Interaction Styles
Direct Manipulation

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Interaction styles – Possible classification

- Menus
- Direct manipulation
- Fill-in-forms
- Dialog boxes
- Function keys
- Command languages
- Natural languages
- 3D interfaces
- …
- Often two or more styles are used simultaneously

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Direct manipulation - outline

- Definition
- Examples
- Semantic and articulatory distance
- Main advantages and disadvantages
- User profile
- Guidelines

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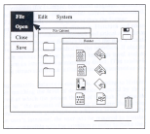
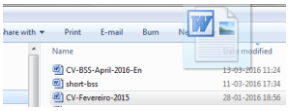
Direct Manipulation (Shneiderman, 1982)

- Can be traced down to Sketchpad https://www.youtube.com/watch?v=USyoT_Ha_bA

- Actions are performed directly on visual representations of the objects
- It is characterized by:

1. Continuous representation of objects
2. Physical actions instead of command languages
3. Fast, incremental, reversible actions with visible results





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Direct Manipulation

- User interacts with visual representation of data objects
  - Continuous visual representation
  - Physical actions or labelled button presses
  - Rapid, incremental, reversible, immediately visible effects

Files & folders on desktop

Selection handles

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Direct manipulation

- Only icons?

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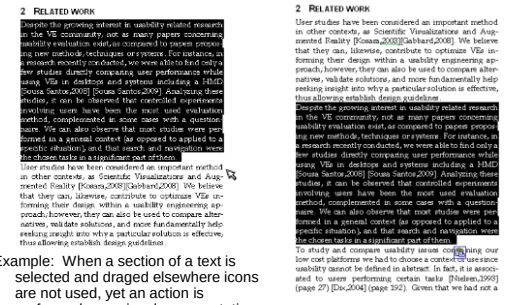
Direct Manipulation

Direct manipulationI doens not necessarily imply icons; however, in most situations they are involved



2 RELATED WORK

Despite the growing interest in usability related research in the VE community, not as many papers concerning usability evaluation exist, as compared to papers proposing new methods, techniques or systems. For instance, in a research recently conducted, we were able to find only a few studies directly comparing user performance while using VEs in desktops and systems including a HMD [Sousa Santos,2008] [Sousa Santos,2009]. Analyzing these studies, it can be observed that controlled experiments involving users have been the most used evaluation method, complemented in some cases with a questionnaire. We can also observe that most studies were performed in a general context (as opposed to applied to a specific situation), and that search and navigation were the chosen tasks in a significant part of them.

User studies have been considered an important method in other contexts, as Scientific Visualizations and Augmented Reality [Kosara,2003][Gabbard,2008]. We believe that they can, likewise, contribute to optimize VEs informing their design within a usability engineering approach; however, they can also be used to compare alternatives, validate solutions, and more fundamentally help seeking insight into why a particular solution is effective, thus allowing establish design guidelines.

Example: When a section of a text is selected and draged elsewhere icons are not used, yet an action is performed on a visual representation of an object (text section)

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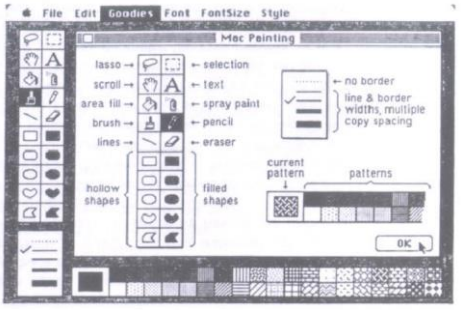
Direct manipulation: examples

One of the earliest commercially available UI using Direct Manipulation (MacPaint)



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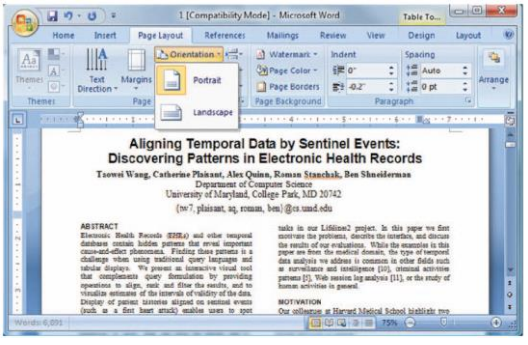
Direct manipulation: examples



