Instrumental Interaction

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Overview

Analysis of WIMP applications

Power vs. Simplicity

Interaction model

Instrumental Interaction

Design Principles

Analysis of WIMP applications

#menus	Menus in menu bar
#cmds	Commands in menus
#dlogs	Commands that lead to a dialog box
#smenus	Sub-menus
#scmds	Commands in sub-menus
#sdlogs	Commands in sub-menus that lead to a dialog box
Tcmds	Total commands: #cmds - #smenus + #scmds
Tdlogs	Total dialog boxes: #dlogs + #sdlogs
Cmds/M	Mean commands per menu: #cmds / #menus
Cmds/SM	Mean commands per sub-menu: #scmds / #smenu
#palettes	Palettes and toolbars
#tools	Widgets in palettes and toolbars
#prefs	Preference pages
#options	Options in preference pages
macros	Whether macros can be defined

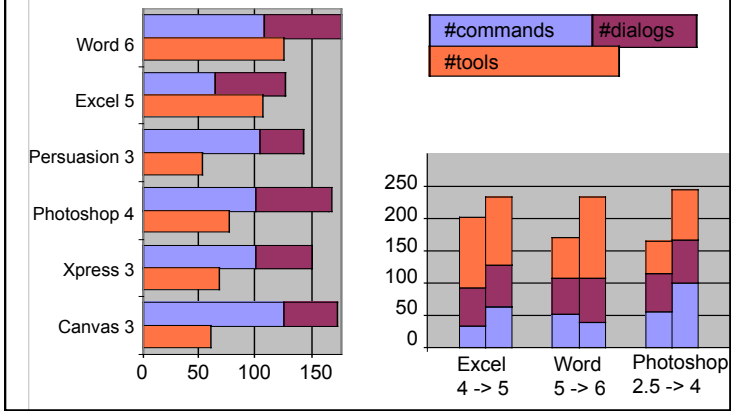
Number of commands

	Word6	Excel5	Persuasion3	Photoshop4	Xpress3	Canvas3		
Criteria	**W6**	**E5**	**Pe3**	**P4**	**X3**	**C3**	**Avg**	**s**
#menus	8	8	7	8	7	8	7.7	0.5
#cmds	106	84	97	111	99	74	95.2	13.8
#dlog	69	44	20	27	40	21	36.8	18.6
#smenu	1	15	27	26	13	22	17.3	9.8
#scmds	3	58	73	82	65	121	67.0	38.4
#sdlog	0	20	20	40	10	28	19.7	13.9
Tcmds	108	127	143	167	151	173	144.8	24.5
Tdlogs	69	64	40	67	50	49	56.5	11.8
Cmds/M	13.3	10.5	13.9	13.9	14.1	9.3	12.5	2.1
Cmds/SM	3.0	3.9	2.7	3.2	5.0	5.5	3.9	1.1
#palettes	9	13	5	11	6	6	8.3	3.2
#tools	125	106	54	77	68	60	81.7	28.0
#prefs	12	10	1	8	5	11	7.8	4.2
#options	113	76	11	51	82	27	60.0	37.7
macros	yes	yes	no	yes	no	yes		

Successive versions

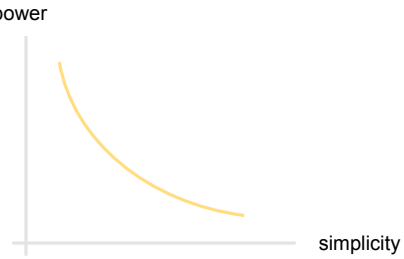
	Excel 4->5			Word 5->6			Photoshop 2.5->4		
Criteria	**E4**	**E5**	**%**	**W5**	**W6**	**%**	**P2**	**P4**	**%**
#menus	8	8	0%	8	8	0%	7	8	+14%
#cmds	93	84	-10%	107	106	-1%	78	111	+42%
#dlog	60	44	-27%	55	69	+25%	21	27	+29%
#smenu	0	15	+ •	0	1	+ •	19	26	+37%
#scmds	0	58	+ •	0	3	+ •	56	82	+46%
#sdlog	0	20	+ •	0	0	+ •	39	40	+3%
Tcmds	93	127	+37%	107	108	+1%	115	167	+45%
Tdlogs	60	64	+7%	55	69	+25%	60	67	+12%
Cmds/M	11.6	10.5	-10%	13.4	13.3	-1%	11.1	13.9	+25%
Cmds/SM	0	3.9	+ •	0	3	+ •	2.9	3.2	+7%
#palettes	8	13	+63%	3	9	+200%	6	11	+83%
#tools	108	106	-2%	63	125	+98%	49	77	+57%
#prefs	0	10	+ •	10	12	+20%	9	8	-11%
#options	0	76	+ •	52	113	+117%	58	51	-12%
macros	yes	yes		no	yes		no	yes	

