# Some Remarks about BCI spelling from the Standpoint of HCI-Oriented Psychology


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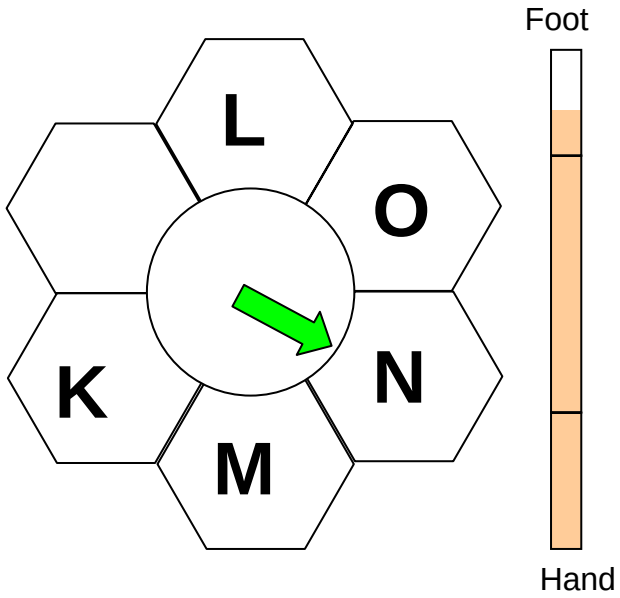
**Thierry Ferrand**, doctoral student
**Didier Casalta**, doctoral student

**Didier Gonzalez**, masters thesis student
**Julien Bastin**, masters thesis student

# Hex-o-Spell

Williamson & Murray-Smith (2005), Berlin BCI




Right-hand imagery: turn the pointer clockwise
Right-foot imagery: extend the pointer (=click)

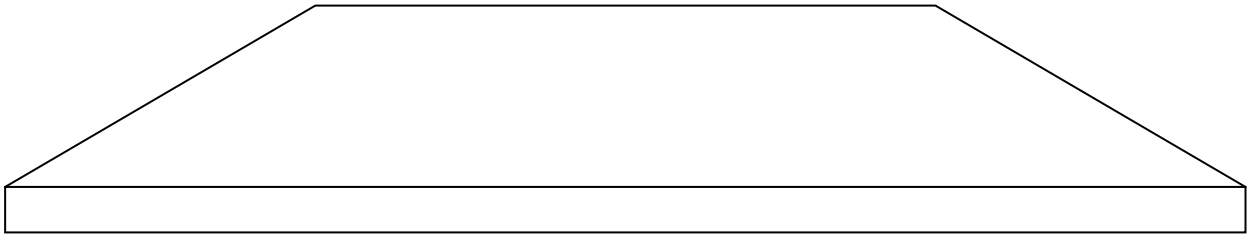
Three questions :

- How about the assignment of actions (turn, extend) to virtual effectors (hand, foot)?
- Can the turning action be facilitated?
- Can the extending action be facilitated?

# The kinematic chain model

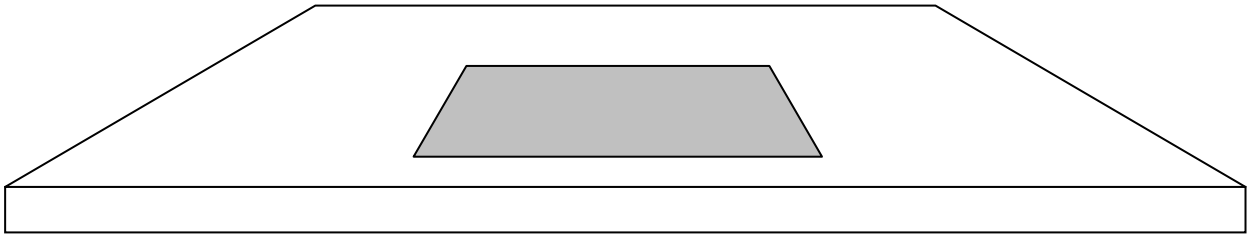
- Guiard, Y. (1987). Asymmetric division of labor in human skilled bimanual action: The kinematic chain as a model. *Journal of Motor Behavior, 19*, 486-517
- Mainstream research on hand “dominance”
  - Hand preference and hand superiority effects
- Implicit assumption: human manual actions are typically one-sided
- Rarity of unimanual actions in the real repertoire of human manual activities
  - Two-handedness overwhelmingly present in handedness questionnaires
- Most two-handed actions asymmetrical
- So, humans use their two hands cooperatively, in differentiated roles
- Is there a pattern regarding hand specialisation?