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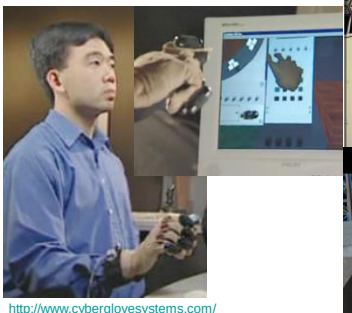
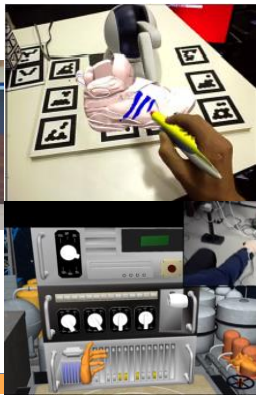
Direct manipulation: examples

http://www.magicvisionlab.com/pub/eckeevr13/paper.pdf

Virtual and augmented reality

Take direct manipulation to another level





http://www.cyberglovesystems.com/cad-evaluator

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Direct manipulation: examples

- WYSIWYG word processors:
  - Complete page visualization
  - Show document as it will be printed
  - Show cursors actions
  - Simple and intuitive manipulation of cursor
  - Icons to speed up frequent actions
  - *Imediate* feedback
  - Easy to revert operations (undo)

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Direct manipulation: degrees

- There is no “pure” direct manipulation User Interface (UI)
- Direct manipulation is a quality which may be present in different degrees
- According to Hutchins, Hollan e Norman (1986) a UI has the following aspects:
  - “Distance” between user’s *thoughts* and system’s requirements for using it to perform task
  - Engagement: Feeling that the user is directly manipulating the objects of interest

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Direct manipulation: Semantic and articulatory

- Distance
  - Semantic Distance – subjective distance between the user's goal and interface semantics
  - Articulatory distance – distance between the meaning of the actions and their physical form

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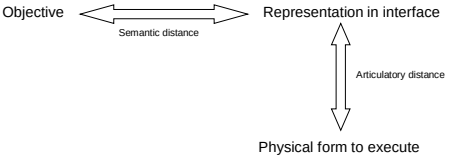
Direct manipulation: Semantic and articulatory



- Command "rotate 90º"
  - low semantic distance but high articulatory distance
- Using mouse to rotate de object while seeing the object moving
  - low semantic and articulatory distance.

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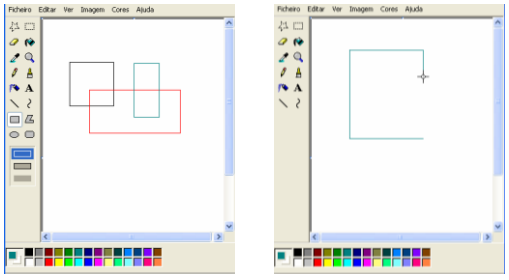
Direct manipulation: Semantic

Semantic Distance

If the objects and actions do not support the users' goals, semantic distance is high



If the user wants to draw rectangles this application has a smaller semantic distance

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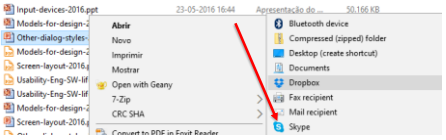
Direct manipulation: Articulatory

Articulatory Distance

When the physical way actions are performed is more similar to their meaning, articulatory distance is smaller

Selecting an option corresponds to a greater articulatory distance

Dragging an icon corresponds to smaller articulatory distance



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Direct manipulation

- Specifying objects by visual correlation implies the presence of direct manipulation
- How actions are specified defines the degree of direct manipulation

Objects	Actions	
visual correlation +	name generation visual correlation analogous action	- direct UI ↓ + direct UI

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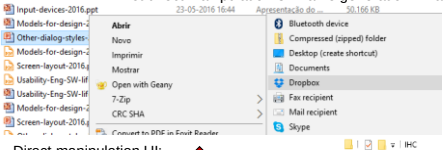
Direct Manipulation

```
bi@ub:~/Desktop$
bi@ub:~/Desktop$ mv java-how-to.txt smartbike_paper/
bi@ub:~/Desktop$
bi@ub:~/Desktop$
```

