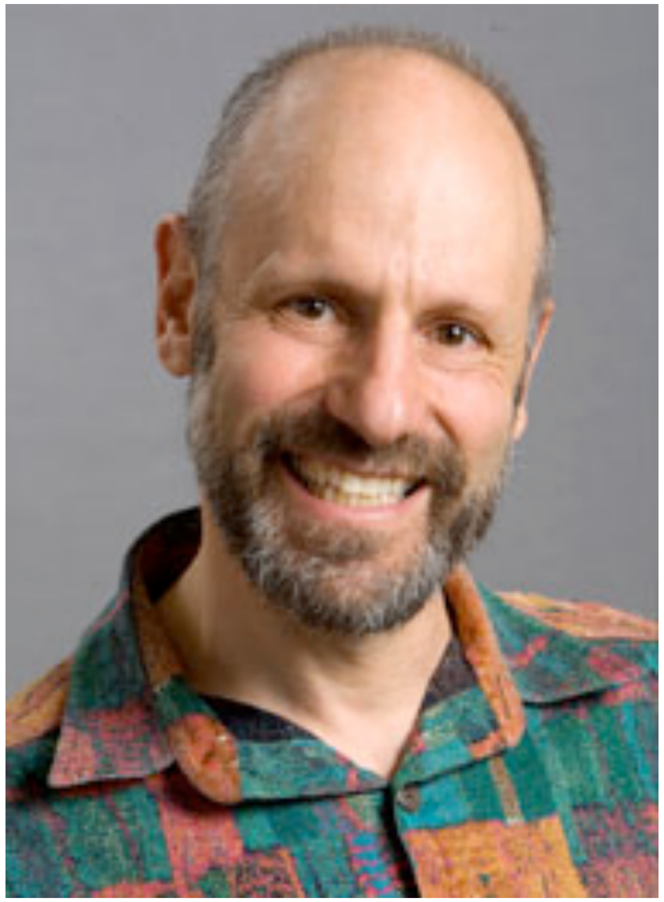
Announcement: Informatik colloquium

7.November, 2pm

room will be announced

Title: Activities in Considerate Systems

- designing for social factors in audio conference systems



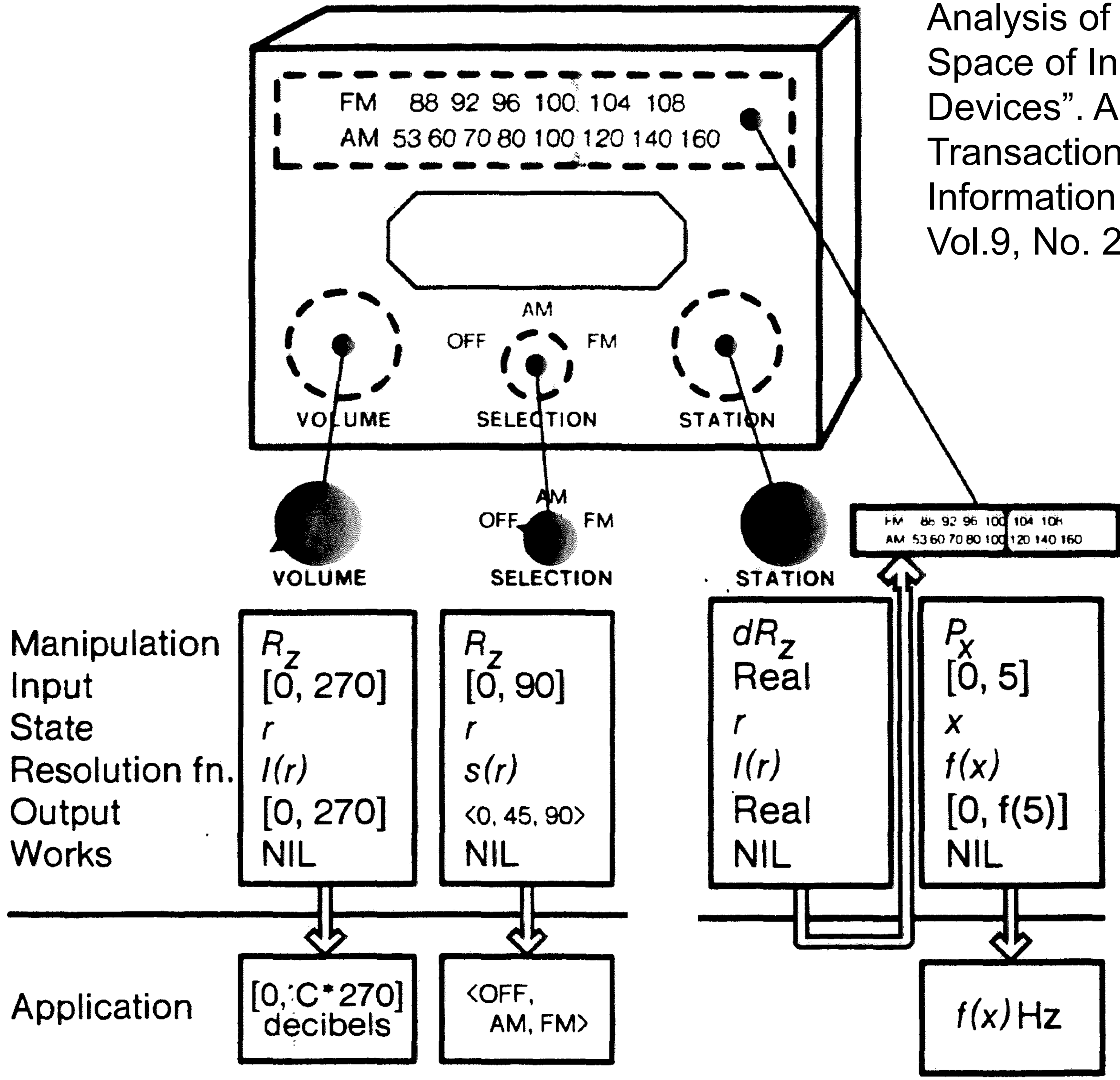
Let's recap

- short version of where our standard desktop interface comes from
  - not all tasks can be augmented using this human-computer setup.
  - as the interface moves into the physical world other design factors become prominent, e.g. social aspects.
- theory
  - learn concepts that you can apply to particular HCI problems.
    - quantification: GOMS KLM
    - Fitts' law
    - morphological approach

Desktop

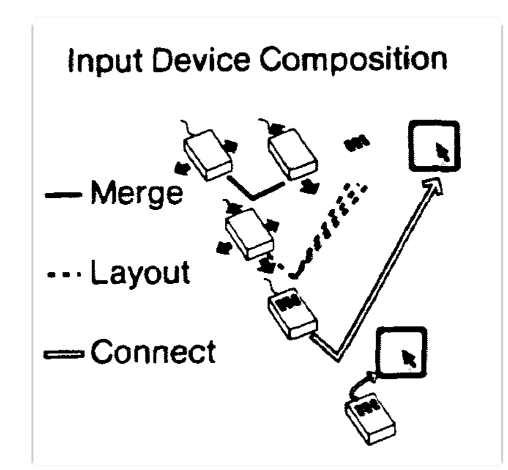
- context and task
- **theory**
  - Quantification
  - Fitts' law
  - **Card's design space**
- interaction techniques
- in/output technologies

Literature: Card et al., "A Morphological Analysis of the Design Space of Input Devices". ACM Transactions on Information Systems, Vol.9, No. 2, 1991