# Handwriting



Table

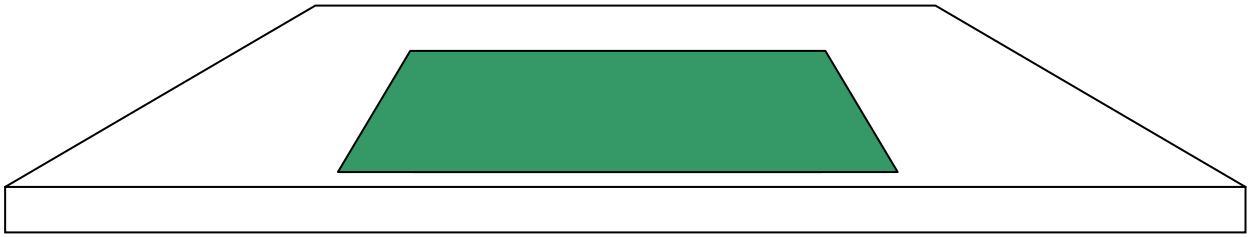
# Handwriting



**Carbon paper**

Table

# Handwriting

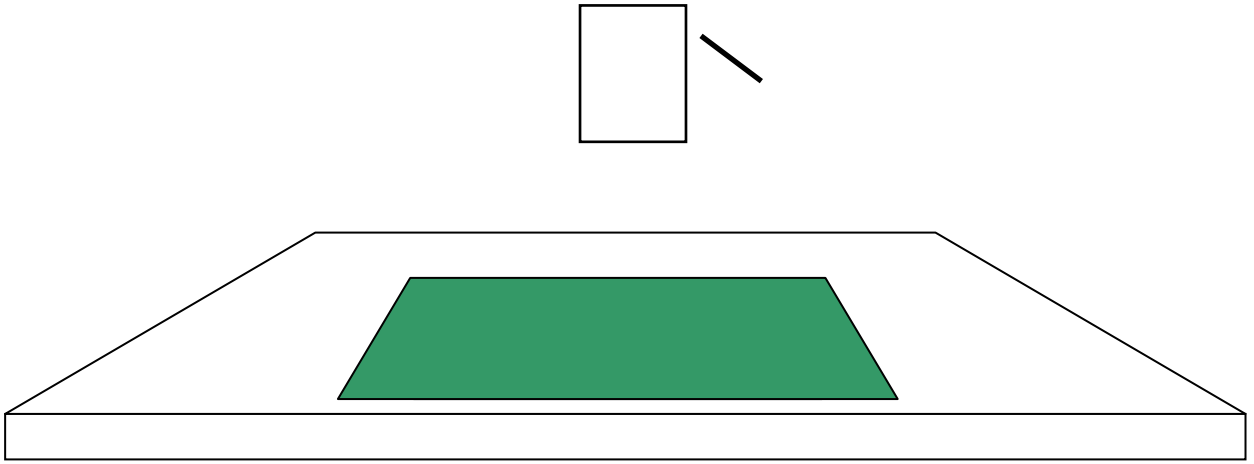


**Thin desk blotter**

Carbon paper

Table

# Handwriting



**Paper and pen**

Desk blotter

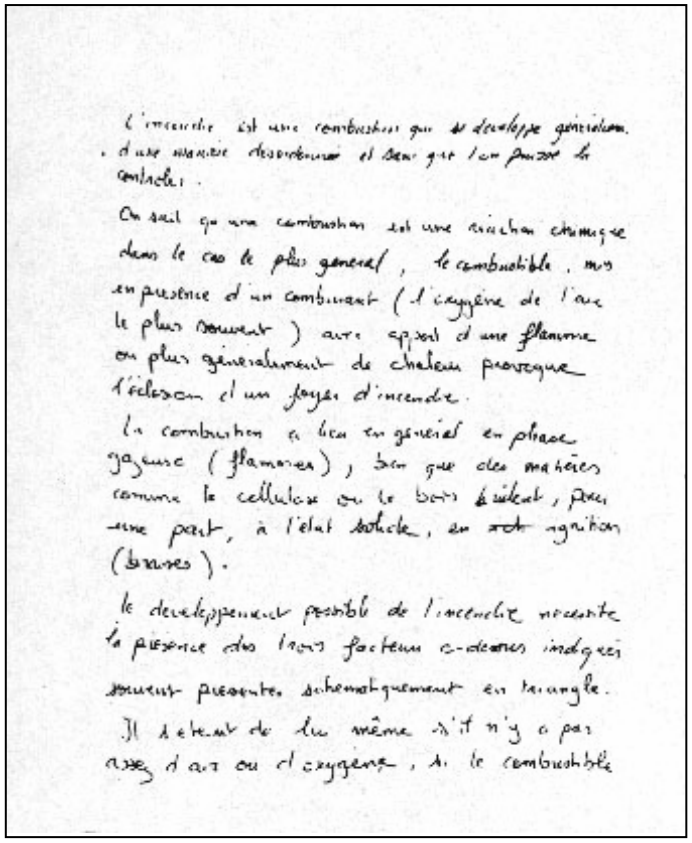
Carbon paper

Table

Two traces:

one on the sheet of paper

one on the table



L'incendie est une combustion qui se développe généralement d'une manière désordonnée et dans le but de l'on parle de combustion.

On sait que une combustion est une réaction chimique dans le cas le plus général, le combustible, mis en présence d'un comburant (l'oxygène de l'air le plus souvent) avec apport d'une flamme ou plus généralement de chaleur provoque l'éclosion et un foyer d'incendie.

La combustion a lieu en général en phase gazeuse (flammes), bien que des matières comme la cellulose ou le bois brûlent, pour une part, à l'état solide, en ~~rot~~ ignition (braises).

Le développement possible de l'incendie nécessite la présence des trois facteurs ci-dessus indiqués souvent présentés schématiquement en triangle.

Il découle de lui même s'il n'y a pas assez d'air ou d'oxygène, si le combustible