Not direct manipulation UI: name generation + name generation



Direct manipulation UI:
visual correlation + visual correlation

+ Direct manipulation UI:
visual correlation + analogous action

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Direct manipulation: Advantages and disadvantages

- Advantages (potential)
  - Easy to learn and remember
  - Direct, WYSIWYG
  - Flexible, easily reversible actions
  - Immediate visual and context feedback
  - Less prone to errors
- Disadvantages
  - Not auto-explanatory
  - May be inefficient
  - Difficult to draw recognizable icons (particularly for actions)
  - Icons occupy more screen real estate then text
  - Need to move between mouse and keyboard
  - Small display might limit interaction

Direct manipulation – User profile

- Knowledge and experience:
  - Moderate system experience
  - Moderate to high task experience
  - Frequent usage of other systems
  - Low computational literacy
- Work and task
  - Low frequency of use
  - Moderate training
  - Optional usage
  - Low structured tasks

Direct Manipulation design: guidelines

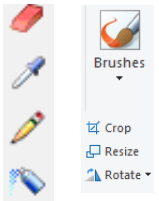
- Minimize articulatory and semantic distance
- Use general guidelines to design a usable UI:
  - Coherence
  - Good conceptual model
  - Feedback
  - Adequate organization of functionality
  - Adequate screen layout
  - Adequate colour usage
  - Adequate error handling
  - Etc.

Direct Manipulation design: guidelines

Coherent Icon scheme

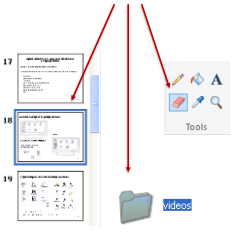
Different schemes:

better: same scheme



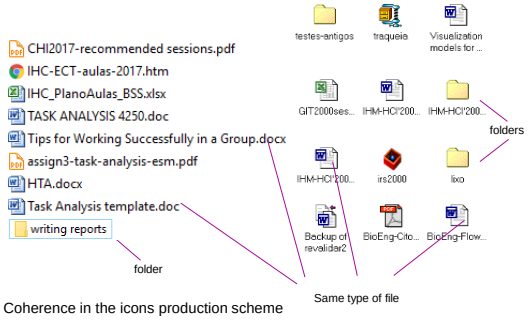
Adding names
(+ recognizable)

Visual selection feedback



Direct Manipulation design: guidelines

Express relation through icon similarity

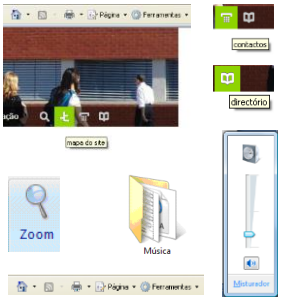


Coherence in the icons production scheme

Direct Manipulation design: guidelines

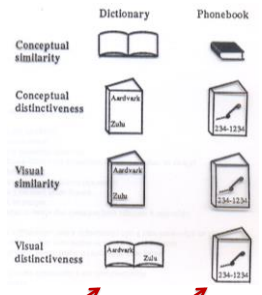
Add names to icons to make them more recognizable

Allow name definition



Direct Manipulation design: guidelines

Icons must be conceptually and visually distinctive



Conceptually similar icons

Best solution: conceptually and visually distinct

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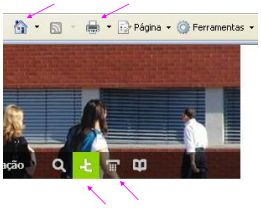
Direct Manipulation design: guidelines

Icons should be specific/familiar not abstract/non-familiar



Familiar Icons?

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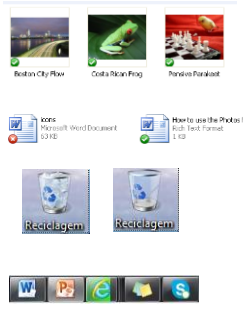
Direct Manipulation design: guidelines

Express objects attributes through icons



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Main Bibliography

- D. Mayhew, *Principles and Guidelines in Software User Interface Design*, Prentice Hall, 1992
- B. Shneiderman & C. Plaisant, *Designing the User Interface. Strategies for Effective Human–Computer Interaction*, 5th ed., Addison Wesley, 2009

Interesting Link

- http://www.interactiondesign.org/encyclopedia/interaction_styles.html

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