

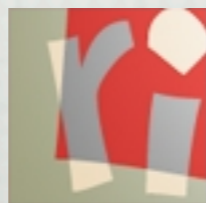
FITG10, 10/06/10

DESIGN AND LEARNING OF MULTI-FINGER INTERACTION:

*Arpege and the case of
multi-finger postures*

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UNIVERSITÉ
PARIS-SUD 11



Introduction

□ 80s : multitouch surfaces

□ 2004 : JazzMutant Lemur

□ 2006 : Jeff Han FTIR

□ 2007 : iPhone

Affordable
multitouch screens
(input + output)

Introduction

but....

INDUSTRIAL DEVICES :

- Just a few gestures are used
- Most of them require a maximum of two fingers

What about research ?

Introduction

but....

INDUSTRIAL DEVICES :

- Just a few gestures are used
- Most of them require a maximum of ~~two~~ one ? fingers



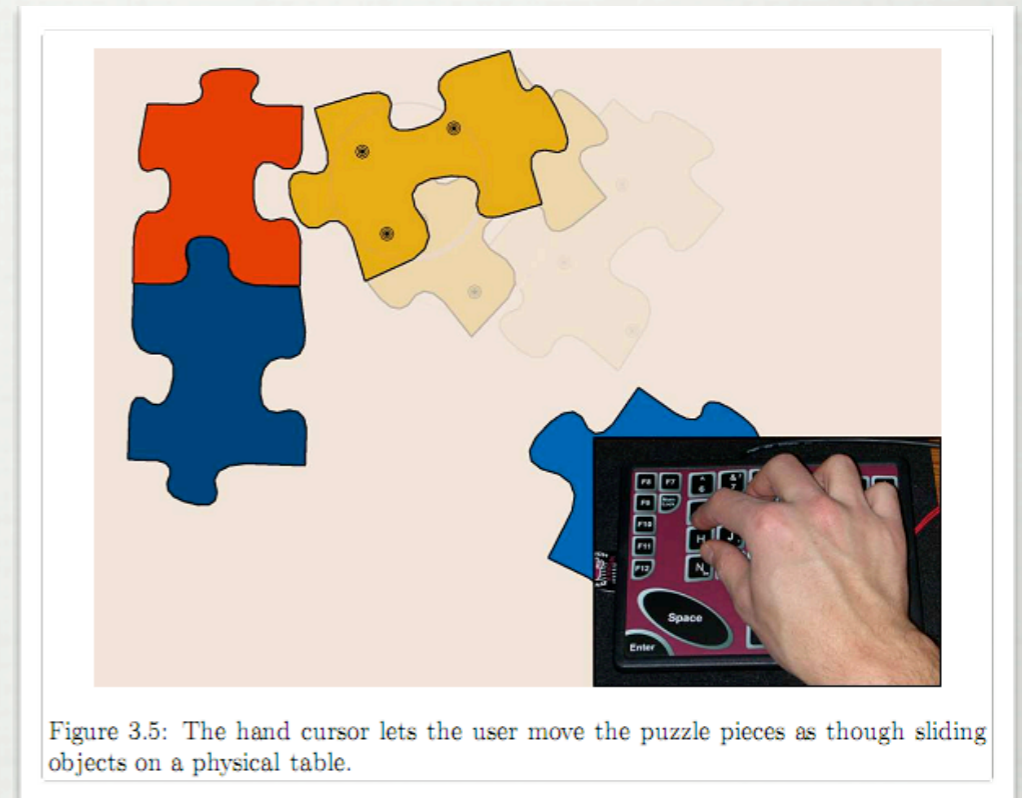
From Apple.com

What about research ?

