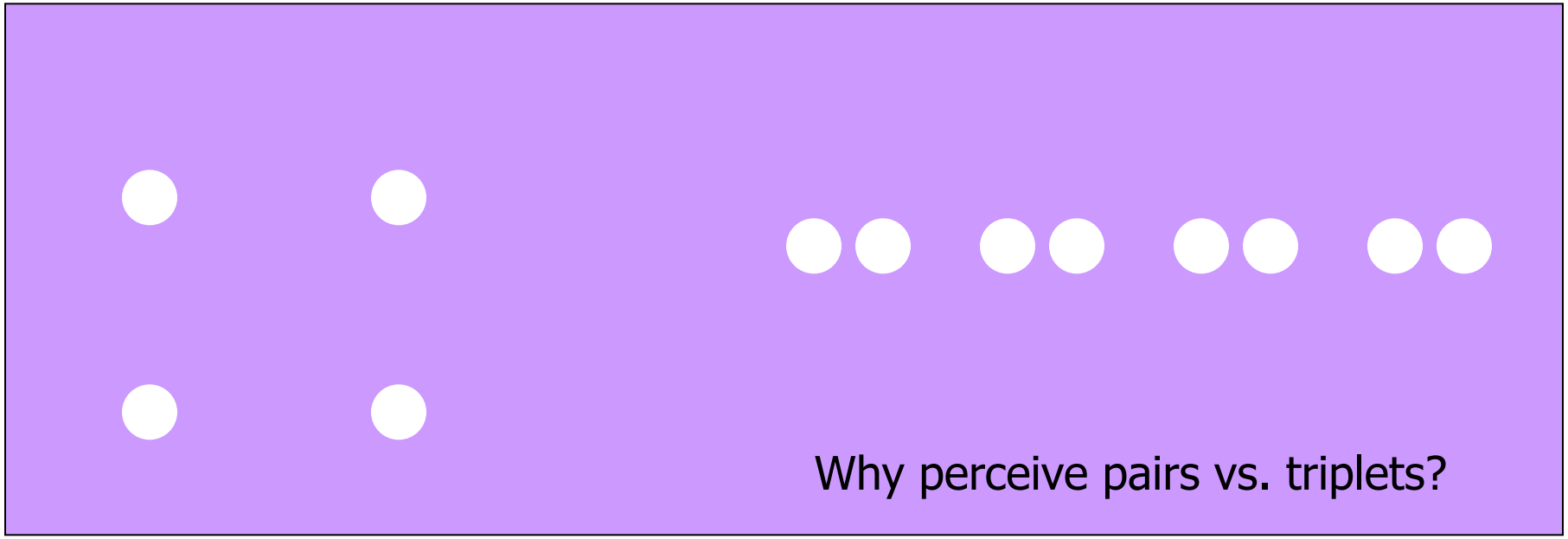
Gestalt Principles

- Idea: forms or patterns transcend the stimuli used to create them.
  - Why do patterns emerge?
  - Under what circumstances?

- Principles of Pattern Recognition
  - “gestalt” German for “pattern” or “form, configuration”
  - Original proposed mechanisms turned out to be wrong
  - Rules themselves are still useful