Analysis of WIMP applications



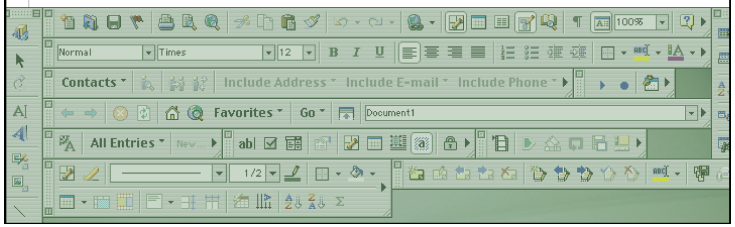
Power vs. Simplicity

Simple things should be simple
Complex things should be possible
How to combine power & simplicity ?



More is less: the illusion of power

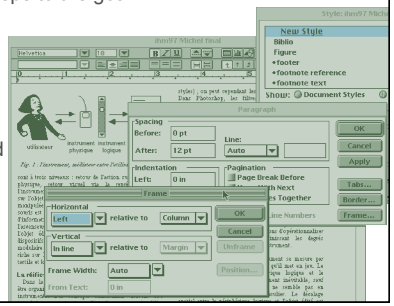
Bloatware
- Too many functions
- More functions with each new version



Marketing software : increased power?

Add features
- More menu items - Each is harder to find
- More commands - Each is harder to learn
- More dialog boxes - More steps to the goal

Add programming
- Macros
- Scripting languages
- Require users to understand programming concepts

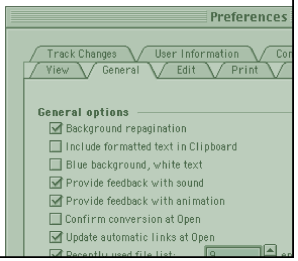


Marketing software : increased simplicity?

Add wizards
- Hard to understand: What did the wizard do?
- Lose control: Wizard may do the wrong thing
- Waste time: Must fix the wizard's mistakes

Add Customization:

Preferences menus
- Hard to navigate
- Hard to translate into user's terms
- Hard to choose relevant settings
- Rarely sharable
- Most users don't bother