Related Work : Gestures

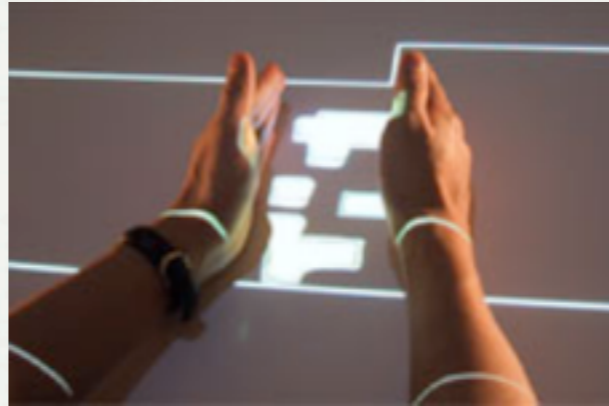
□ Multi-finger direct manipulation

➔ Just a few propositions...



Moscovich et al., GI 2006

Related Work : Gestures



Wu et al., CHI 2003

□ «Natural interaction»



Wilson et al., UIST 2008

Related Work : Gestures

◎ Advantages ?

- ➔ Take advantage of available knowledge
- ➔ «Could» be easier for novices

◎ Drawbacks ?

- ➔ still implicit vocabulary (not everything is taken into account)
- ➔ limited : lack of expressiveness (richness, grammar?) for experts
(music, sign language, ...)

Related Work : Gestures

□ Don Norman (2010) *Living with complexity* :

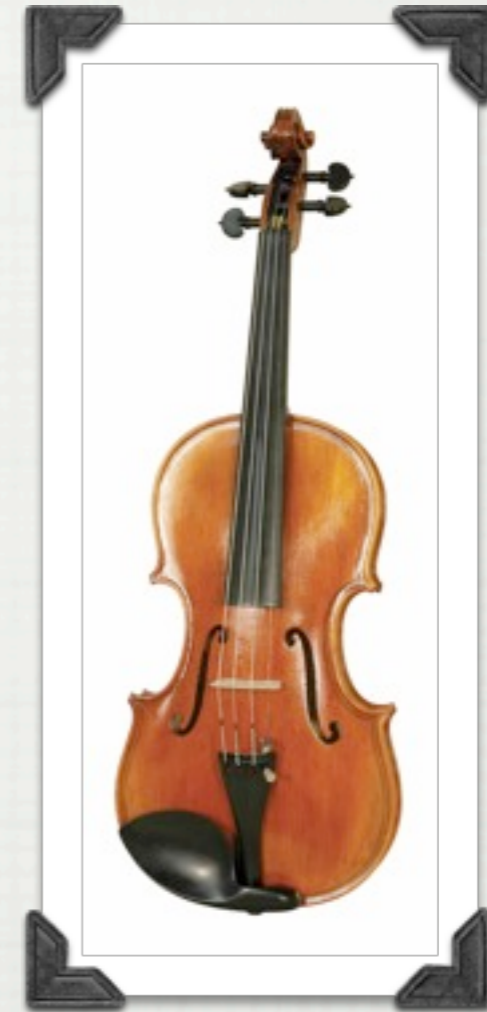
« We seek rich, satisfying lives, and richness goes along with complexity »

➔ A solution for Norman : goods designs

Related Work : Gestures

Back to the past

Related Work : Gestures



- Engelbart (1962) usability Dilemma :

High-Performance vs Ease-of-Use

- ➔ « The high-performance knowledge workers of the future are expected to be very skillful »

Related Work : Gestures

Back to the past

Related Work : Gestures



- Neandertal (200 000 years ago) :