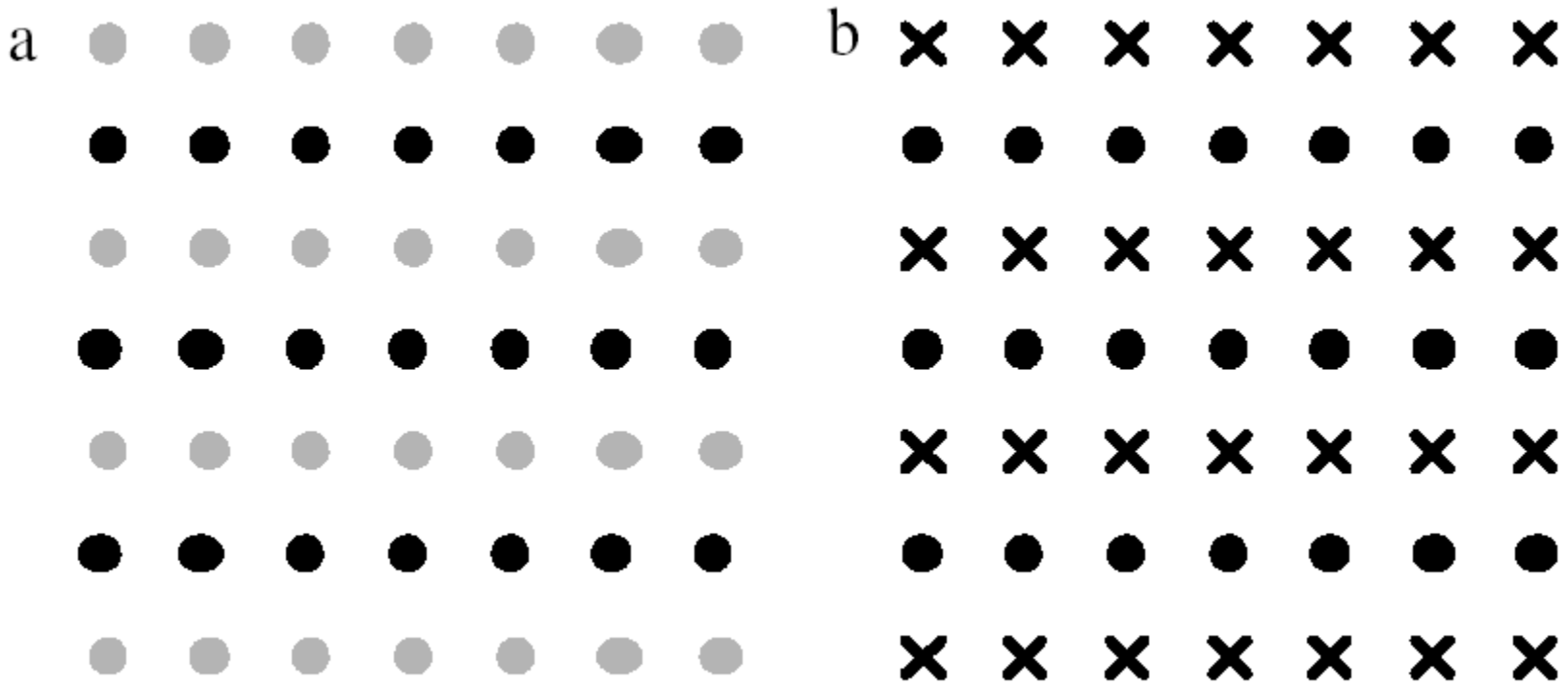
Gestalt Properties

Proximity



Gestalt Properties

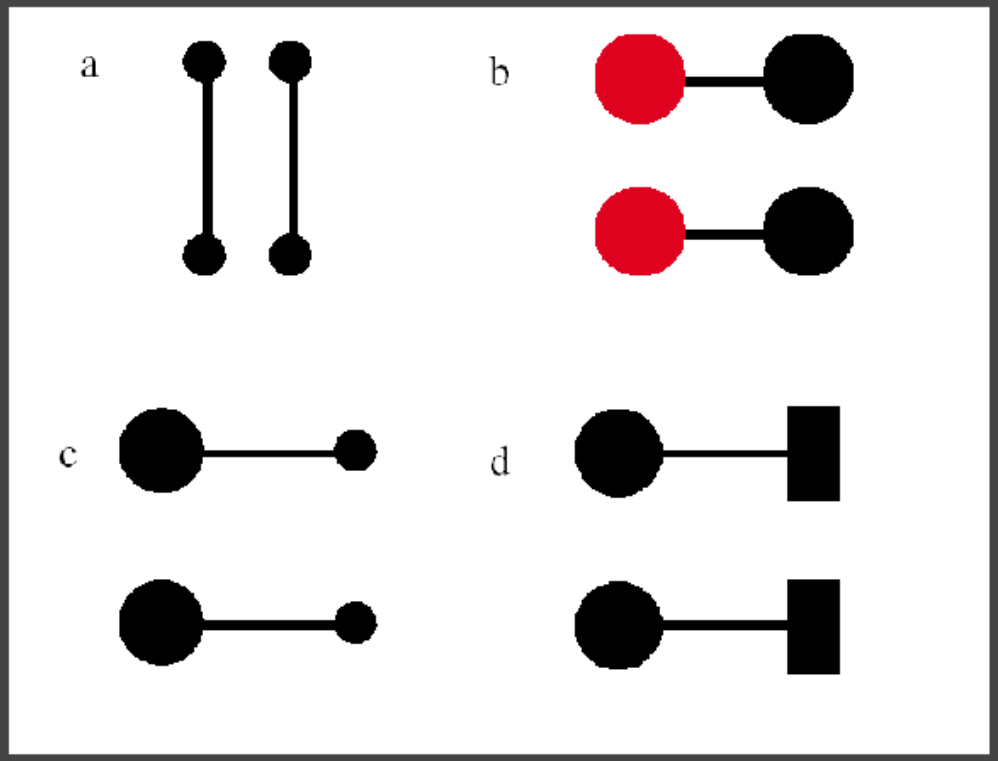
Similarity



Gestalt Properties

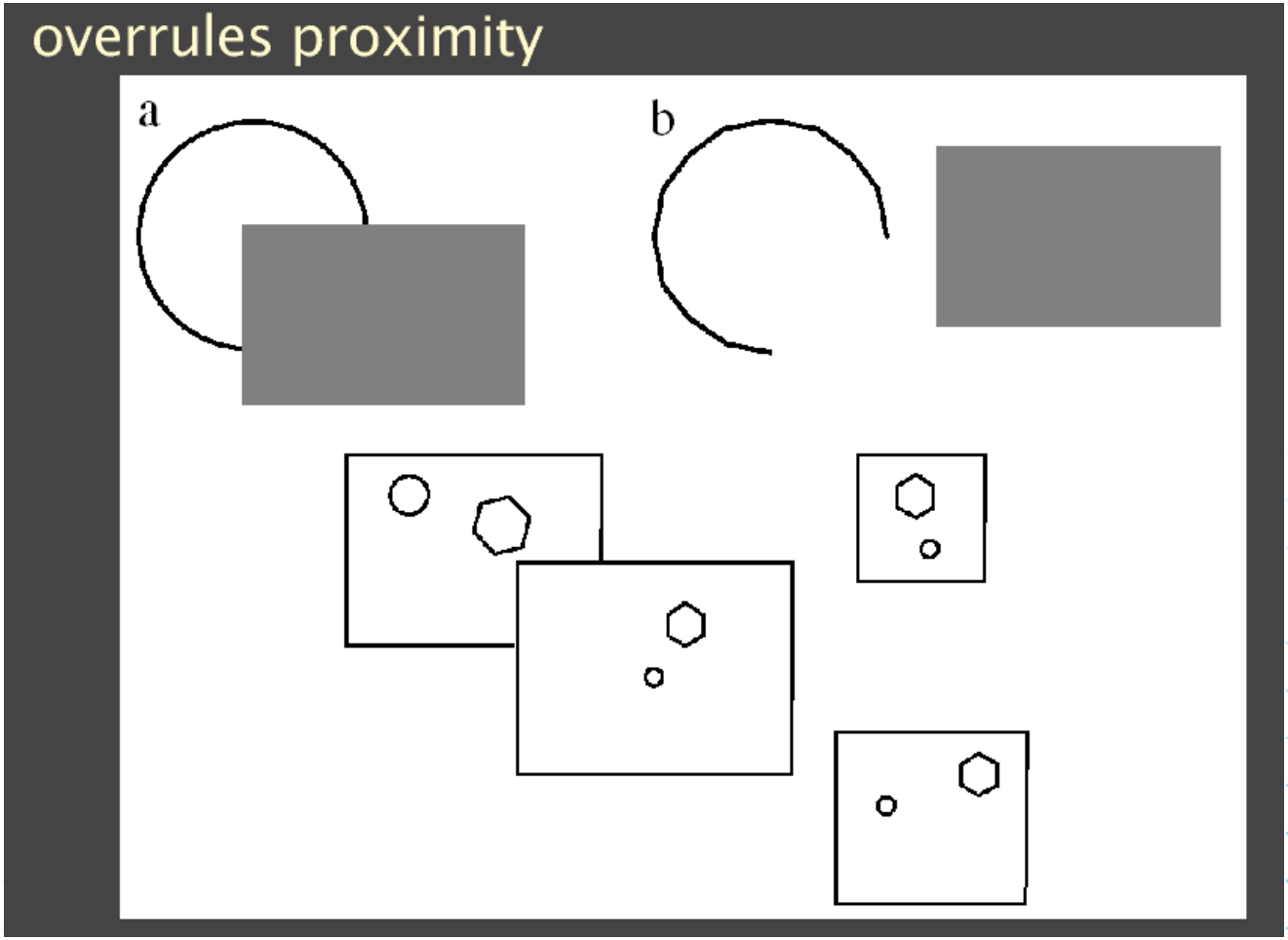
Connectedness

can overrule size, shape



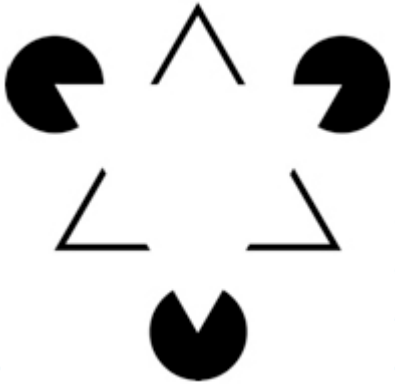
Gestalt Properties

Closure



Gestalt Laws of Perceptual Organization (Kaufman 74)

- Figure and Ground
  - Escher illustrations are good examples
  - Vase/Face contrast
- Subjective Contour



Thanks for your attention!