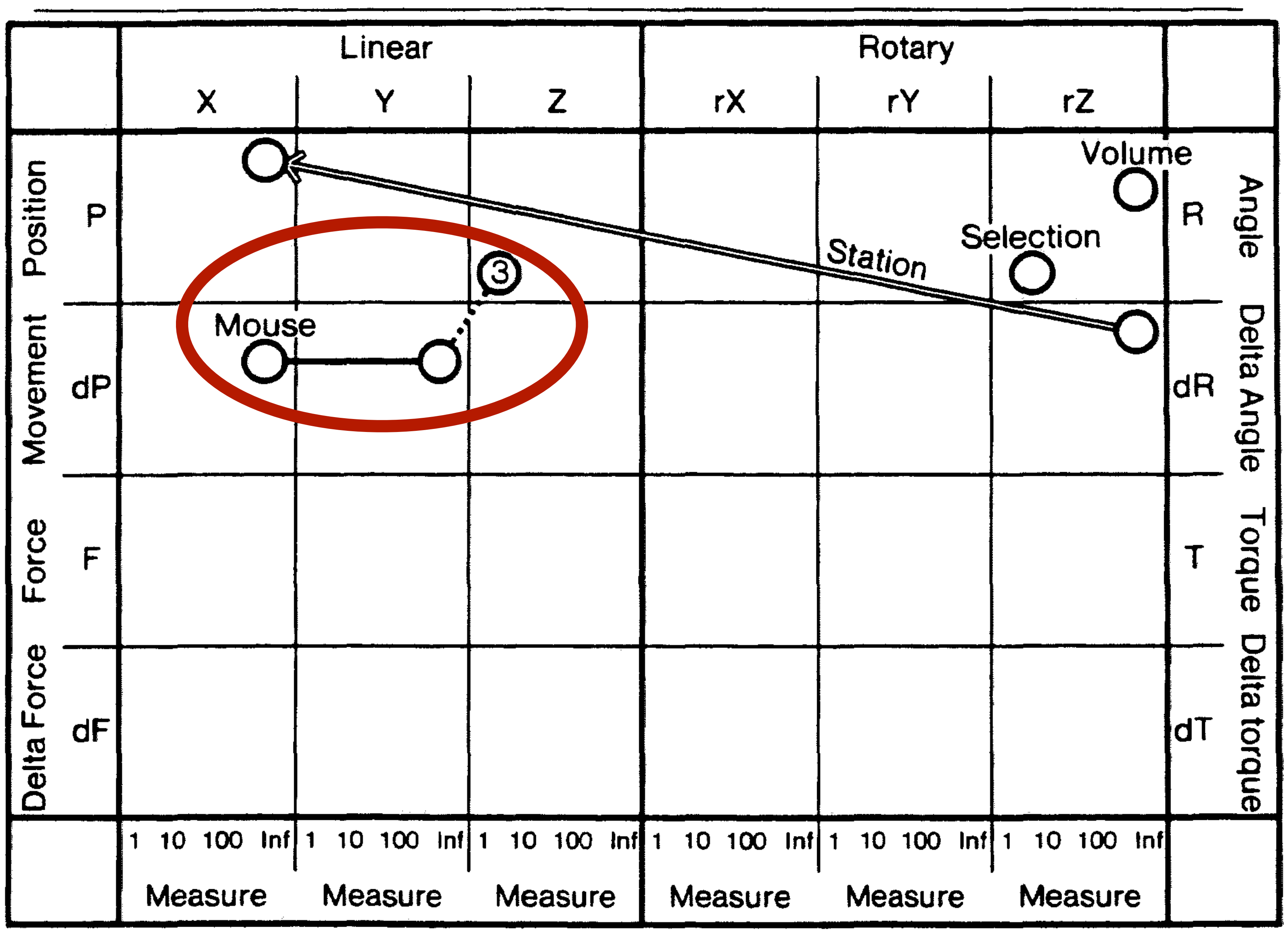
Composition Operators

- merge composition
  - two devices can be composed so that their common sets are merged
- layout composition
  - several devices laid out together in a control panel
- connect composition
  - two devices connected that the output of one is cascaded to the input of the other



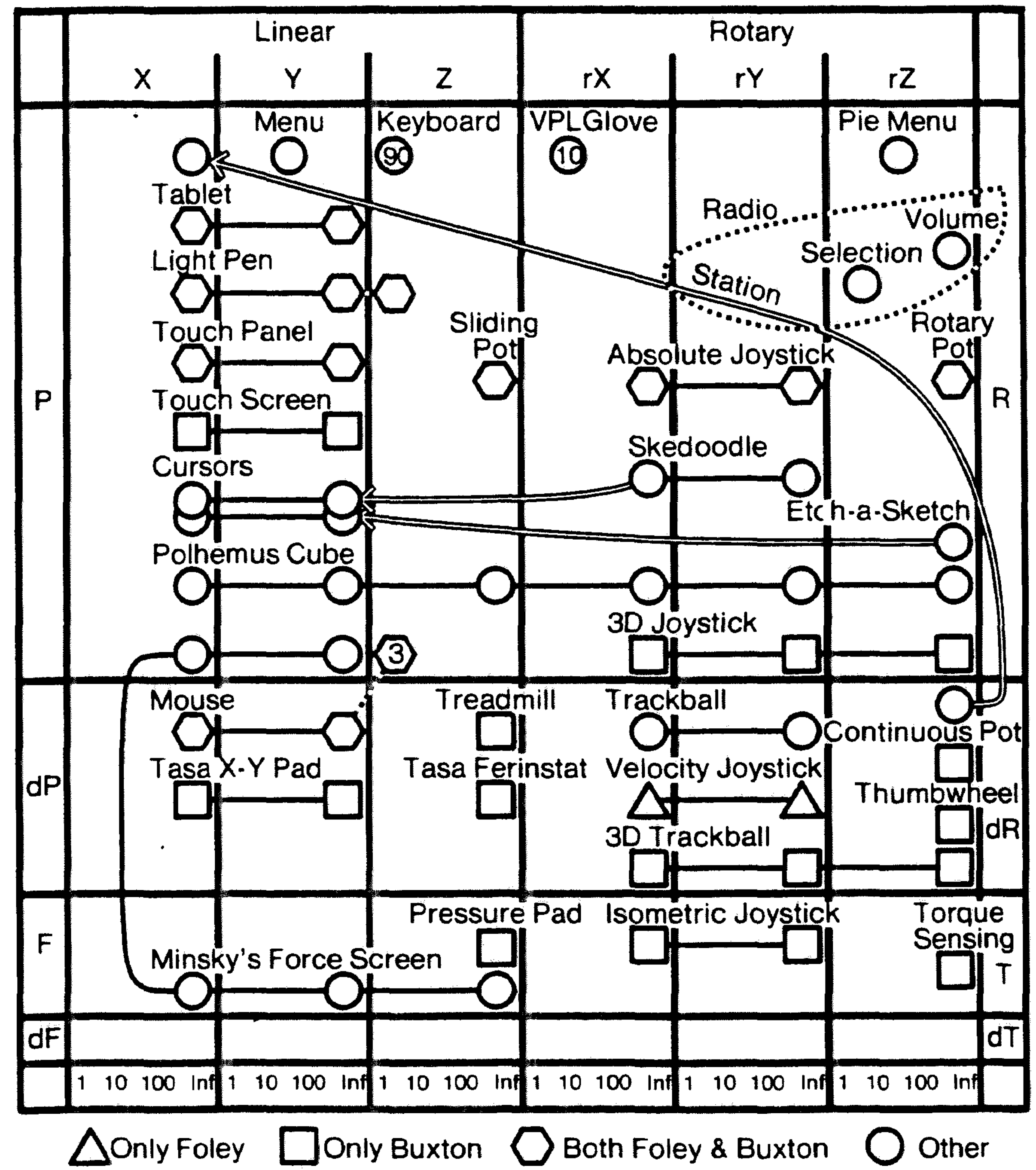
Literature: Card et al., "A Morphological Analysis of the Design Space of Input Devices". ACM Transactions on Information Systems, Vol.9, No. 2, 1991

Visual Description



Importance for interaction design?

- Morphological Approach
  - cope with complexity, cope with large number of alternatives.
- Descriptive power (how?)
- Generative power (how?)



Take-away Message

- models are important
  - research:
    - communicate interdisciplinary field
    - establish understanding of a phenomena
    - work on systematic ways of exploring designs
  - industry:
    - can reduce costs of testing different designs
    - generate ideas for the next product
- require models that enable
  - description
  - prediction
  - generation of new ideas.
- reality vs. model

Self-revealing interfaces

- *the only way to see a behavior in your users is to induce it (Widgor and Wixon, Brave NUI World: designing natural UIs for touch and Gesture)*
- affordance
  - Gibson
  - Norman

Literature: Widgor and Wixon, Chapter 20: self-revealing gestures, in Brave NUI World

Affordance Theory

- behaviorism (perception drives action)
  - world is perceived by recognizing object shapes and spatial relationships among them, **and object possibilities of action (affordance)**
- norman, perceived affordance:

> "...the term *affordance* refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. [...] Affordances provide strong clues to the operations of things. Plates are for pushing. Knobs are for turning. Slots are for inserting things into. Balls are for throwing or bouncing. When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction needed." (Norman 1988, p.9)

- Gibson:
  - perceived in a direct, immediate way with no higher-level cognitive processing.