Paper trace

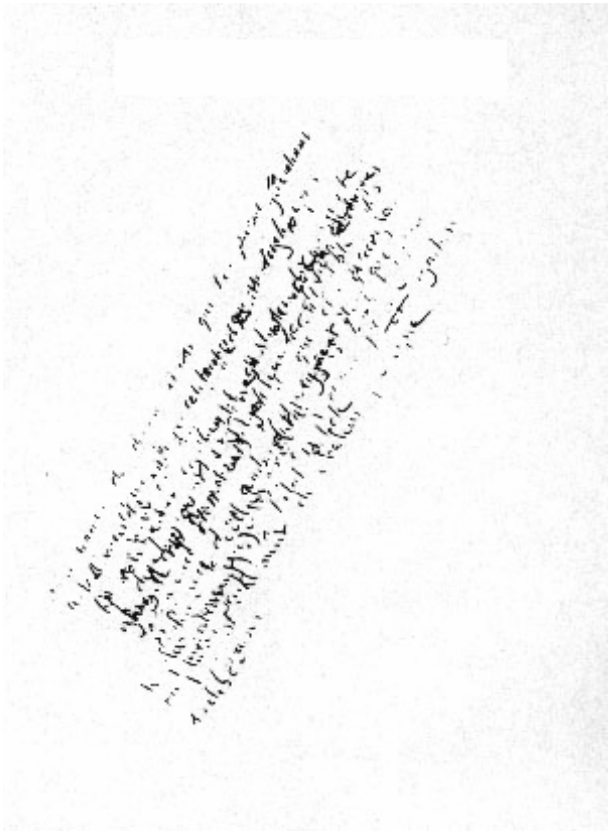
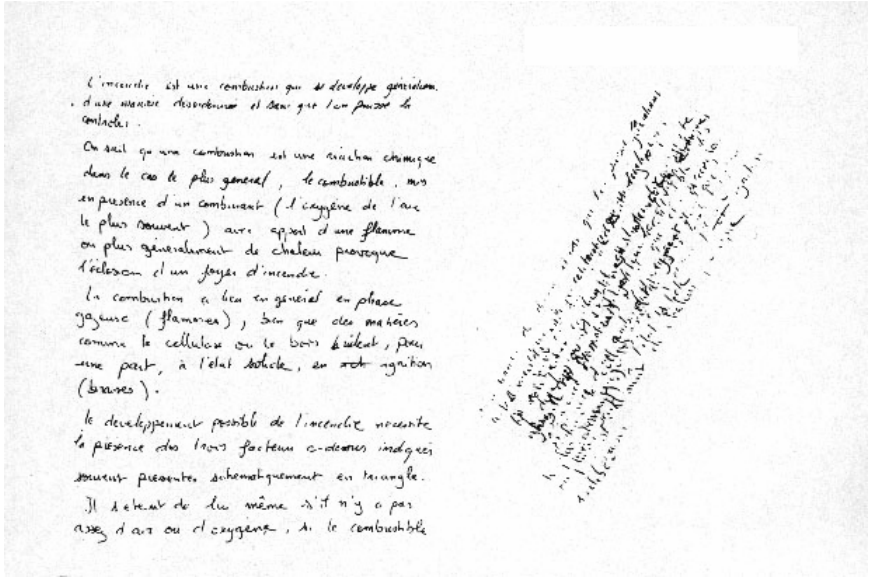


Table trace



L'incendie est une combustion qui se développe généralement d'une manière désordonnée et dans une partie de combustible.

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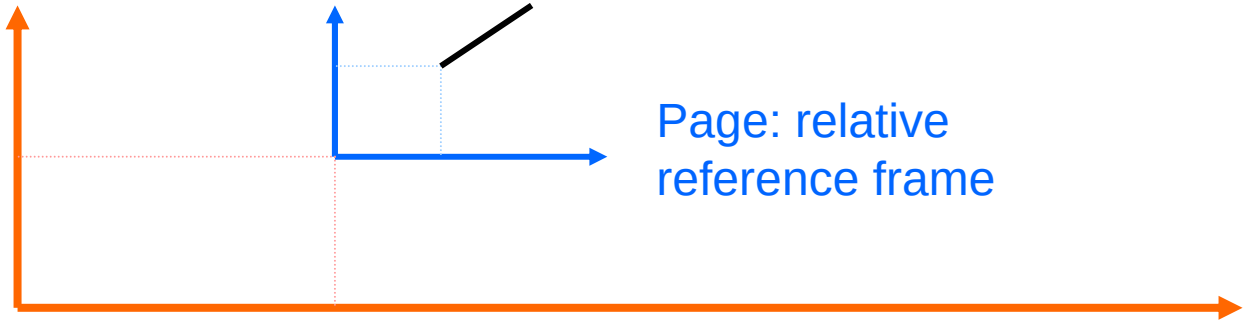
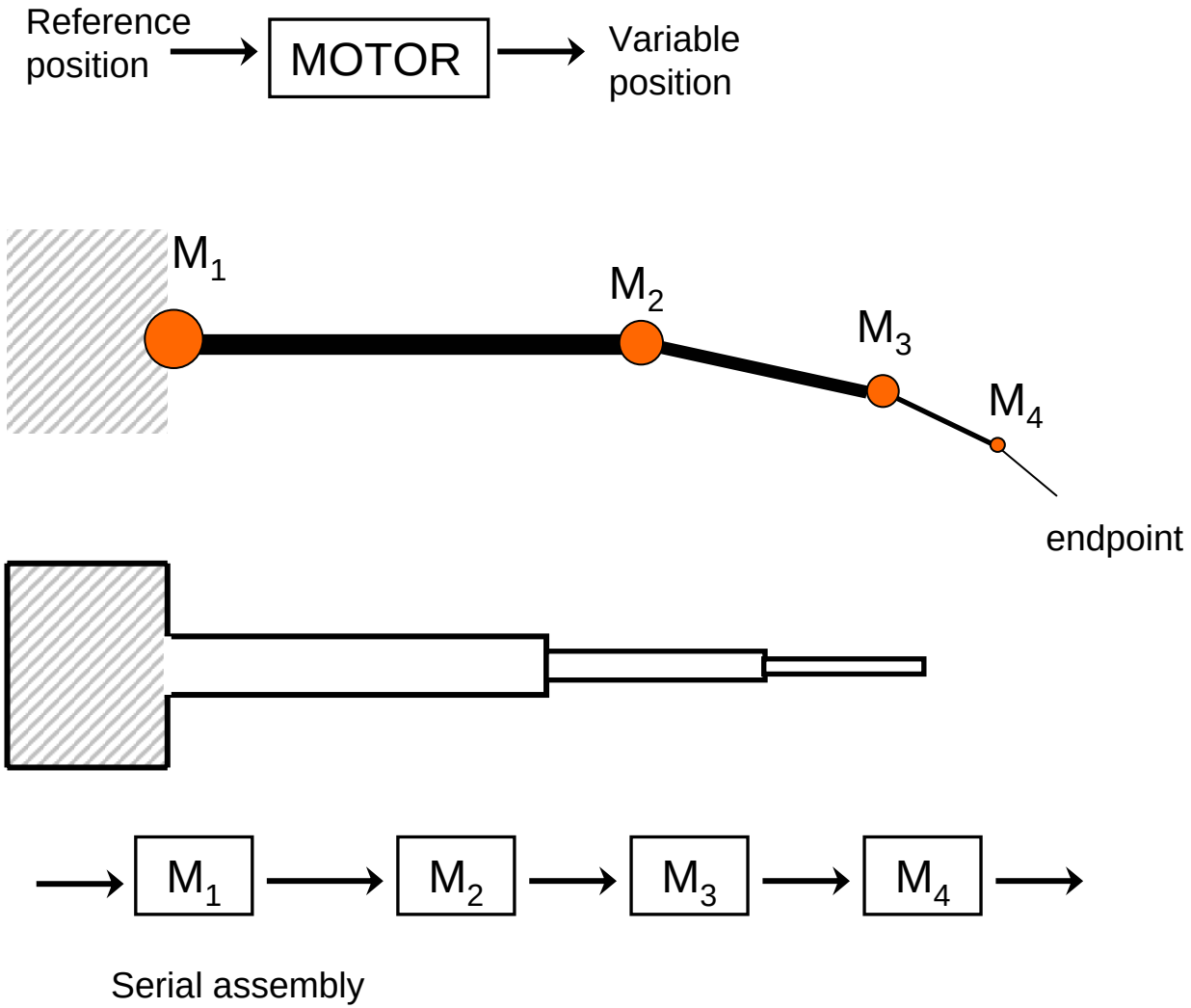


