Sélection de commandes / Post-Wimp interfaces

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Diapositives inspirées de Gilles Bailly et Aurélien Tabard
What?
Interactive Systems
Interactive Systems
Command Selection
Why?
1 / Affects all Interactive Systems
Toolbox
Context menu
Hotkeys
Toolbox
Menubar
Toolbar
Ribbon
Command line
We need to:

- **present, organize** available commands
- let users **select** commands

2/ affect all interaction paradigms
Launch Menu

Metro Menu
Some math...

Technique 1

 VS.

Technique 2

3/ can have a big impact
Some math...

0.5 seconds

Technique 1

VS.

Technique 2

3/ can have a big impact
Some math...

0.5 seconds
500 million users

Technique 1

VS.

Technique 2

3/ can have a big impact
Some math...

0.5 seconds
500 million users
5 commands per user per day

3/ can have a big impact
Some math...

0.5 seconds
500 million users
5 commands per user per day
= 465 billion seconds per year

Technique 1

VS.

Technique 2

3/ can have a big impact
Some math...

0.5 seconds
500 million users
5 commands per user per day
= 465 billion seconds per year
= 126 million hours

3/ can have a big impact
Some math...

0.5 seconds
500 million users
5 commands per user per day
= 465 billion seconds per year
= 126 million hours
= 14,400 years

3/ can have a big impact
4/ Designing usable menu systems
Numerous novel interaction techniques have been proposed in the literature.
Goals

Simple Model of Performance

J Scarr, A Cockburn, C Gutwin and P Quinn.
Performance vs. Time
Ultimate Performance
Ultimate Performance
Increase Ultimate Performance

Reduce Learning Time

Ultimate Performance

Performance

Learning Time

Time
Performance vs. Learning Time

Increase Ultimate Performance

Reduce Learning Time

Ultimate Performance
Reduce Learning Time

Increase Ultimate Performance

Ultimate Performance

Performance

Learning Time

Time
Performance

Time

Ultimate Performance

Increase Ultimate Performance

Reduce Learning Time

Ultimate Performance

Learning Time

Time
Ultimate Performance

Increase Ultimate Performance

Reduce Learning Time

Performance

Learning Time

Time
Performance vs. Learning Time

- Increase Ultimate Performance
- Reduce Learning Time

Graph showing the relationship between performance and learning time, with an arrow indicating an increase in ultimate performance and a corresponding decrease in learning time.
Performance vs. Learning Time

Increase Ultimate Performance

Reduce Learning Time

Ultimate Performance
Performance vs. Time chart:

- **Increase Ultimate Performance**
- **Reduce Learning Time**
- **Ultimate Performance**
Increase ultimate performance.

Reduce learning time.
Performance

Learning Time

Increase Ultimate Performance

Ultimate Performance

Reduce Learning Time

Learning Time

Time
Ultimate Performance

Performance

Learning Time

Time
Performance vs. Learning Time

Ultimate Performance

Learning Time vs. Time
Criteria

10s Brainstorming

Ultimate Performance

Learning Time
Criteria

Ultimate Performance

Learning Time

non exhaustive list
Criteria

Speed
Accuracy

Ultimate Performance

Learning Time

non exhaustive list
Criteria

Ultimate Performance

Speed
Accuracy

Immediate Usability
Extended Learning
Learning Time

non exhaustive list
Criteria

Accessibility
Satisfaction
Fatigue
etc.

Speed
Accuracy

Ultimate Performance

Immediate Usability
Extended Learning
Learning Time

non exhaustive list
Criteria

Accessibility
Satisfaction
Fatigue
etc.

Speed
Accuracy

Immediate Usability
Extended Learning

Learning Time

Ultimate Performance

non exhaustive list
Learning Time

Immediate Usability

Learning Time
Learning Time

Immediate Usability

Initial Performance

Learning Time
Interactive Public Displays
Performance vs. Learning Time Graph

- **Immediate Usability**
- **Extended Learning**
- **Initial performance**
- **Ultimate Performance**
is it so easy?
Several Modalities?
Several Modalities?

First modality
ex: Menu

Second modality
ex: Hotkeys
Performance Dip

Modality Switch

Performance

Time

Modality 1

Modality 2

 keystroke: ⌘ + C
Performance vs. Time

- **Modality 1**
- **Modality 2**

**Performance dip**
- Ultimate performance (M1)
- Ultimate performance (M2)

- Initial performance
- Immediate usability
- Extended Learning
- Modality Switch

- $\text{Alt + C}$
Pointing  Text entry  Commands
Pointing  Text entry  Commands
1. Traditional Interaction Technique
2. Novel Interaction Technique
3. Model of Menu Performance
How?