Norman, D. : Affordances and Design, jnd.org

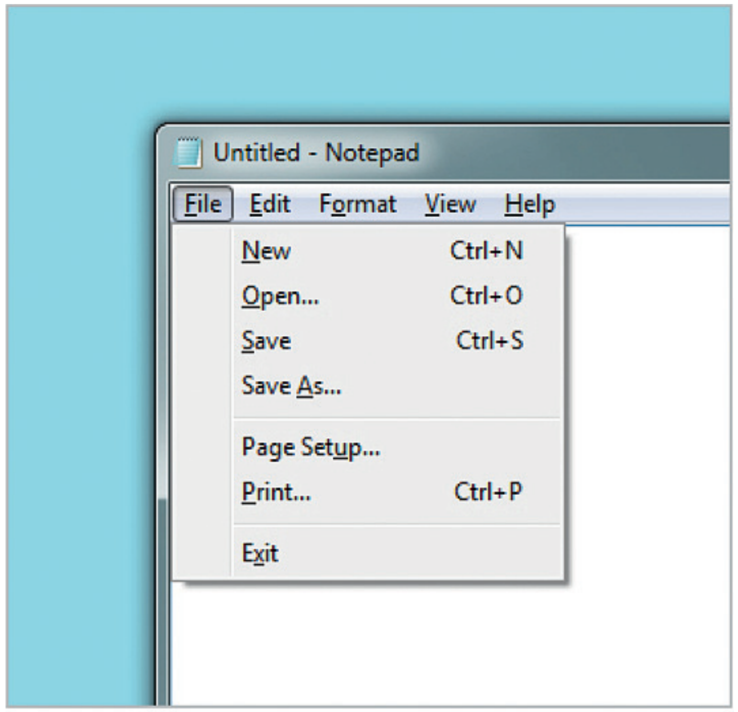
Self-revealing interfaces

- *the only way to see a behavior in your users is to induce it (Widgor and Wixon, Brave NUI World: designing natural UIs for touch and Gesture)*
- affordance
  - Gibson
  - Norman
- transition novice to expert
  - revelation
  - learning

Literature: Widgor and Wixon, Chapter 20: self-revealing gestures, in Brave NUI World

Self-revealing interfaces

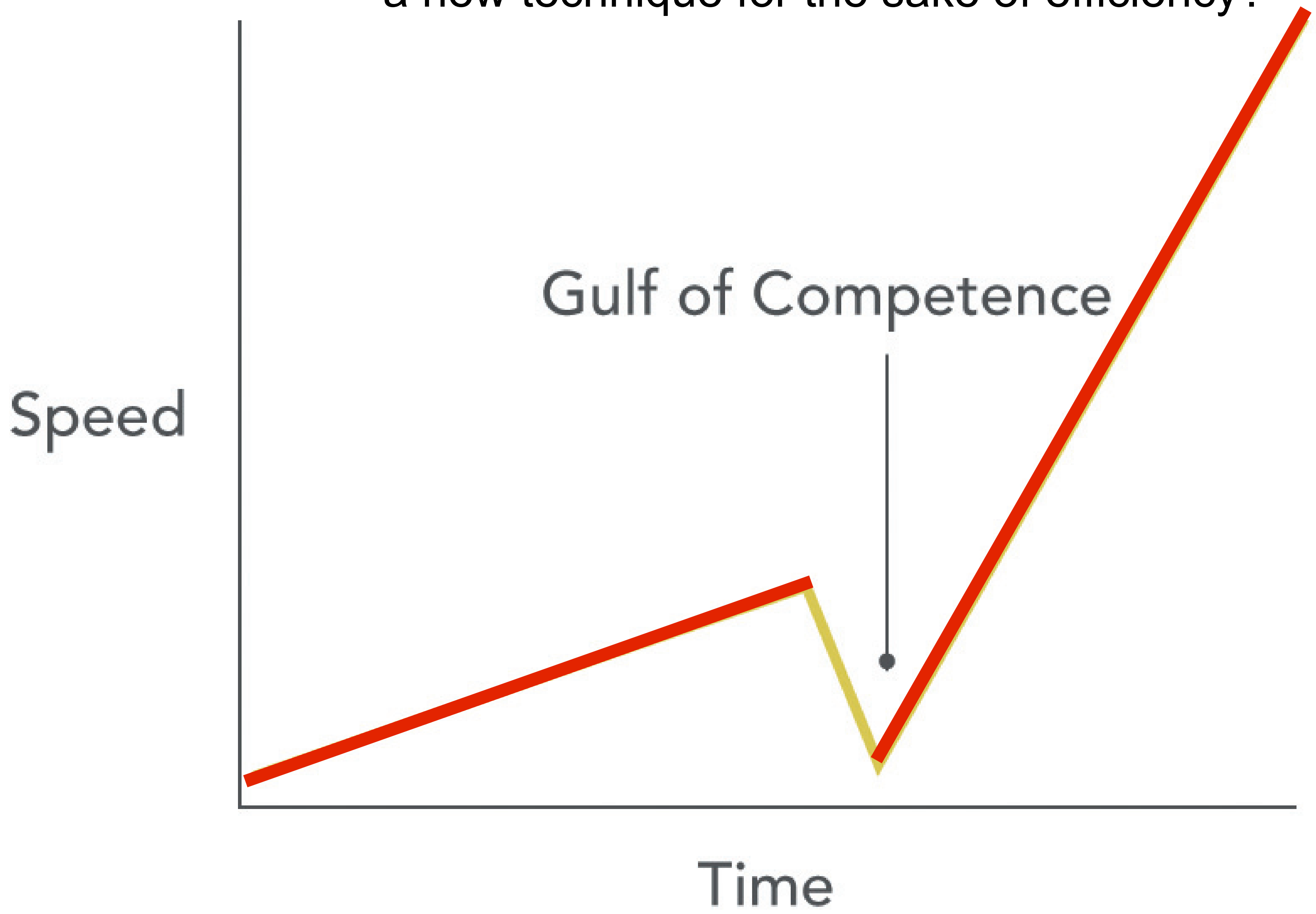
- example on-screen menu navigation vs. hot keys
  - more efficient to use hot keys
  - transition comes at a cost. gulf of competence



Widgor and Wixon, Chapter 20: self-revealing gestures, in Brave NUI World

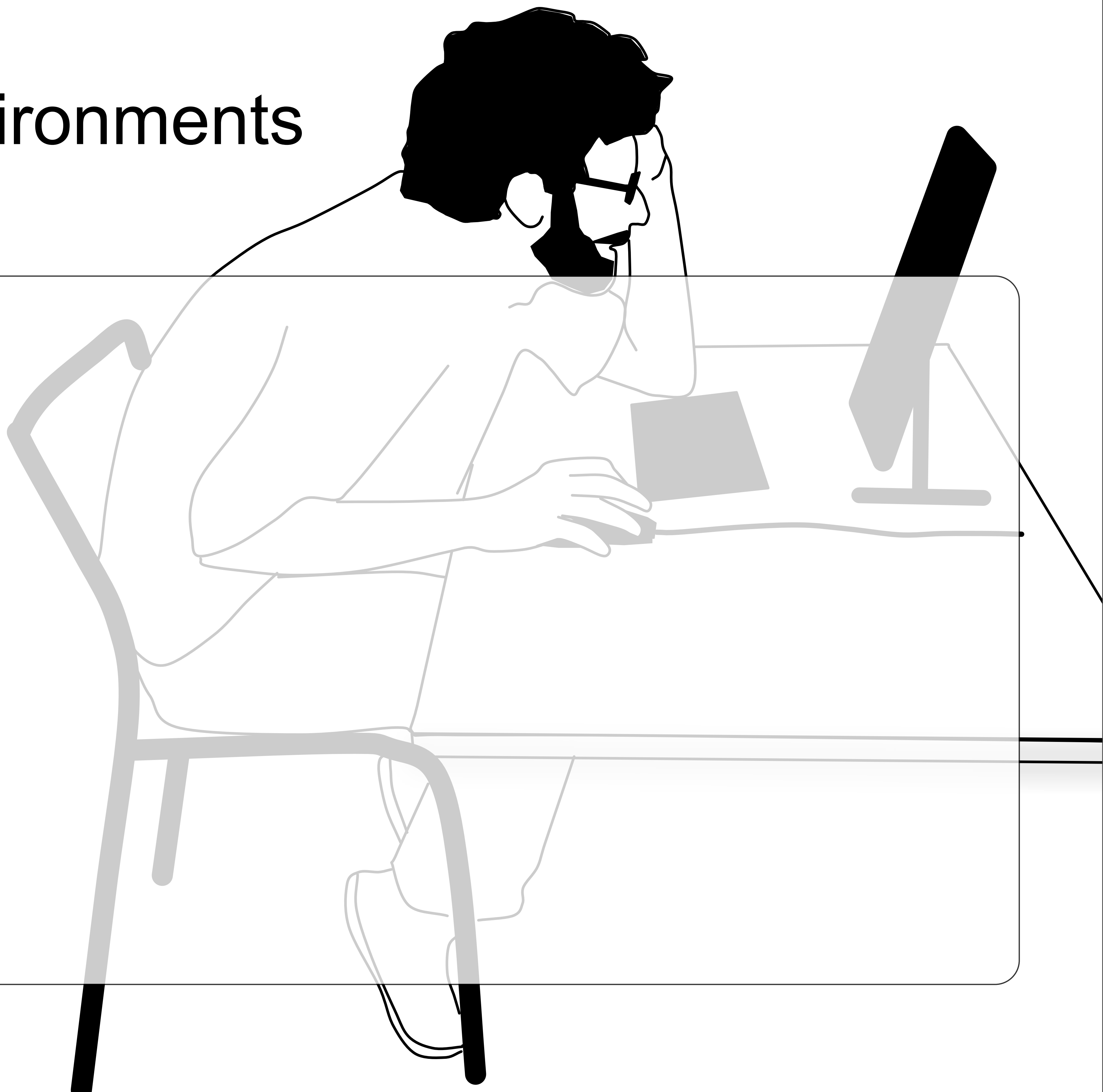
Gulf of competence

how do we get people to change their behavior and adapt a new technique for the sake of efficiency?