Page: relative reference frame

Table: 'absolute' reference frame

# The kinematic chain model



**Regularities in a kinematic chain**

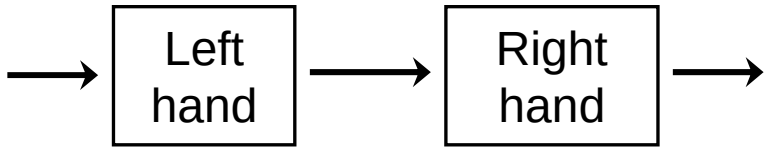
1. Distal to proximal reference
2. Scale gradient

   spatial resolution

   temporal resolution
3. Proximal precedence

**The model: left and right hands like proximal and distal links in a chain**

1. Right to left reference
2. Left macro scale, right micro scale
3. Left-hand precedence

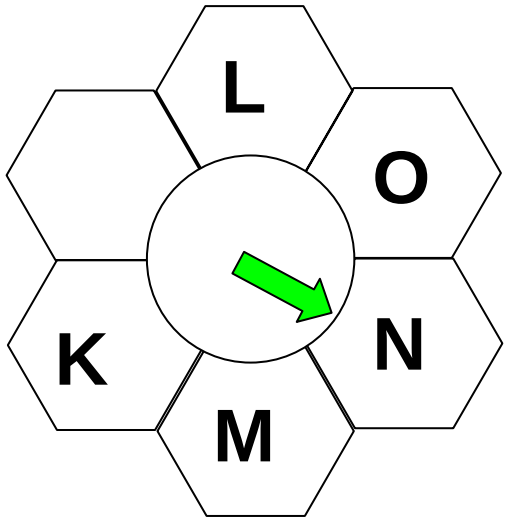


# HCI: Two-handed interaction

Buxton , W . and B . Myers ( 1986 ) A Study in Two - Handed Input . Proc . ACM CHI ' 86

# Hex-o-Spell

Williamson & Murray-Smith (2005), Berlin BCI




Right-hand imagery: turn the pointer clockwise
Right-foot imagery: extend the pointer (=click)

Then why not use the reversed assignment?