Traditional Interaction Techniques
Brainstorming (30s)
Pros & Cons
Several modalities
Hierarchical organization
Exploration
Flexibility
Several modalities
Hierarchical organization
Exploration
Flexibility
Several modalities
Hierarchical organization
Exploration
Flexibility
Several modalities
Hierarchical organization
Exploration
Flexibility

Object <-> Command
No direct access
Visible Modal commands
Visible Modal commands

Object <-> Command
Small Target
No text Label
Occlusion (content area)
No organization
Hierarchical organization
In place
Contextual
Transient visualization

Open
Move to Trash
Get Info
Compress “A”
Burn “A” to Disc...
Duplicate
Make Alias
Copy “A”
Clean Up Selection
Show View Options

Label:

Folder Actions Setup...
OmniFocus: Send to Inbox
Open File in BBEdit

Activation
Touch screen?
\[ \mathbb{1} + C \]
Direct access (fast)
Left Hand
No [keyboard Mouse] transition

[Image of a diagram with symbols and the text "⌘ + C"]
Direct access (fast)
Left Hand
No [keyboard Mouse] transition

Recall rather recognition
Collision & Arbitrary mappings
Finger coordination
Require a keyboard
Focus of attention
No ideal solutions

Menu bar

Toolbox

Context menu

Keyboard shortcuts
How?

“Novel” Interaction Techniques
## Strategies

<table>
<thead>
<tr>
<th>First modality</th>
<th>Second modality</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>+ C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menu System</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert mode</th>
</tr>
</thead>
</table>
### Strategies

<table>
<thead>
<tr>
<th>First modality</th>
<th>Second modality</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Menu System" /></td>
<td>Ctrl + C</td>
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</tbody>
</table>

### Dimension

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Menu" /></td>
</tr>
</tbody>
</table>

### Menu System
Item: geometry

Frequency Ordered menus

Split menus
Item: geometry

Frequency Ordered menus

Split menus
Item: geometry

Folded Menus
Item: Visual cues

icons
Item: Visual cues

Ephemeral menus
[Findlater et al. 09]
## Strategies

<table>
<thead>
<tr>
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<th>Dimension Item</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Menu</td>
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<tr>
<td></td>
<td>Menu System</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Second modality</th>
<th>Expert mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mathbb{E} + C$</td>
<td></td>
</tr>
</tbody>
</table>
## Strategies

<table>
<thead>
<tr>
<th>First modality</th>
<th>Dimension</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Menu</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Menu System</td>
</tr>
<tr>
<td>Second modality</td>
<td>Expert mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\mathcal{M} + C$</td>
<td></td>
</tr>
</tbody>
</table>
Menu: Layout

Square menus (grid layout)
[Ahlstrom et al. 10]
Menu: Layout

Pie Menus

[Callahan et al. 08]
Menu: Geometry
### Strategies

<table>
<thead>
<tr>
<th>First modality</th>
<th>Second modality</th>
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<tbody>
<tr>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Shortcut" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menu</td>
<td>Menu System</td>
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</tbody>
</table>

**Shortcut:** Ctrl + C
## Strategies

<table>
<thead>
<tr>
<th>First modality</th>
<th>Second modality</th>
<th>Menu System</th>
</tr>
</thead>
<tbody>
<tr>
<td>![First modality Image]</td>
<td>![Second modality Image]</td>
<td>![Menu System Image]</td>
</tr>
</tbody>
</table>

### Options
- **Dimension**
- **Item**
- **Menu**
- **Expert mode**

**Key Combinations**
- **⌘ + C**
narrow and deep
(6 clicks from A to B)

Page A

Page B

broad and shallow
(10 main page options for 10 content items)
<table>
<thead>
<tr>
<th>Mise en page</th>
<th>Avantage d’une structure en largeur</th>
<th>Avantage d’une structure en profondeur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recherche visuelle</td>
<td>Balayage des items plus facile</td>
<td>Réduction du nombre d’items à lire</td>
</tr>
<tr>
<td>Sélection d’un item</td>
<td>Chemin plus court</td>
<td></td>
</tr>
<tr>
<td>navigation</td>
<td>Réduction du nombre de branches visitées par erreur</td>
<td></td>
</tr>
<tr>
<td>précision</td>
<td></td>
<td>Geste plus précis pour les menus circulaires</td>
</tr>
<tr>
<td>Charge cognitive</td>
<td>Noms des sous-menus moins abstraits</td>
<td>Réduction du nombre d’alternatives</td>
</tr>
<tr>
<td>Apprentissage</td>
<td>Construction plus facile d’une représentation mentale de la hiérarchie</td>
<td></td>
</tr>
<tr>
<td>Espace écran</td>
<td></td>
<td>Moins d’items affichés simultanément</td>
</tr>
</tbody>
</table>
Menu: Large number of items
Menu:
Large number of items