Widgor and Wixon, Chapter 20: self-revealing gestures, in Brave NUI World

Desktop Environments



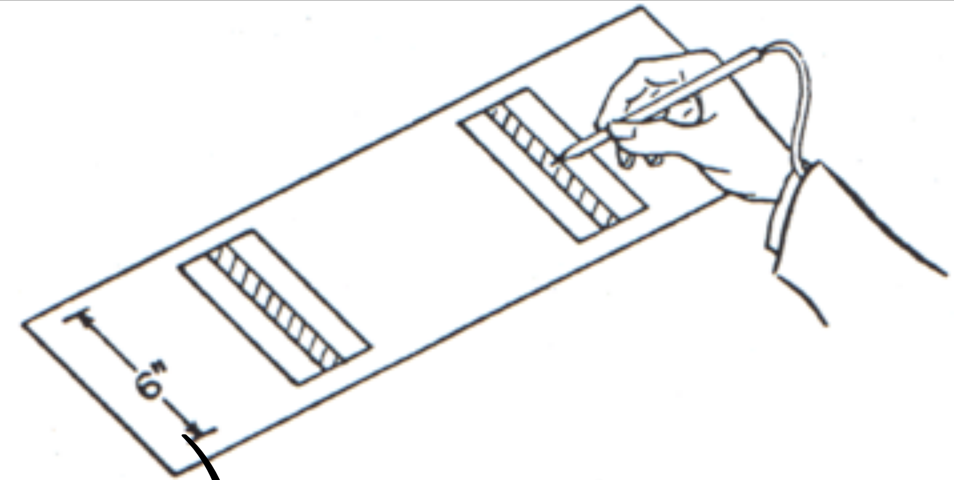
context and task

theory

interaction techniques

in/output technologies

Pointing - Fitts' Law



$$MT = a + b\log_2\left(\frac{D}{W} + 1\right),$$

- a, b vary according to nature of acquisition task, the kind of motion performed or the muscles used.
- visual/display space and motor/control space

Pointing - Fitts' Law

$$MT = a + b \log_2\left(\frac{D}{W} + 1\right),$$

- D = distance to target
  - D_m - motor space, D_v - virtual space
- W = width of target
  - target width vs. effective target width

$$CDgain = \frac{V_{pointer}}{V_{device}}$$

- control-display gain = unit free coefficient that maps the movement of the pointing device to the movement of the display pointer
  - gain = 1: display pointer moves exactly the same distance and speed as the control device
  - gain < 1: display pointer moves slower, covering less distance than the control device
  - gain > 1: display pointer moves proportionality farther and faster than the control device cursor movement.
- goal: decrease MT!
- how?

Literature: Géry Casiez, "The impact of Control-Display Gain on User Performance in Pointing Tasks". In HCI, Vol.3 2008, pp. 215-250.

Drag-and-pop - ‘*decrease D*’

http://patrickbaudisch.com/projects/dragandpop/

Drag-and-pop - ‘*decrease D*’

- Idea: temporarily bringing virtual proxy of the most likely potential set of targets towards the cursor.
- originally designed for desktop icons
- challenges if applied to other elements?
  - proxies overlay
  - occlusion of valuable information
  - selection of targets in distance or vicinity
  - calm visual design to avoid annoyance

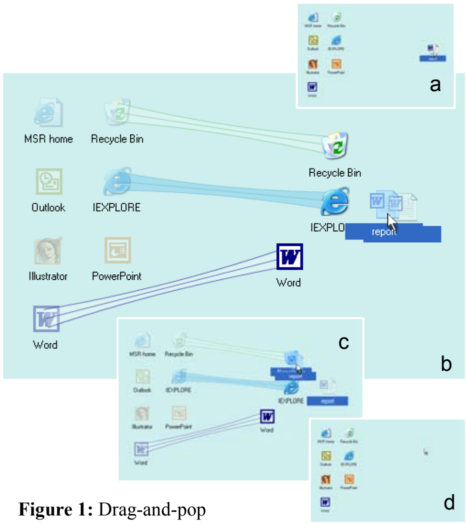
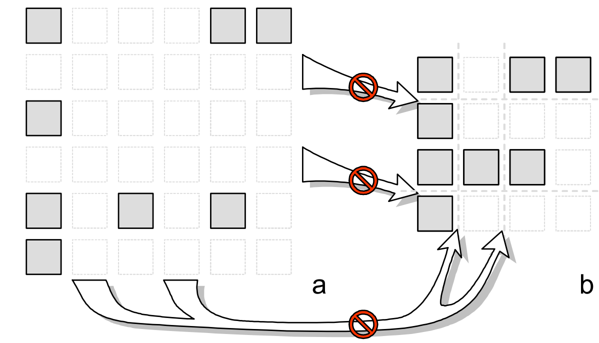


Figure 1: Drag-and-pop

Literature: Baudisch et al. Drag-and-Pop and Drag-and-Pick: Techniques for Accessing Remote Screen Content on Touch and Pen-operated Systems. In Proc Interact'03, pp. 57--64.

Drag-and-pop - ‘*decrease D*’



- Drag-and-pop’s candidate:
  - icons of compatible type
  - tip icons layout: snap icons to a grid, remove empty rows and columns
  - icons located within a certain angle from the initial drag direction.
  - if(no. of qualifying icons > limit)
    - eliminate tip icon candidates until hard limit is met starting from outside, going inwards.

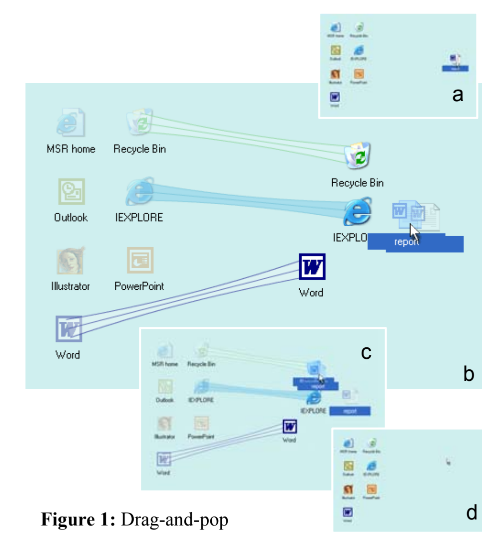


Figure 1: Drag-and-pop

- Results:
  - not significantly faster on desktop
  - advantage for very large screens

Literature: Baudisch et al. Drag-and-Pop and Drag-and-Pick: Techniques for Accessing Remote Screen Content on Touch and Pen-operated Systems. In Proc Interact'03, pp. 57--64.

Object Pointing - '*decrease D*'

- Guiard et al. noted that in most real graphical user interface are a significant number of pixels serving no useful function other than providing a pleasing interface layout.
- 50 selectable object, 400 px size, 1600x1200 px display
  - how many pixels are "used"?
  - from a total of how many pixels?
- skip the "empty space"

Literature: Guiard et al., "Object pointing: a complement to bitmap pointing in GUIs". 2004

Object Pointing - ‘*decrease D*’

- Idea: if cursor leaves a selectable object and its velocity exceeds a threshold, it jumps to the next available target.
  - advantages: 74% faster than regular pointing for a reciprocal pointing task.
  - disadvantages:
    - selection or manipulation of an individual pixel (text character in word processor)
    - tools are often tiled together
    - jumping motion might be annoying (controlled experiment vs. field study)

Literature: Guiard et al., “Object pointing: a complement to bitmap pointing in GUIs”. 2004

TorusDesktop - ‘*decrease D*’

http://insitu.lri.fr/TorusDesktop/TorusDesktop

TorusDesktop - ‘*decrease D*’

- does not require target awareness
  - easier to integrate into existing systems
- cursor wrapping: teleports mouse cursor to the opposite side of the screen when it passes one of the screen edges.
- immediate jump problem:
  - trigger wrapping inadvertently
  - difficult to find new cursor location
  - harder to interact on targets at the border
- Pointing improvement cannot be determined strictly by Fitts’ law. It depends on the users decision
  - 5-10% of screen size as dead zone
  - pointing faster for targets whose distance is greater than 80% the width of a 2560-pixel wide display.