Material from
Authors of Human Computer Interaction
Alan Dix, et al, Kate Dehbashi

National standards

- The first one in the field of UI was defined in Germany in mid of 80's
- This standard was a base for the ISO standard (namely ISO 9241)
- This standard includes not only rules for UI design but also for UI use (working conditions at the workplace etc…)

Guidance to Standards Developers

- **ISO/IEC Guide 71**:2001 *Guidelines to address the needs of older persons and people with disabilities when developing standards*
  - Identifies areas in need of accessibility consideration
    - Sensory abilities; Physical abilities; Cognitive abilities; Allergies
  - Revision has just started
    - Focus shifting to inclusive design

- **ISO TR 22411**:2008 *Ergonomic data and ergonomic guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities*
  - A second version is now under development
    - It needs to coordinate with new version of Guide 71

Guidance to Standards Developers

- **ISO/IEC TRs 29138** *Information technology — Accessibility considerations for people with disabilities*
  - **Part 1**: 2009 *User needs summary*
    - currently 150 needs identified (with very little duplication)
  - **Part 2**: 2009 *Standards inventory*
    - Currently organized in 6 categories
      - 102 Accessibility Focused
      - 191 Related
  - **Part 3**: 2009 *Guidance on user needs mapping*
    - Updates are currently underway
    - To be published as “information documents” rather than TR’s
    - Information also to be placed in a publicly available database

Standards with broad applicability

- **ISO 9241-20**:2008 *Accessibility guidelines for information/communication technology (ICT) equipment and services*
- **ISO/IEC 13066-1**:2011 *Information Technology — Interoperability with Assistive Technology (AT) Part 1: Requirements and recommendations for interoperability*
- **ISO 9241-171**:2008 *Guidance on software accessibility*
- **ISO/IEC 29136**:(2012) *Accessibility of personal computer hardware*
- **ISO/IEC 24756**: 2009 *Information technology — Framework for specifying a common access profile (CAP) of needs and capabilities of users, systems, and their environments*

Standards with broad applicability

- **ISO/IEC 24751** *Individualized Adaptability and Accessibility in E-learning, Education and Training*
  - **Part 1**: 2008 *Framework and reference model*
  - **Part 2**: 2008 *"Access for all" personal needs and preferences for digital delivery*
  - **Part 3**: 2008 *"Access for all" digital resource description*
  - **Part 9**: NP *"Access for all" personal user interface preferences*
  - **Part 10**: NP *"Access for all" user interface characteristics*
  - **Part 11**: CD *"Access for all" personal needs and preferences for non- digital resources*
  - **Part 12**: CD *"Access for all" non-digital resource description*
  - **Part 13**: CD *"Access for all" personal needs and preferences for LET events*
  - **Part 14**: CD *"Access for all" LET events description*

Component Accessibility

- **ISO/IEC 24786**: 2010 *Accessible user interface for accessibility settings*
- **ISO/IEC 13066 Accessibility API Technical Reports**
  - Current TR's under development:
    - **Part 2**: 2012 *Windows automation framework accessibility API*
    - **Part 3**: 2012 *I-Accessible2 accessibility API*
    - **Part 4**: 2013 *Linux/UNIX graphical environments accessibility API*
    - **Part 6**: 2013 *Java accessibility API*
- **ISO/IEC 20071** *User interface component accessibility*
  - **Part 11**:2012 – *TR Guidance on creating alternative text for images*

Accessibility going mainstream

- **Moving from accessibility standard to mainstream standard**
  - **ISO/IEC 19766**: 2007 *Guidelines for the design of icons and symbols to be accessible to all users – Including the elderly and persons with disabilities*

NOTE: ISO/IEC19766 is already replaced and completely incorporated within:

- **ISO/IEC 11581-10**: 2010 *Information Technology — User Interface Icons —Framework and General Guidance*

- **Inclusion in a new mainstream standard**
  - **ISO 9241-129**: 2010 *Guidance on individualization*