Fish-eye menus
### Strategies

<table>
<thead>
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<th>First modality</th>
<th>Second modality</th>
<th>Dimension Item</th>
<th>Menu</th>
<th>Menu System</th>
<th>Expert mode</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="First modality" /></td>
<td><img src="image2.png" alt="Second modality" /></td>
<td><img src="image3.png" alt="Dimension Item" /></td>
<td><img src="image4.png" alt="Menu" /></td>
<td><img src="image5.png" alt="Menu System" /></td>
<td>££ + C</td>
</tr>
</tbody>
</table>
Strategies

First modality

Second modality

Menu System

Expert mode
Expert Mode: Mapping
Métamorphose
Métamorphe
Alignment commands:
- Align Right
- Align Bottom
- Align Left
- Align Top
Dichotomous Commands
Why are hotkeys underused?
Mouse
Mouse

Expose
Expose and Keyboard Selection

Keyboard
ExposeHotkey (EHK)
ExposeHotkey (EHK)
ExposeHotkey (EHK)
Gestural Menu Techniques
Marking menus

[Kurtenbach et al. 91]
Demo of Marking Menus Versus Linear Menus

Autodesk Research
Demo of Marking Menus Versus Linear Menus

Autodesk Research
Speed & Accuracy

Learning & Memorization

Satisfaction

Other?
Speed & Accuracy

Learning & Memorization

Satisfaction

Other?

Brainstorming (2 minutes)
Pros & Cons & Properties (why)
Speed & Accuracy
- Circular design (decrease the average distance)
- Scale independence (the size of the marks does not matter)
- Expert mode (direct access)

Learning & Memorization
- Spatial memory (orientation)
- Muscular memory (fluid transition)
- Semantic relationship (open / close)

Satisfaction
- Gestural interaction

Software adequacy
- In place
- Eyes-free selection (do not require visual control)
- **Number of commands** (menu depth: 3 / menu breadth: 8)
- require space
Compound marks
Limitations of Hierarchical Marking
Limitations of Hierarchical Marking
Limitations of Hierarchical Marking
Limitations of Hierarchical Marking
Limitations of Hierarchical Marking
Limitations of Hierarchical Marking
Limitations of Hierarchical Marking
Limitations of Hierarchical Marking

NE-E-NE-E
Limitations of Hierarchical Marking

NE-E - NE - E
Limitations of Hierarchical Marking

NE-E - NE - E
Maya
Marking menus with Linear portions
Simple marks (Menu depth)
Simple marks
Simple marks
Simple marks
Simple marks
Simple marks
Limitation of simple marks?

– forget that I have a mark already → error
– (they are “modal”)
Flower Menus (curved gestures)
Fame or Shame?

How to predict whether a novel menu technique will be efficient?
Model of Menu Performance

A Predictive Model of Menu Performance.
ACM CHI'07. ACM Press, pages 627-636
Performance vs. Time

- **Modality 1**
- **Modality 2**

- **Ultimate performance (M1)**
- **Ultimate performance (M2)**

- **Performance dip**

- **Initial performance**

- **Immediate usability**

- **Extended Learning**

- **Modality Switch**

- **Modality 1**
- **Modality 2**

- **Δ** + C
Performance over time for two modalities:

- Modality 1:
  - Initial performance
  - Ultimate performance (M1)
  - Performance dip
  - Extended Learning
  - Immediate usability

- Modality 2:
  - Ultimate performance (M2)
  - Performance dip
  - Modality Switch

The diagram illustrates the performance trajectory over time for both modalities, showing the impact of extended learning and the switch between modalities.
Activate submenu

Localization

Activate menu

Menu Opened

Select item

Item Selected

Activate item

Item Activated
Activate submenu

Localization

MenuOpened

Select item

ItemSelected

Activate item

ItemActivated

Activate menu

MenuOpened

Select item

ItemSelected

Activate item

ItemActivated
Activate submenu

- Localization
- Menu Opened
- Item Selected
- Item Activated

Activate menu
Select item
Activate item
Execute command
Activate submenu

Menu Opened

Localization

Select item

Activate item

Select hotkey

Item Selected

Execute command

Item Activated

Activate menu
Activate submenu

Localization

Menu Opened

Select item

Item Selected

Activate item

If hierarchical item

Item Activated

Execute command

Start state

Accept state

State

Transition

Activate menu

Select hotkey
Goal:

Select the command “Find”

Novice Users
1) Localization: Visual search
2) Pointing task
Goal:
Select the command “Find”

Novice Users
1) Localization: Visual search
2) Pointing task
Goal:

Select the command “Find”

Novice Users
1) Localization: Visual search
2) Pointing task
Goal:

Select "Find"

Novice Users
1) Localization: Visual search
2) Pointing task

Expert Users
1) Localization: Decision time
2) Pointing task
Goal:

Select “Find”

Novice Users
1) Localization: Visual search
2) Pointing task

Expert Users
1) Localization: Decision time
2) Pointing task
Goal:

Select “Find”

Novice Users
1) Localization: Visual search
2) Pointing task

Expert Users
1) Localization: Decision time
2) Pointing task
a) Visual search
b) Decision time
c) Pointing task
d) Learning
Fitts’ Law (Pointing task)
Fitts’ Law (Pointing task)

\[ T = a + b \log_2(1 + D/W) \]
Fitts’ Law (Pointing task)

\[ T = a + b \log_2(1 + \frac{D}{W}) \]

\[ T = a + b \log_2(1 + \frac{n \cdot h}{h}) \]

\[ T = a + b \log_2(1 + n) \]

n: the number of items
h: item height
Fitts’ Law (Pointing task)

\[ T = a + b \log_2(1 + \frac{D}{W}) \]

\[ T = a + b \log_2(1 + \frac{n \cdot h}{h}) \]

\[ T = a + b \log_2(1 + n) \]

n: the number of items
h: item height
Localization: Novice

Visual search
Localization: Novice

Visual search

\[ T = a + b \cdot n \]
Localization

Novice: Visual search

\[ T = a + b \times n \]

Expert: Decision Time
(Hyck-Hyman Law)

\[ T = a + b \log_2(1/p_i) \]

\( P_i \): probability of the event
a) Visual search
b) Decision time
c) Pointing task
d) Learning

Novice: e=0 (visual search)
Expert: e=1 (decision time)
a) Visual search
b) Decision time
c) Pointing task
d) Learning

Novice: $e=0$
(visual search)

$$T_{vs} = a_{vs} + b_{vs} \times n$$

Expert: $e=1$
(decision time)
a) Visual search
b) Decision time
c) Pointing task
d) Learning

Novice: $e=0$
(visual search)

$$T_{vs} = a_{vs} + b_{vs} \times n$$

Expert: $e=1$
(decision time)

$$T_d = a_d + b_d \times \log_2(1/Pi)$$
a) Visual search
b) Decision time
c) Pointing task
d) Learning

\[ T_l = (1-e) \cdot T_{vs} + e \cdot T_d \]

Novice: \( e = 0 \) (visual search)

\[ T_{vs} = a_{vs} + b_{vs} \cdot n \]

Expert: \( e = 1 \) (decision time)

\[ T_d = a_d + b_d \cdot \log_2 \left( \frac{1}{P_i} \right) \]
Brainstorming (30s)
Limitations & Possible Improvements
Inspection
Pointage
Saliency
<table>
<thead>
<tr>
<th>Label 1</th>
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<tbody>
<tr>
<td>Label 2</td>
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<td>Label 7</td>
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<tr>
<td>Label 8</td>
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<tr>
<td>Quit</td>
</tr>
<tr>
<td>Label 1</td>
</tr>
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<td>---------</td>
</tr>
<tr>
<td>Label 3</td>
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<td>Label 5</td>
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<td>Label 5</td>
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<td>Label 6</td>
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<tr>
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</tr>
<tr>
<td>Label 8</td>
</tr>
<tr>
<td>Quit</td>
</tr>
</tbody>
</table>
Where is **Save As**?

<table>
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<td>Label 4</td>
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<tr>
<td>Label 6</td>
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<tr>
<td>Label 7</td>
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<td>Label 8</td>
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</table>
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<tr>
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</tr>
<tr>
<td>Label 8</td>
</tr>
<tr>
<td>Label 9</td>
</tr>
</tbody>
</table>
Post-Wimp interaction
Windows Icons Menus Pointer
Not "direct enough"

Indirect interaction through manipulation of interface elements
pCubee
Ian Stavness, Billy Lam, Sidney Fels
Human Communication Technologies Lab
University of British Columbia 2010
pCubeee
Ian Stavness, Billy Lam, Sidney Fels
Human Communication Technologies Lab
University of British Columbia  2010
Physical embodiment of digital information and computation
Architecture of Tangible UIs
SenseBoard (2001)
SenseBoard (2001)
I/O Brush (2004)
I/O Brush (2004)
Gestural interaction
A gesture is a motion of the body that contains information [Kurtenbach]
A gesture is a motion of the body that contains information [Kurtenbach]
Shark 2004/Shapewriter 2007
Shark 2004/Shapewriter 2007
Why?