Costs vs. benefits

Simple things are harder

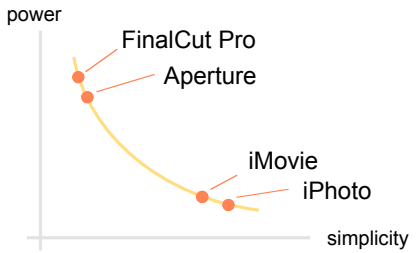
Complex things are not used

Cost of learning
- Learned skills made obsolete
- No path from novice to expert

Cost of making choices
- Cognitive: more decisions
- Sensory-motor: more steps

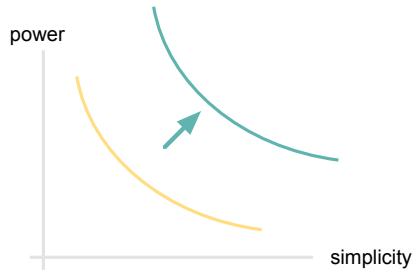
A better approach

Specializing software
- Example: Apple Macintosh

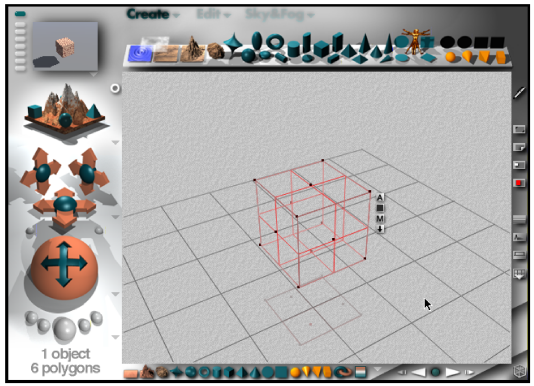


Another approach

Shifting the curve

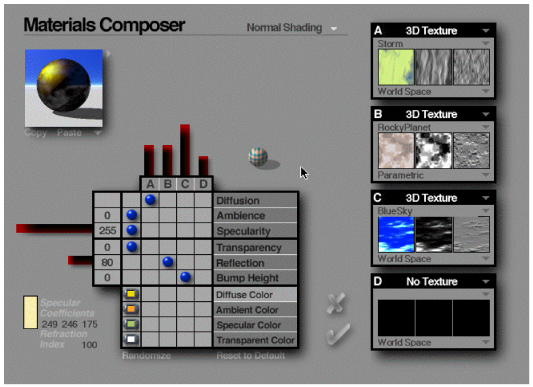


Going beyond WIMP



Bryce2
(Metatools)

Complexity can be simple



Bryce2
(Metatools)

Comparison: Bryce vs WIMP

Criteria	Avg	Bryce2	% of Avg
#menus	7.7	3	38.9%
#cmds	95.2	45	47.3%
#dlog	36.8	18	48.9%
#smenu	17.3	0	0.0%
#scmds	67.0	0	0.0%
#sdlog	19.7	0	0.0%
Tcmds	144.8	45	31.1%
Tdlogs	56.5	18	31.8%
Cmds/M	12.5	15.0	120.0%
Cmds/SM	3.9	0.0	0.0%
#palettes	8.3	9	108.4%
#tools	81.7	71	86.9%
#prefs	7.8	1	12.8%
#options	60.0	5	8.3%

No menus,
No windows,
No dialog boxess

Graphical design
Interaction design
Layered approach

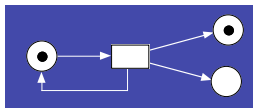
Case study: CPN 2000 Project

Beaudouin-Lafon & Mackay, 2000

Redesign of Design/CPN
- Current use world-wide: 600+ organizations

Purpose:
- Edit and simulate coloured Petri Nets

Opportunity:
- Explore research questions with a real-world application

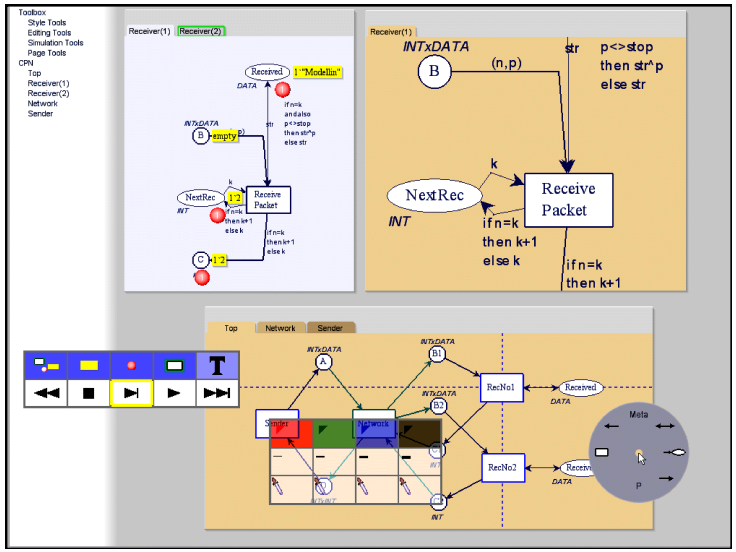


Two key design decisions

Support two-handed input
- Dominant and non-dominant hands

Integrate four interaction techniques:
- Toolglasses
- Floating palettes
- Contextual menus
- Bi-manual interaction

Why these techniques?
- User studies show context affects tool preference
- Palettes: focus on command
- Marking menus: focus on object
- Toolglasses: mixed focus



Less is more: the power of simplicity

CPN2000 case study

New version has more power but
- no menu bar
- no title bars
- no scrollbars
- no dialog boxes
- no selection