Literature: Huot et al., “TorusDesktop: pointing via the backdoor is sometimes shorter”. CHI 2011

'Increase W'

- fish-eye-dock menu in MacOS X
  - icons expand when cursor is over them.
    - advantage: effective use of screen real estate
    - disadvantage: occluding neighboring targets

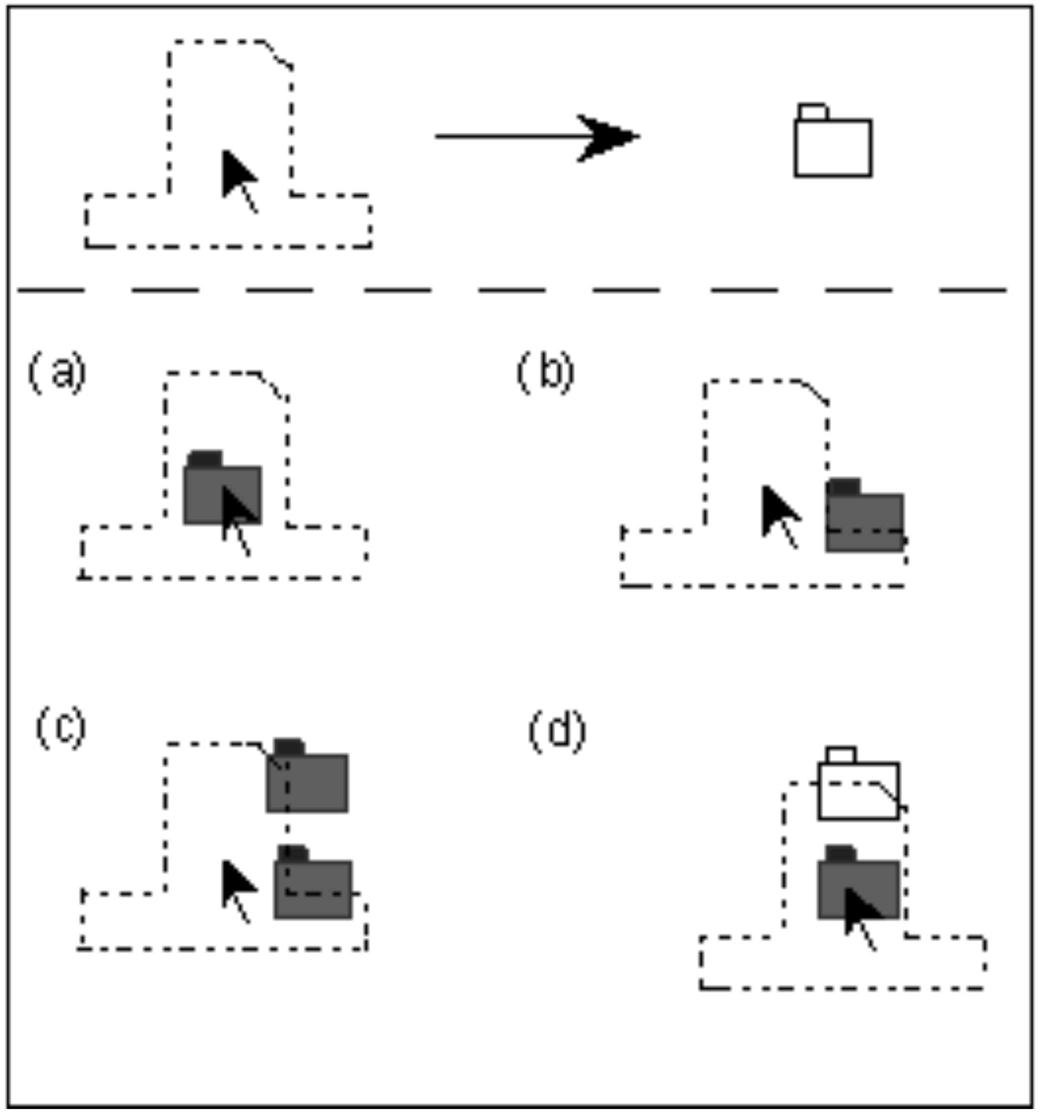
http://maxcdn.webappers.com/img/2008/03/fish-eye-dock-menu.png

Area Cursor - ‘Increase W’

Point cursor: Area cursor:

Literature: Kabbash et al., “The Prince Technique: Fitts’ Law and Selection Using Area Cursor”. CHI’95

Area Cursor - ‘Increase W’



“Why do people miss the Trash icon so often? Perhaps it’s because we’re attending to the file we’re moving, rather than the location of the pointer”

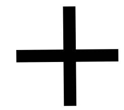
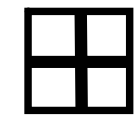
Literature: Kabbash et al., “The Prince Technique: Fitts’ Law and Selection Using Area Cursor”. CHI’95

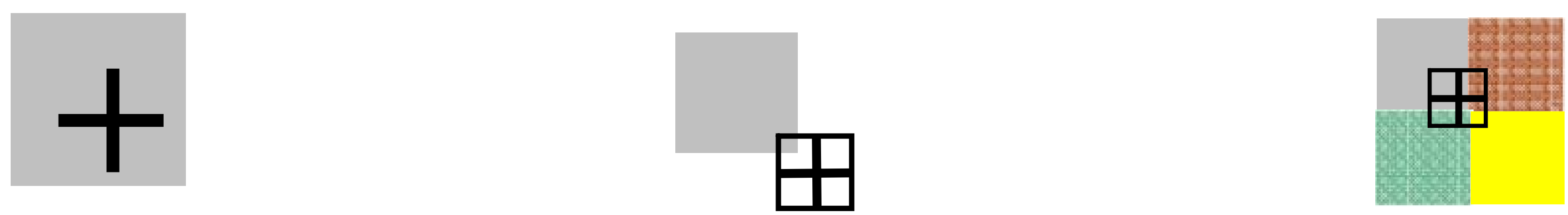
Area Cursor - ‘Increase W’

- area around the cursor, the so called ‘hot spot’, is larger than the single pixel of standard cursors.
  - advantage: easier to point to very small targets. ID of pointing task with area cursor is smaller than with point cursor.
  - disadvantage: target ambiguity with dense target groups.

Literature: Kabbash et al., “The Prince Technique: Fitts’ Law and Selection Using Area Cursor”. CHI’95

Area Cursor - ‘Increase W’

Point cursor:  Area cursor: 



http://dl.acm.org/citation.cfm?id=1056159

- problem: ambiguity with dense target groups
- solution:cursor has two hot spots, (1) whole cursor area and (2) cursor point
  - if target far away, cursor behaves like area cursor, if more targets within area, it behaves like standard pointing.

Literature: Kabbash et al., “The Prince Technique: Fitts’ Law and Selection Using Area Cursor”. CHI’95

Desktop

context and task

theory

interaction techniques

pointing

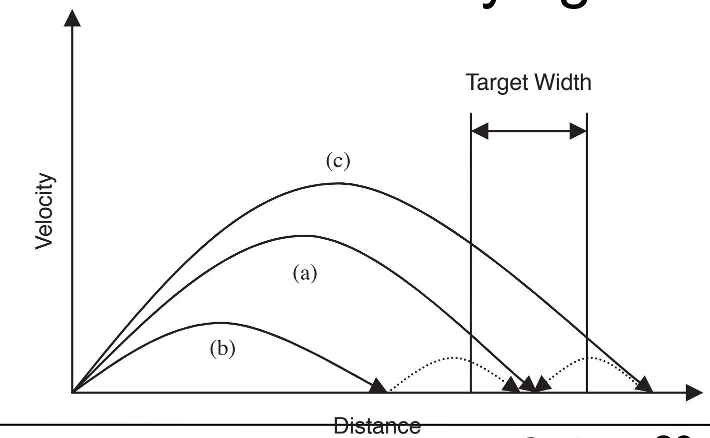
menu

revelation techniques

in/output technologies

Semantic Pointing - ‘decreasing A’ **AND** ‘increasing W’

- dynamically vary the C-D gain, so called “mouse acceleration” techniques.
  - if user moves device fast, intents to cover large distance.
- adjust C-D gain based on knowledge about the targets (sticky targets).
  - idea: increase if cursor outside of targets, decrease when inside of target
- adventage:
  - significantly decreases target acquisition time.
  - in particular small targets and older people had more benefit with this technique.
- disadventage:
  - ‘getting’ stuck when crossing other targets.
  - with small targets, movement to fast to trigger event for underlying widget.