Turn action ⇨ foot

extend action ⇨ hand

## Hex-o-Spell

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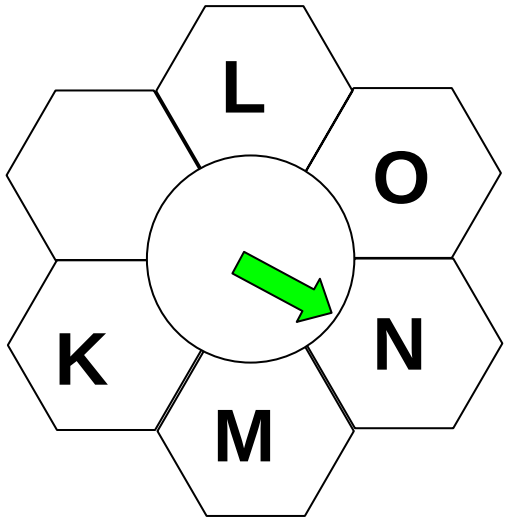
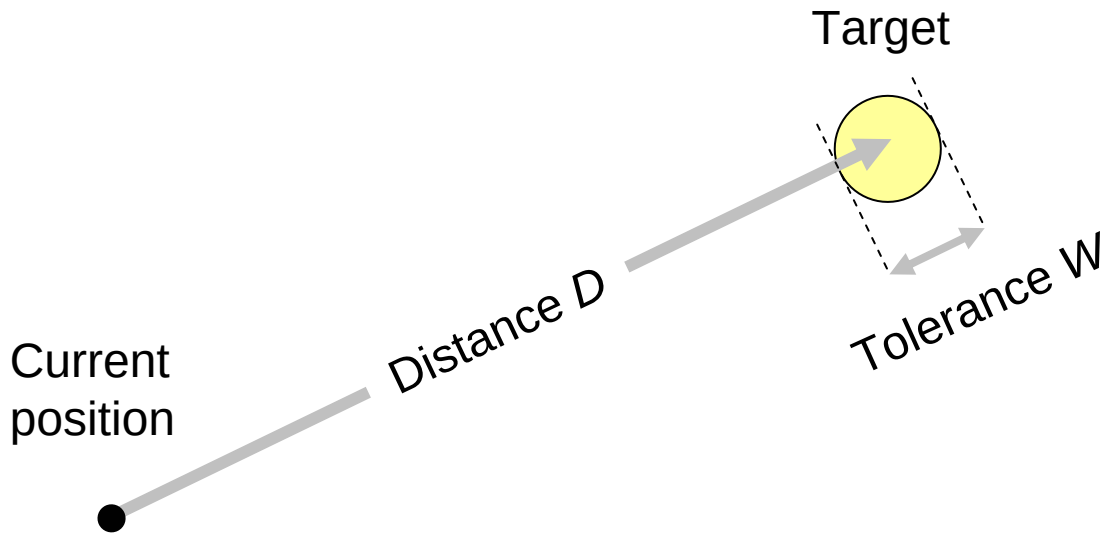


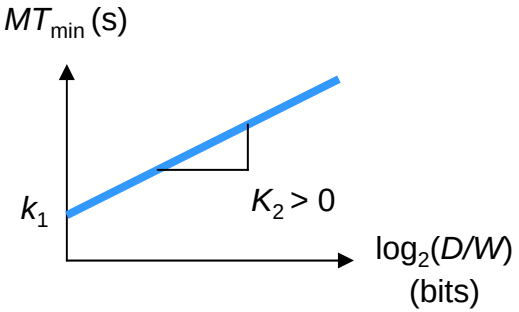

Why not facilitate the turn action?

Angular target acquisition task: Fitts' pointing paradigm

# Pointing and Fitts' law




Fitts' law $MT = k_1 + k_2 \log_2(D/W)$



# Assisting pointing in the WIMP interface

*The Problem = To make pointing easier in the WIMP interface than it is in the real world*

$$MT = a + b \log_2(D/W + 1)$$

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***Enlarge W***

MacGuffin &
Balakrishnan (CHI'02)

# Assisting pointing in the WIMP interface

*The Problem = To make pointing easier in the WIMP interface than it is in the real world*

Baudisch et al.
(Interact'03)
*Drag and Pop*

***Reduce D***

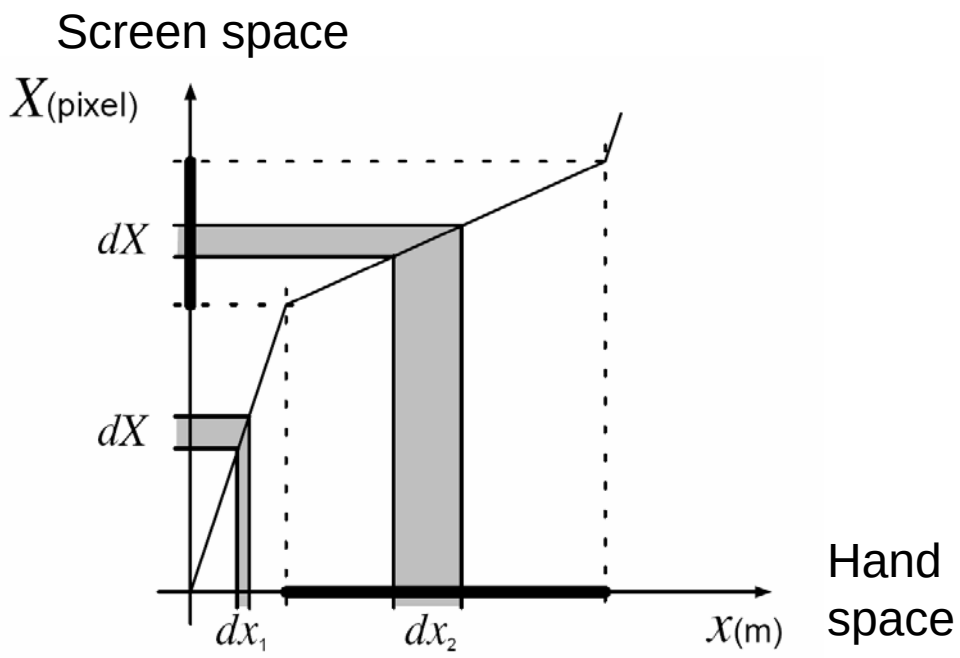
$$MT = a + b \log_2(D/W + 1)$$

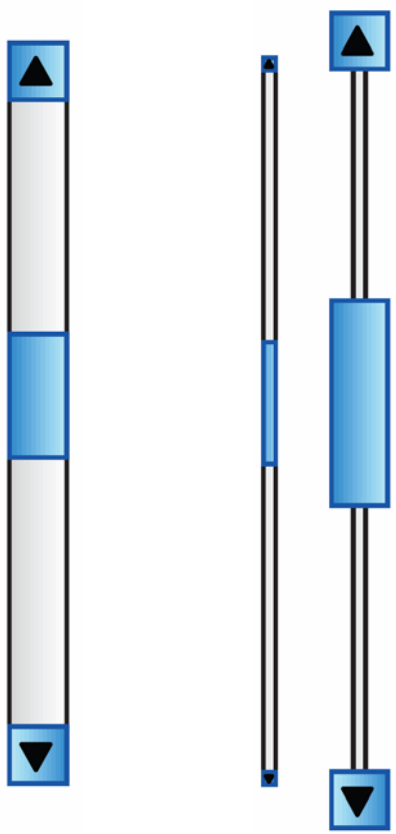
***Enlarge W***

MacGuffin &
Balakrishnan (CHI'02)