This required
- Participatory design process
- *Interaction model*
- Implementation from scratch

Interaction model

Definition

- Set of principles, rules and properties
  that guide the design of an interactive system
- Helps combine interaction techniques
  in a consistent way

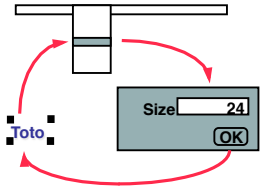
Properties

- Descriptive:
  describes a range of existing interactive systems
- Evaluative:
  helps evaluate interactive systems
- Generative:
  helps create new interaction techniques

Need for a new interaction model

Direct manipulation

… is often too indirect



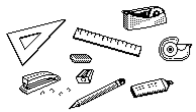
Support more direct forms of interaction

Instrumental interaction

Beaudouin-Lafon 97

Inspiration

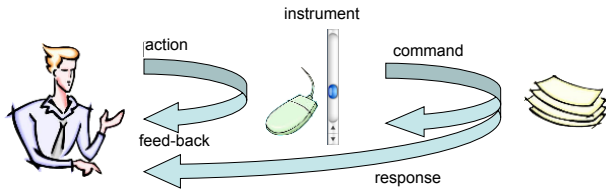
- Interaction with our environment
  is mediated by tools and instrumentsTwo categories of objects



- Domain objects
- Interaction instruments

Interaction instruments

Conceptual model



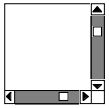
Two levels of interaction: mediation

Instruments and modes

An instrument turns a mode into an object

Activating a mode = activating an instrument

Spatial mode: pointing



Temporal mode: selection

Cost of activation

Describing current WIMP interfaces

WIMP interfaces are based on widgets

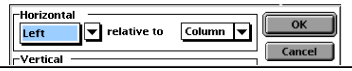
Instruments of (in)direct manipulation

Handles, Title bars

Menus, Toolbars

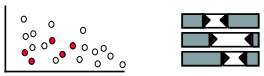
Scrollbars

Dialog and Property boxes



Describing novel interaction techniques

Dynamic Queries

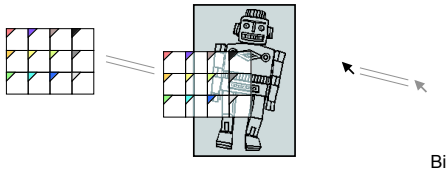


Ahlberg

Dropable Tools

Bederson et al.

Toolglasses

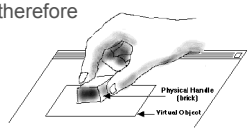


Bier et al.

Describing novel interaction techniques

Tangible interfaces

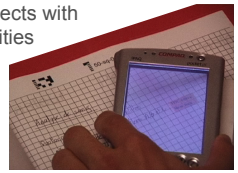
More input devices and therefore more instruments



Fitzmaurice
Ishii
Mackay
Rekimoto
Ullmer

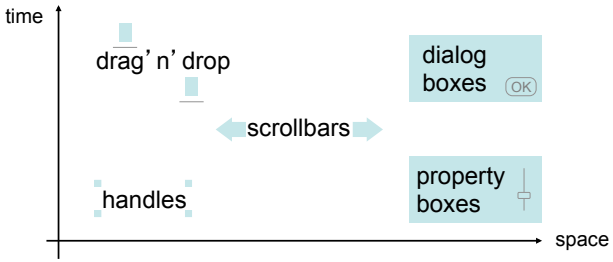
Augmented/Mixed reality

Augmenting physical objects with computational capabilities



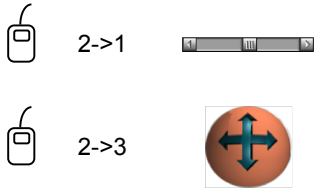
Evaluation : Properties of an instrument

Degree of indirection
- Spatial offset
- Temporal offset



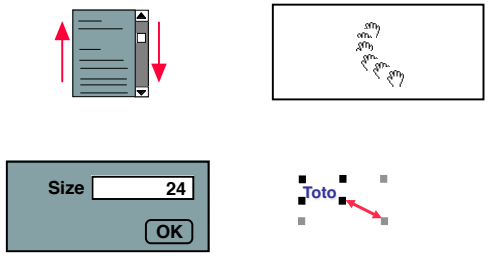
Evaluation : Properties of an instrument