Literature: Worden et al., “Making computers easier for older adults to use: area cursors and sticky icons”. CHI’97
Keyson et al. “Dynamic cursor gain and tactual feedback in the capture of cursor movements.”

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Semantic Pointing - ‘decreasing A’ **AND** ‘increasing W’

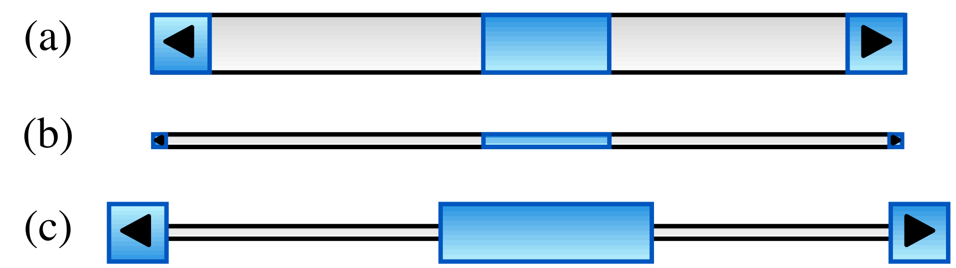


Figure 12: Scroll-bar redesign
(a) original version. (b) new version: visual space (what it looks like) and (c) motor space (what it feels like when interacting with it).

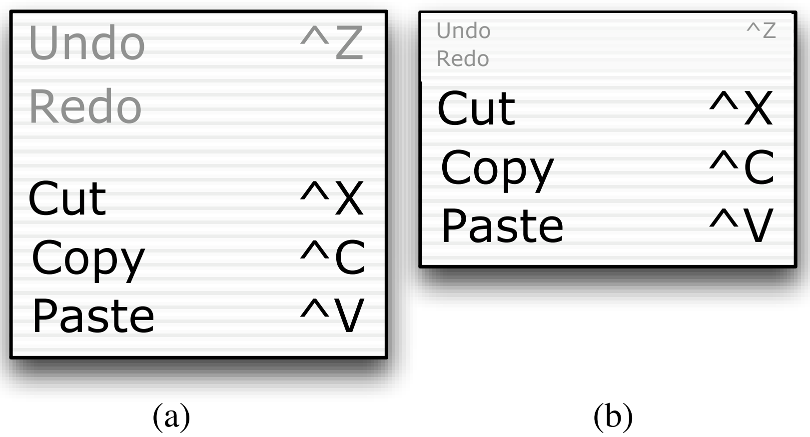


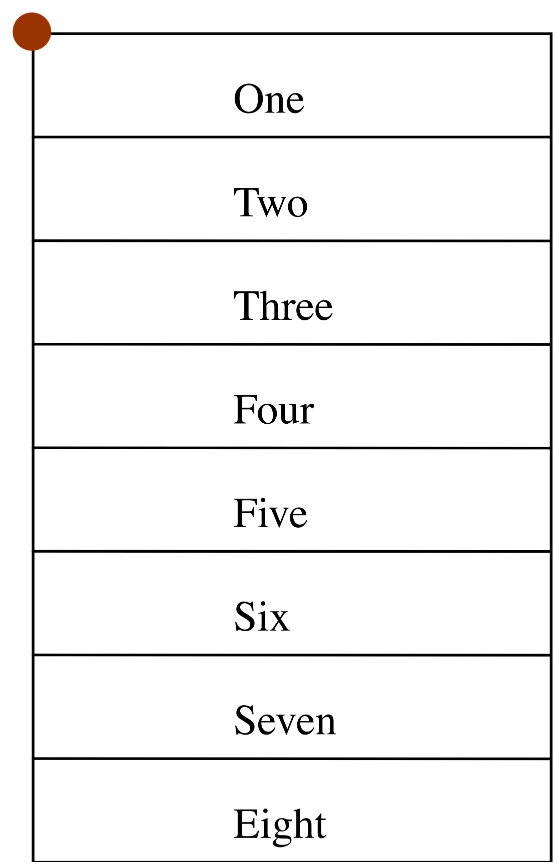
Figure 13: Menu redesign
(a) unchanged visual version (b) motor space version

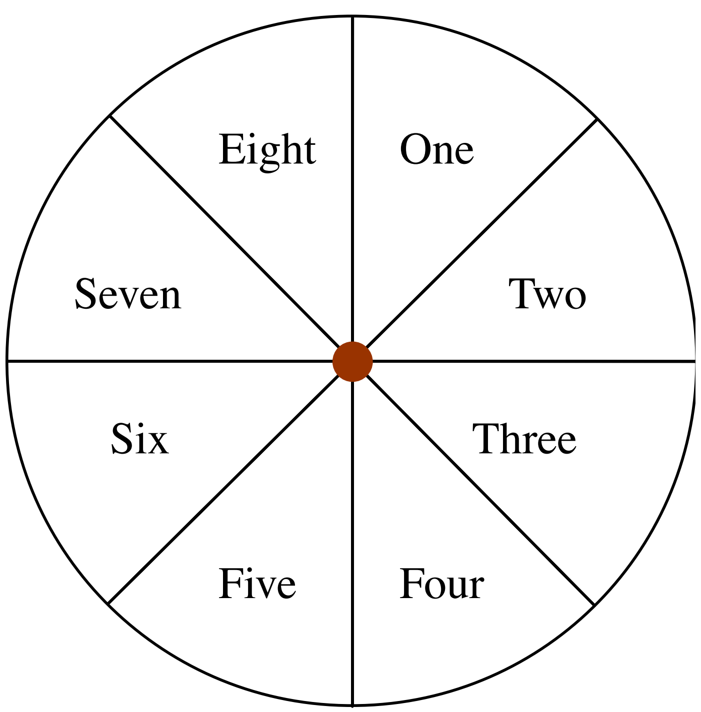
Figure 14: Button redesign
(a) unchanged visual version (b) motor space version

Pointing Techniques

- drag-and-pop
  - temporarily bring items to cursor
- object pointing
  - skip empty space between targets
- area cursor
  - pointing hot spot is larger than a pixel
- semantic pointing
  - dynamically vary C-D-gain

Importance for Menu Techniques





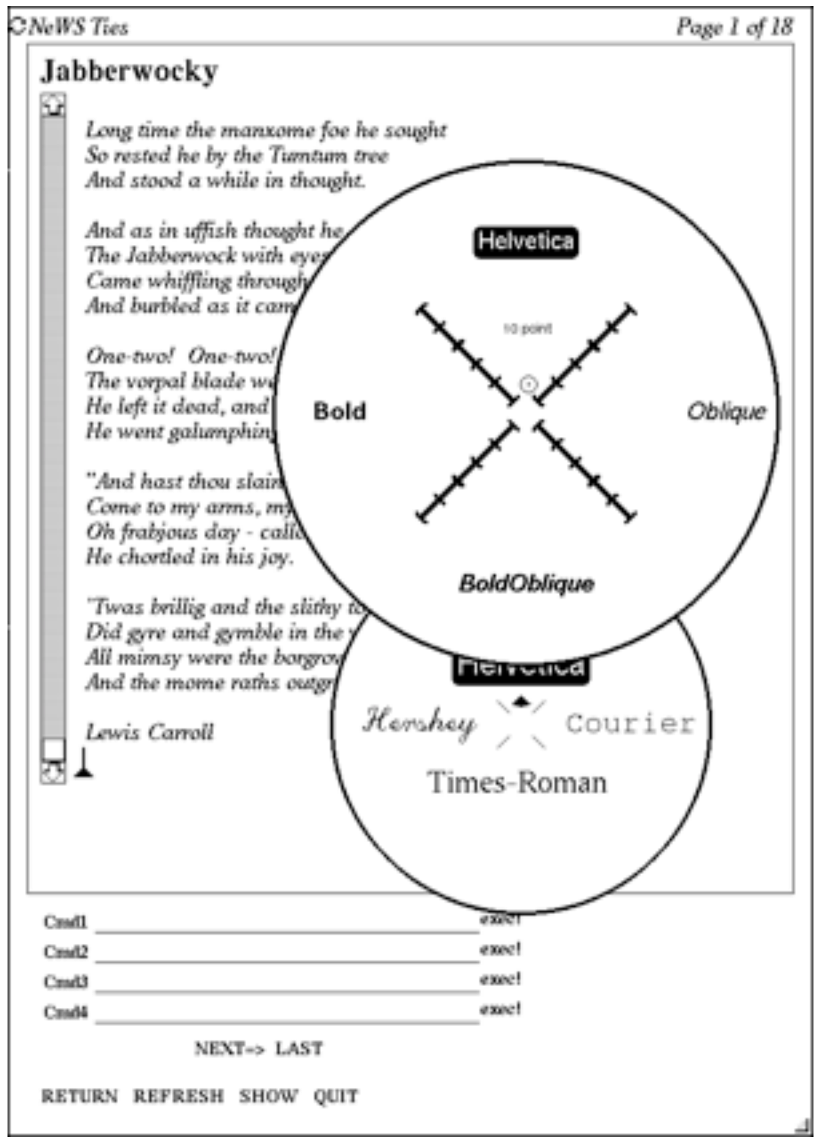
http://dl.acm.org/citation.cfm?id=1056159