# ***Semantic Pointing***: Continuous modulation of the DC gain

Blanch, R. , Guiard, Y. , Beaudouin-Lafon, M. (2004). Semantic pointing: Improving target acquisition with control-display ratio adaptation. *Proc. CHI'2004*.

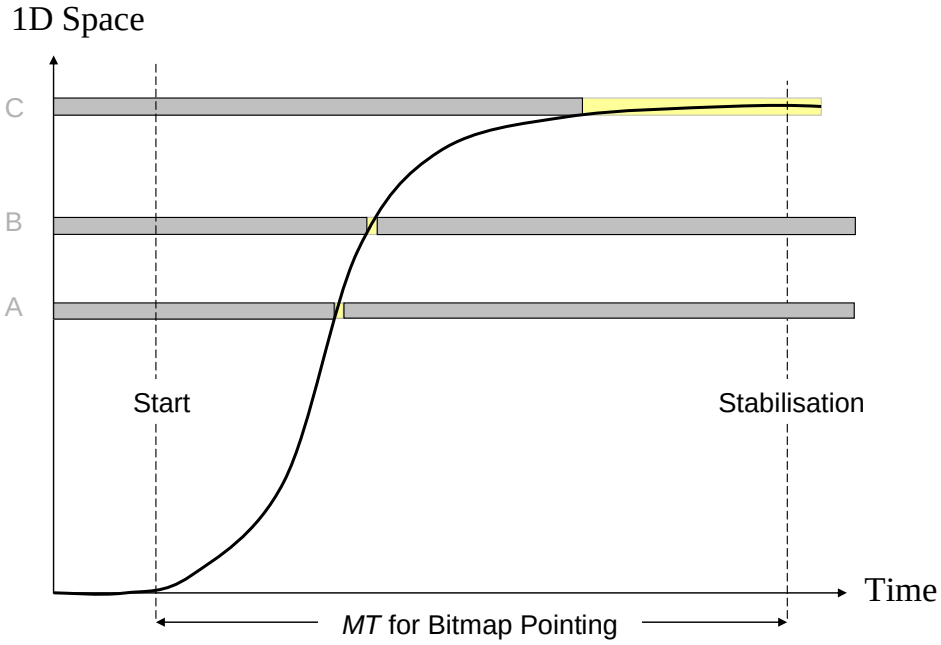


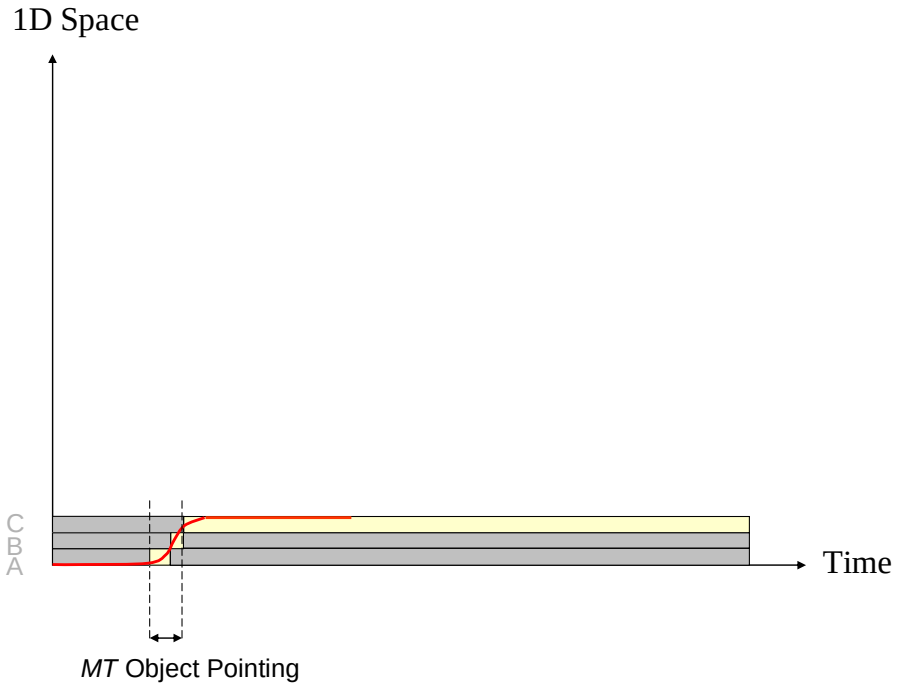

# *Object Pointing*: Jumping from object to object

Guiard, Y., Blanch, R., & Beaudouin-Lafon, M. (2004). Object pointing: A complement to bitmap pointing in GUIs. *Proc. Graphics Interface 2004.*