- Based on user's existing drawing and handwriting skills [Kurtenbach et al. 94]
- Physically chunk a command and its operands into a single action [Buxton et al. 86]
- Implicit and fast mode switching
- A lot of works in HCI
Applications: mouse gestures
Applications: mouse gestures
Smartphone
Smartphone
Tabletop
Speed & Accuracy

Learning & Memorization

Satisfaction

Other?
Text entry

Command selection
Object selection
Object selection
Selection+command in one gesture
Selection+command in one gesture
Challenges

Create a gesture set
Define a gesture-command mapping

Imagine that you are designer
You have a list of 24 commands and
You want to build a gestural interface

How do you proceed?
Create a gesture set

Symbolic gestures

self-mapping
Create a gesture set

Abstract Gestures

- + Organization
- + Accuracy
- - Gesture shape suggests no meaning
Define a mapping

User defined gestures

Capture “natural” mappings
Define a mapping

User defined gestures

Capture “natural” mappings

<table>
<thead>
<tr>
<th>command</th>
<th>number of gestures</th>
<th>% choosing “winner”</th>
</tr>
</thead>
<tbody>
<tr>
<td>accept</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>minimize</td>
<td>3</td>
<td>90.9%</td>
</tr>
<tr>
<td>previous</td>
<td>2</td>
<td>90.9%</td>
</tr>
<tr>
<td>select single</td>
<td>3</td>
<td>90.9%</td>
</tr>
<tr>
<td>help</td>
<td>3</td>
<td>86.4%</td>
</tr>
<tr>
<td>next</td>
<td>2</td>
<td>86.4%</td>
</tr>
<tr>
<td>open</td>
<td>5</td>
<td>86.4%</td>
</tr>
<tr>
<td>move</td>
<td>3</td>
<td>81.8%</td>
</tr>
<tr>
<td>out</td>
<td>2</td>
<td>77.3%</td>
</tr>
<tr>
<td>rotate</td>
<td>4</td>
<td>68.2%</td>
</tr>
<tr>
<td>shrink</td>
<td>5</td>
<td>68.2%</td>
</tr>
<tr>
<td>delete</td>
<td>5</td>
<td>63.6%</td>
</tr>
<tr>
<td>pan</td>
<td>2</td>
<td>63.6%</td>
</tr>
<tr>
<td>undo</td>
<td>4</td>
<td>63.6%</td>
</tr>
<tr>
<td>select group</td>
<td>3</td>
<td>59.1%</td>
</tr>
<tr>
<td>menu</td>
<td>5</td>
<td>54.5%</td>
</tr>
<tr>
<td>paste</td>
<td>4</td>
<td>54.5%</td>
</tr>
<tr>
<td>reject</td>
<td>5</td>
<td>54.5%</td>
</tr>
<tr>
<td>enlarge</td>
<td>5</td>
<td>45.5%</td>
</tr>
<tr>
<td>zoom in</td>
<td>5</td>
<td>45.0%</td>
</tr>
<tr>
<td>duplicate</td>
<td>4</td>
<td>36.4%</td>
</tr>
<tr>
<td>zoom out</td>
<td>6</td>
<td>22.7%</td>
</tr>
</tbody>
</table>
Define a mapping

Semantic relationships
Focus on the relation between

- the different gestures
- the different commands

Highlight:

- Similarity
- Opposition
- etc.
Other post-wimp interfaces
Scratch input
Scratch input
Scratch input
Watch-it
Watch-it
Pinstripe
- Hiroshi Ishii — Tangible User Interfaces
- pCubee — University of British Columbia
- I/O Brush — Tangible Media Group
- Sense board — Tangible Media Group
- Shapewriter — Shumin Zhai
- Marking Menus — Bill Buxton and Gordon Kurtenbach
- Scriboli — Ken Hinckley
- Cyclostar — Télécom ParisTech
- User-defined gestures
- Foundational Issues in Touch-Surface Stroke Gesture Design
- Chris Harrison webpage
- WatchIt — Télécom ParisTech
- Pinstripe — Aachen University