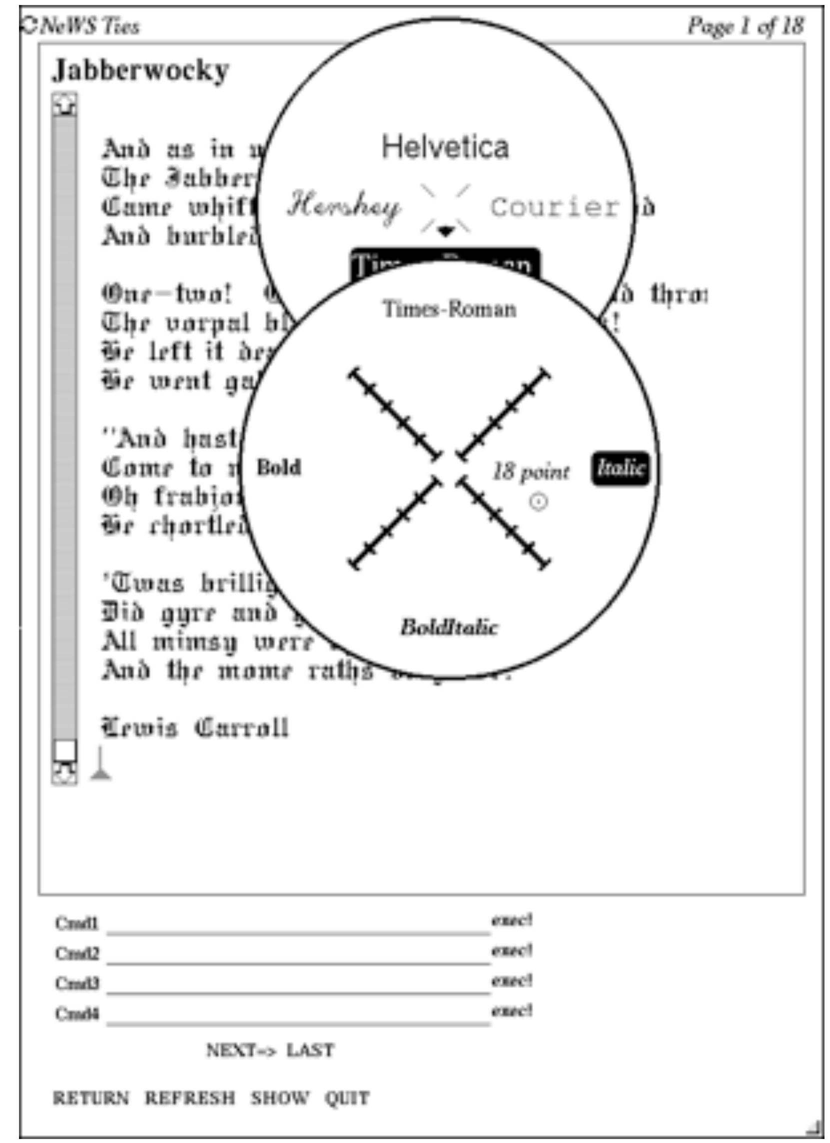
Pie Menus

- invokes a circular menu with a click. cursor is centered in small inactive region in the menu center. Move cursor to item and select it.
  - advantage:
    - placement in opposite directions for complementary items.
    - spatially oriented items can be put in their appropriate directions.
    - taking advantage of muscle memory
  - disadvantage:
    - requires more screen real estate than linear menus.
    - limited to 8 items
- Implemented in Sun Microsystem's NeWS window system and MIT's X windows windows management system.

Literature: Don Hopkins. "Pies:Implementation, Evaluation and Application of Circular Menus, Tech. Report, University of Maryland."

Don Hopkins' Pie Menu examples

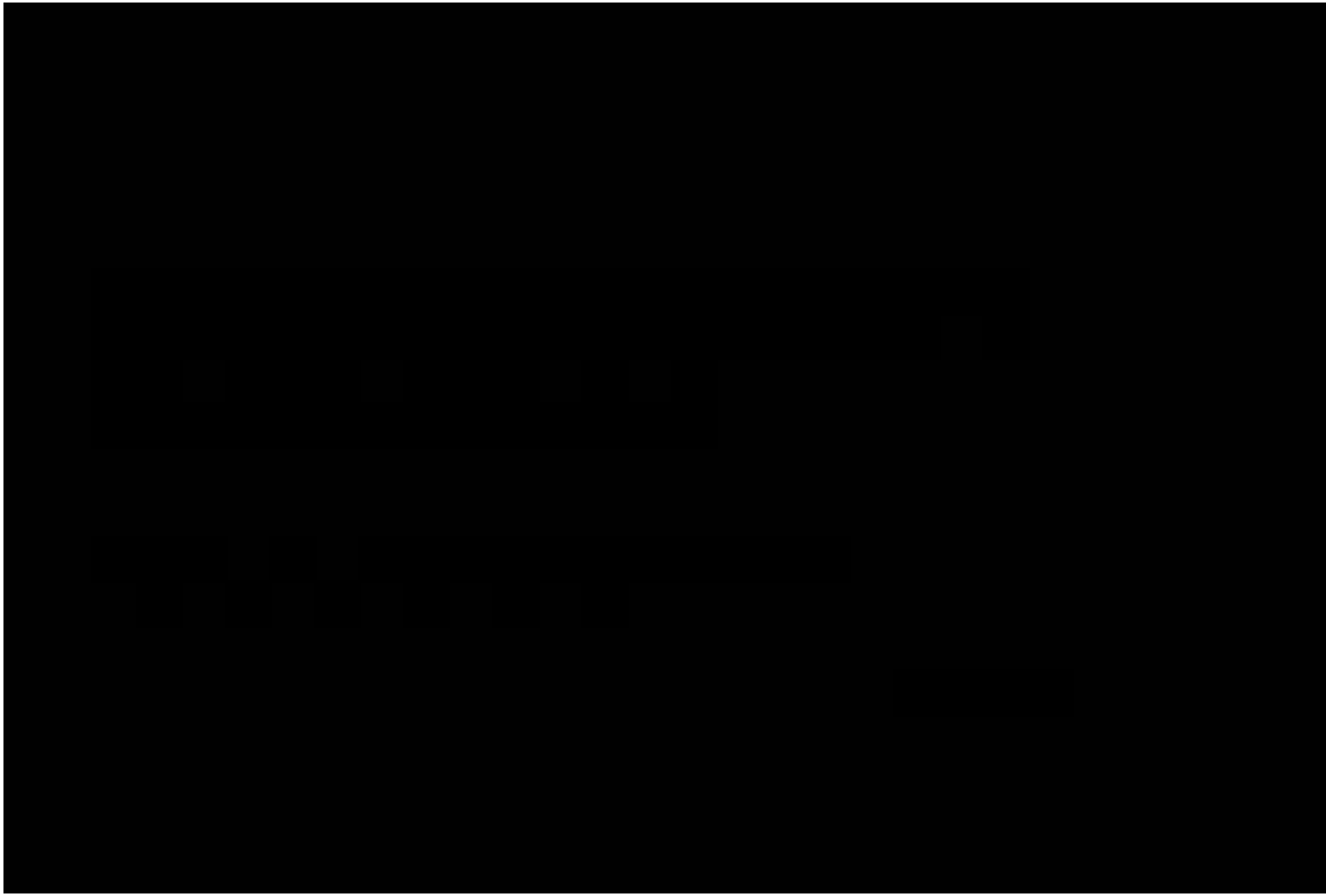




http://www.donhopkins.com/drupal/node/94

Literature: Don Hopkins. "Pies:Implementation, Evaluation and Application of Circular Menus, Tech. Report, University of Maryland."