## Usual bitmap pointing

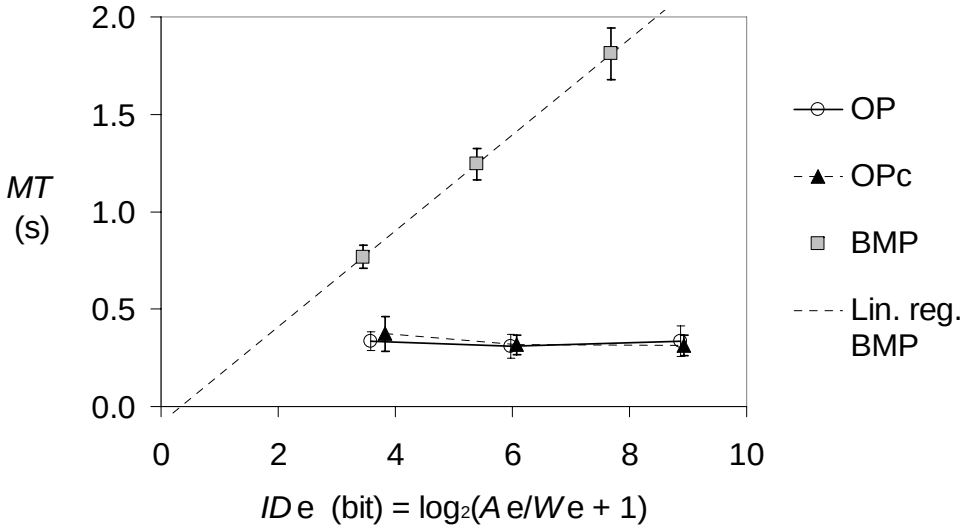



## Object pointing

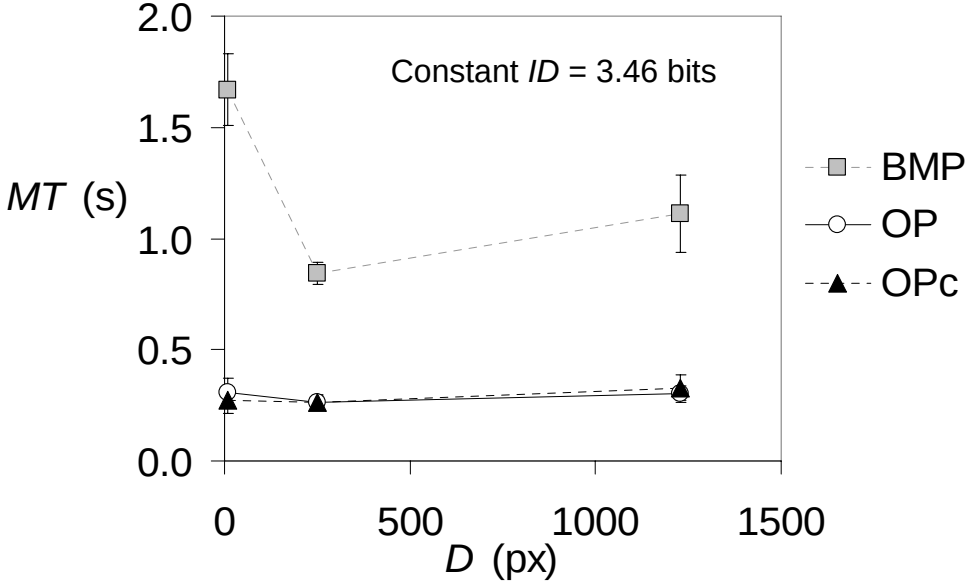


Object Pointing:

*MT* independent of the *ID*




*MT* independent of *scale*



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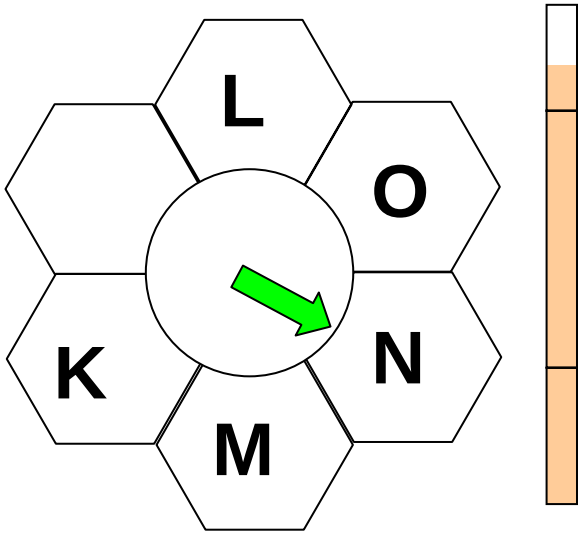



***Rotation speed*** = a constant with on/off control

***Extension speed*** = a constant with on/off control

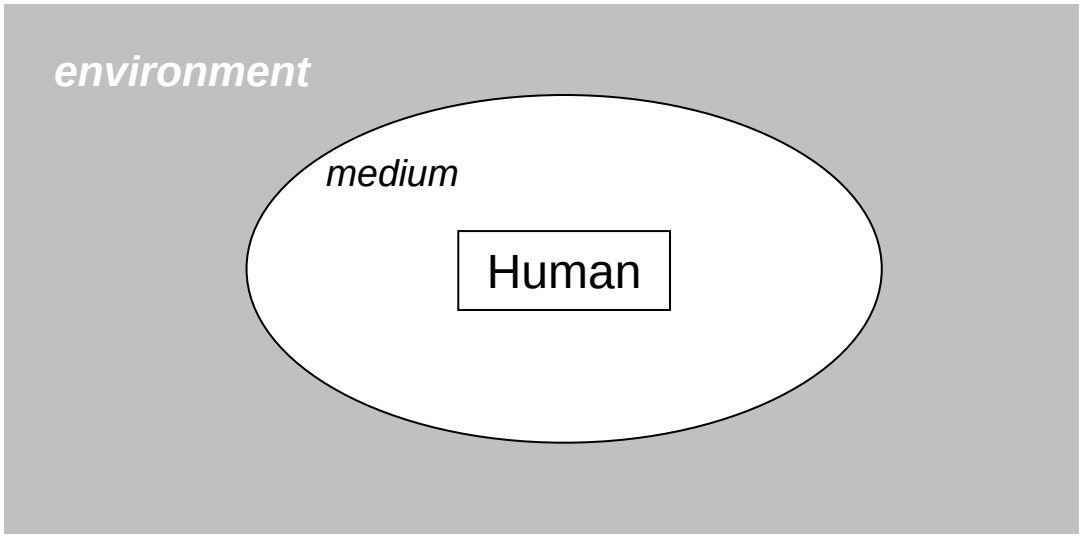
Why not try to *modulate* these speeds to accelerate the angular selection and the linear validation processes?