Degree of integration
- How to use the degrees of freedom of the physical device
- Integrality & separability of input devices (Jacob et al., 94)



Evaluation : Properties of an instrument

Degree of conformance
- Similarity between physical action and effect on object



Generative power : Three design principles

Reification
- extends the notion of what constitutes an object

Polymorphism
- extends the power of commands with respect to these objects

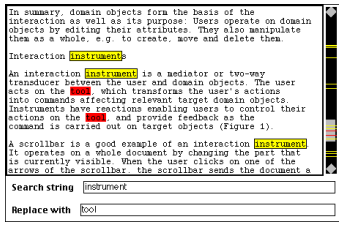
Reuse
- provides a way of capturing and reusing interaction patterns

Example : text search instrument

Classic search:
- Sequential
- Modal

Search instrument:
- Show all occurences
- Allow replacing occurences in any order

Augmented scrollbar



Reification

Turns concepts into (interface) objects

Interaction instrument
- Reification of a command into an interface widget

Example :
- scrolling a document -> scrollbar

Examples
- Guidelines: reification of alignment
- Layers: reification of mode

Polymorphism

Extends commands to multiple object types

Common examples:
- Cut, paste, delete, move

Context-dependent commands

Homogenous groups
- If applicable to one object, then applicable to a group of same-type objects

Heterogeneous groups
- Applicable to a heterogeneous group if it has meaning for individual object types

Reuse

Captures interaction patterns for later reuse

Output reuse
- Reuse previously created objects
- Example: duplicate, copy/paste

Input reuse
- Reuse previous commands
- Example: redo, history, macros

Magnetic guidelines

Reification of the alignment command

Power and simplicity
- Align command vs Align object:
- Align (now) vs Align (and keep aligned)

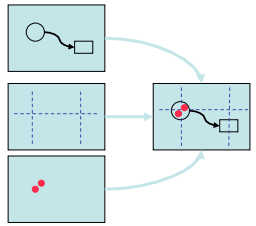
Multiple shapes
- Horizontal, vertical, diagonal, circular, rectangular
- Distribute objects

Decomposition
- Create / Move / Add object / Remove object

Layers

A mode defines:
- Which objects are visible
- Which commands are available

Layer = reification of mode
- Turn layer on/off
- Guidelines, simulation, annotations...

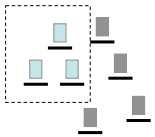


Increased power
- Combine layers

Example in CPN2000: debug mode, simulation mode

Groups

Reification + Polymorphism



Group = reification of a selection

Polymorphism:
- Apply a command to a group = apply it to each object in the group
- Generic commands: Open, Edit, Cut-Copy-Paste

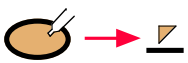
Examples in CPN2000
- Folders = Groups of pages
- Index = Hierarchy of documents and palettes
- Magnetic guidelines = Groups of layout-constrained objects
- Styles = Objects that share graphical attributes

Styles

Reification + Output reuse

Style object
- Reification of a collection of attributes
- Objects that share a style = group
- Editing style affects all objects in group

Style picker
- Copies any object's current attributes



Style dropper
- Applies style to any object

Macros

Input reuse + Reification + Polymorphism

Reuse
- Record a sequence of commands as a macro

Polymorphism:
- Apply macro as a command in new contexts

Reification:
- Edit macro as first class object

Integrating the principles

Reification and polymorphism
- More objects and fewer commands

Reification facilitates output reuse
- More first-class objects can be reused

Polymorphism facilitates input reuse
- Increases the scope of commands

Design principles

Increase simplicity
- Reification: direct instruments not indirect commands
- Polymorphism: fewer commands
- Reuse: copy/redo rather than re-create from scratch

Increase power
- Reification: commands as first-class objects
- Polymorphism: same command works in multiple contexts
- Reuse: path to programming/scripting

Conclusion

Instrumental Interaction makes explicit the artifacts involved in the mediation between user and objects of interest

Descriptive, evaluative and generative model

Design principles help combine power and simplicity