Marking Menus



http://www.youtube.com/watch?v=dtH9GdFSQaw

Marking Menus

- combination of pop-up radial menus and gesture recognition
- advantages:
  - scale independent of movements
  - less visually taxing
- disadvantage:
  - limited number of items (8 - 12 items)

Marking Menu Variations

- compound-stroke menu (hierarchical MM)
  - spatial composition of marks.
  - gesture performed continuously without releasing the mouse button.
  - problem: requires large physical input space, limited depth even for experts
- multi-stroke menu
  - temporal composition of marks
  - each elementary stroke completed with mouse release
  - problem: delay needed to determine if stroke belongs to previous sequence or starts new one.

Literature:
•Kurtenbach et al. “The limits of expert performance using hierarchical marking menus.” CHI’93
•Zhao et al. “Simple vs. compound mark hierarchical marking menus.” UIST’04

http://www.youtube.com/watch?v=XtdOQWiVLXM

Marking Menu Variations

- zone and polygon menu
  - consider relative position and orientation of elementary strokes relative to origin the first mouse click.
    - position within a zone
    - position on a polygon
  - extending the breadth to 32/16 items

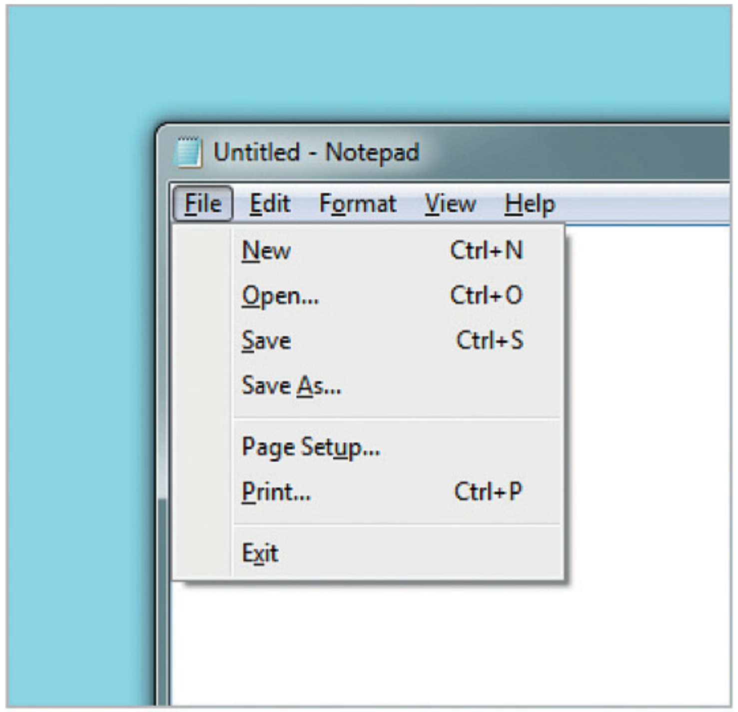
Literature:
Zhao et al. “Zone and polygon menus: using relative position to increase the breadth of multi-stroke marking menus.” CHI’06

Menu techniques

- Pie Menus
  - ID equal for all items
- Marking Menus
  - limitations: max 12 items (acceptable error rate)
- Hierarchical marking menus: “zigzag” marks
  - limited to breadth-8, depth of 2 levels
- Multi-Stroke marking menus
  - temporal composition instead of spatial composition
- Zone and Polygon MM
  - relative position + angle

Keyboard Short-cuts

- communicating an alternative way to access the command.
- what might be the problem with this type of communication regarding the gulf of competence?



Widgor and Wixon, Chapter 20: self-revealing gestures, in Brave NUI World

ExposeHK

- idea: display hotkeys at the position of a button when holding down command key

Literature:
Malacria et al. “Promoting Hotkey Use through Rehearsal with ExposeHK” CHI’13

ExposeHK

- Enable hotkey browsing:
  - use mouse pointing to get short-cut feedback to commit it to memory creates a *performance dip*
  - discourages hotkey use, traps user in pointer-based ‘beginner mode’
  - browse without pointing action.

Literature:
Malacria et al. “Promoting Hotkey Use through Rehearsal with ExposeHK” CHI’13

ExposeHK

- Enable physical rehearsal:
  - "*guidance should be a physical rehearsal of the way an expert would issue a command*" (Kurtenbach)
  - use the same modality for browsing and rehearsing hotkeys.

Literature:
Malacria et al. "Promoting Hotkey Use through Rehearsal with ExposeHK" CHI'13

Desktop

- context and task
- theory
- interaction techniques
  - pointing
  - menu
  - **revelation techniques**
- in/output technologies

ExposeHK

- Rapid hotkey identification for intermediate user:
  - exploit the expert behavior people already have (e.g. spatial memory and knowledge about virtual environment)

Literature:
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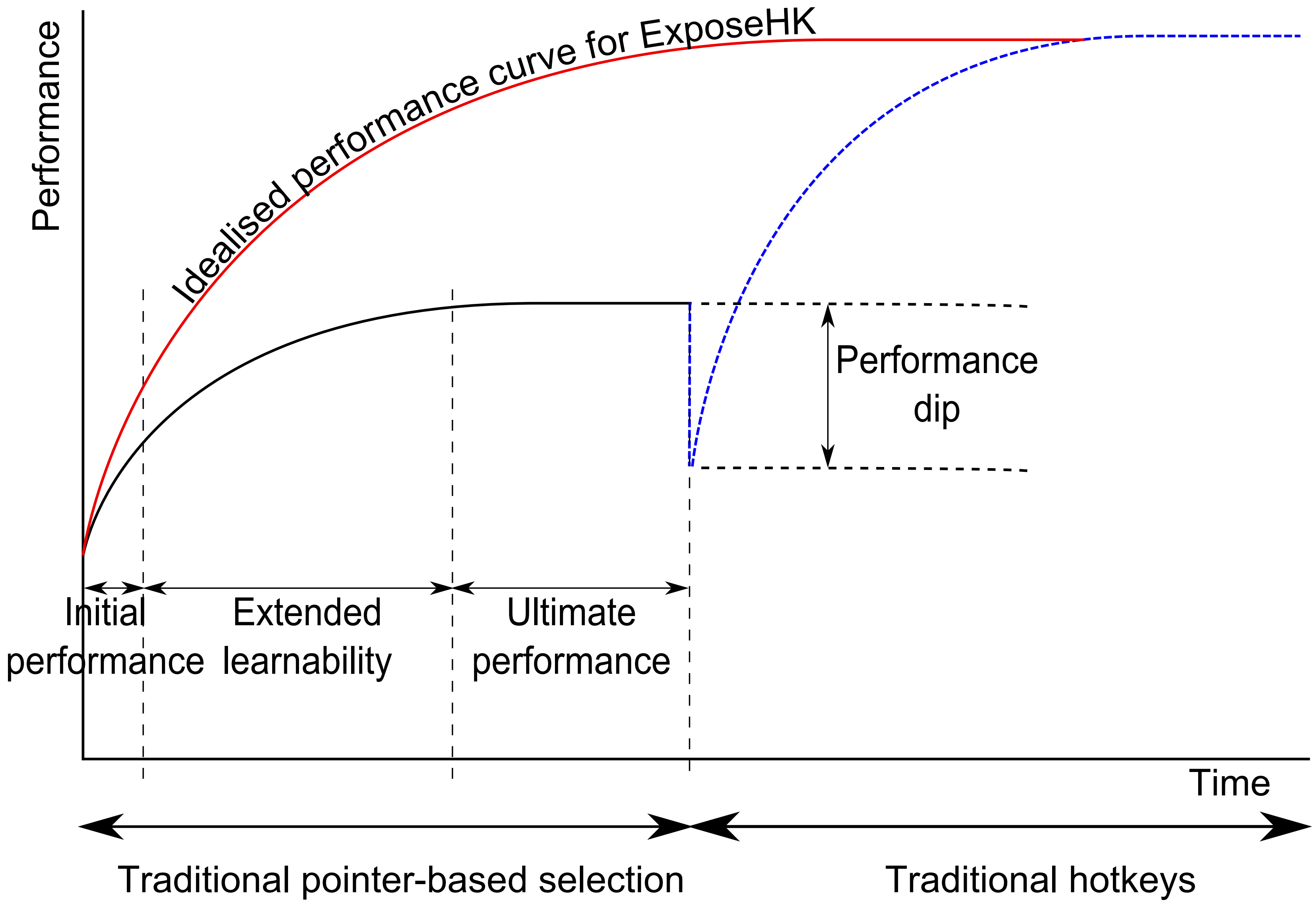
ExposeHK



Literature:
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take-away message

- Models
  - inspire a whole set of novel techniques
  - opens a new perspective
    - e.g. the separation of motor vs. display space
  - apply knowledge to all other pointing devices similar to a mouse or understand the difference to other input devices to spark new techniques to enhance input.
- Concepts enable you to have new perspectives on interaction design.
  - reapply concepts in different interfaces!