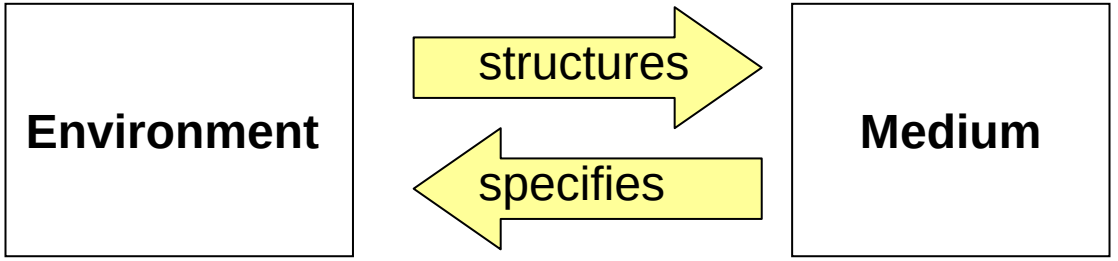
# Gibsonian metatheory

J.J. Gibson: The subject matter of psychology: Human-environment Interaction

Perception/action coupling

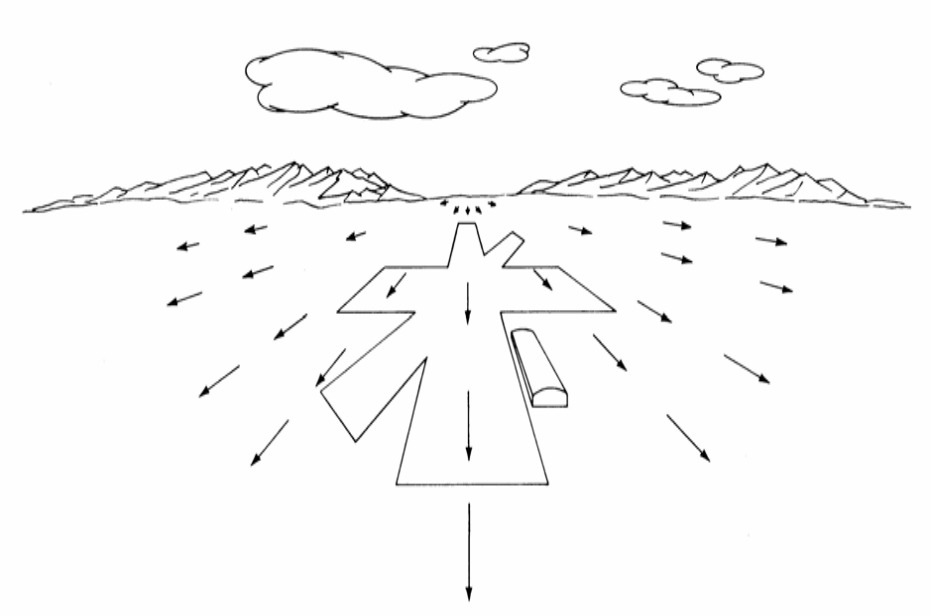
A lot of this interaction involves the *medium*

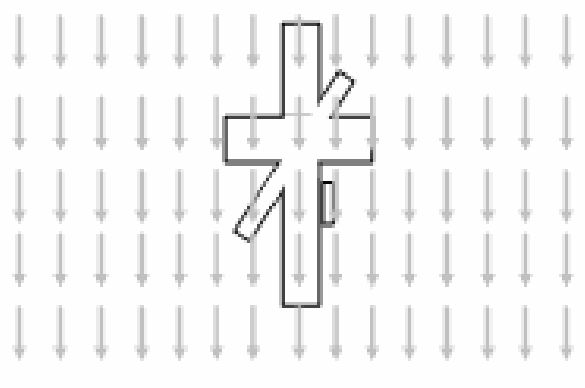


- Shannon’s communication model irrelevant to perception and action in general
  - Nature doesn’t talk to us: we explore and actively pick up information
  - No arbitrary codes, natural laws
  - What we pick up are invariants in flows

- Information for the senses: specification
  - Example: aiming direction in an optical flow field





  - Laws of nature (nature doesn't speak to us)
  - Information inexhaustible: perceiving means picking up information
  - Everything flows: Information in invariants

- Information in Shannon's sense
  - The communication model: a signal through a channel
  - Arbitrary codes
  - Limited transmission capacity

# Gunnar Johansson's paradigm

## Perception biological motion

Troje, N. F. (2002). Decomposing biological motion: A framework for analysis and synthesis of human gait patterns. *Journal of Vision*, *2*(5), 371-387, http://journalofvision.org/2/5/2/, doi:10.1167/2.5.2.
http://www.journalofvision.org/2/5/2/genderclass.html