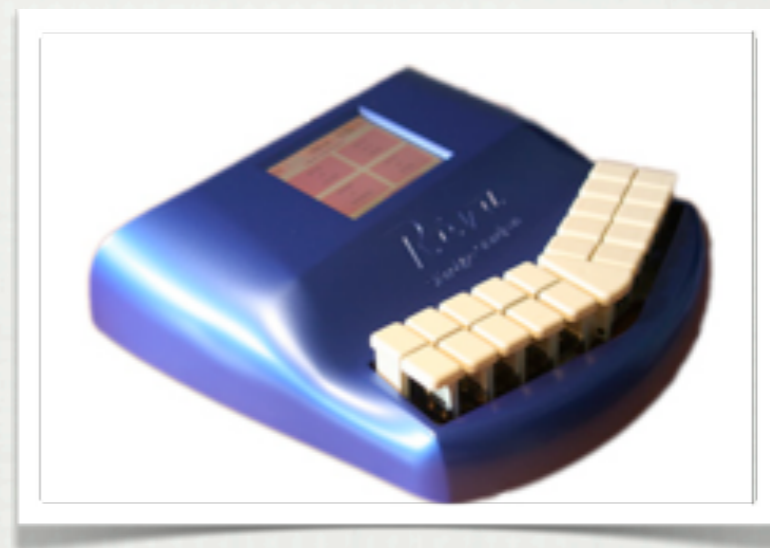
«Let's design advanced tools we can learn how to use and master»

Related Work : Gestures

- Abstract/iconic gestures vocabularies



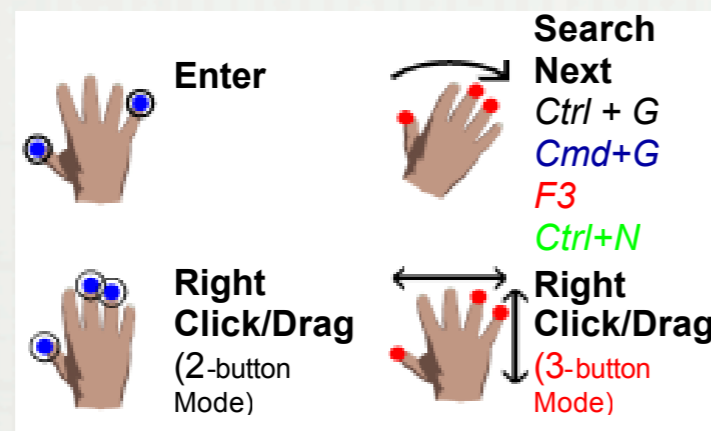
Engelbart's keyset (1962)



Stenotype (225 words/min)

Related Work : Gestures

□ Abstract/iconic gestures vocabularies



FingerWorks[®], 2002

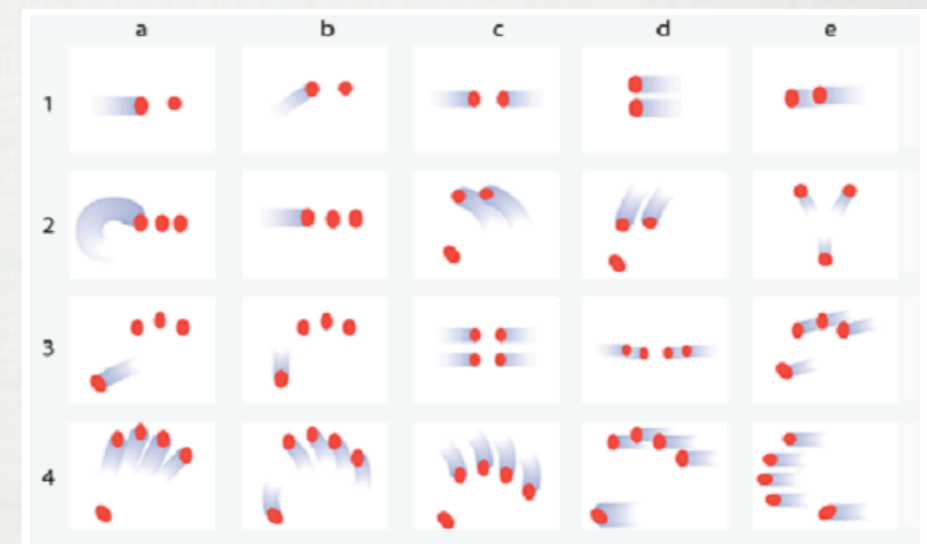


Figure 2. Vocabulary of gestures demonstrating the subtleties that can be recognized. The starting positions of the fingers are shown in red, the blue trails show the path during the gesture.

➔ Expressiveness, possibilities

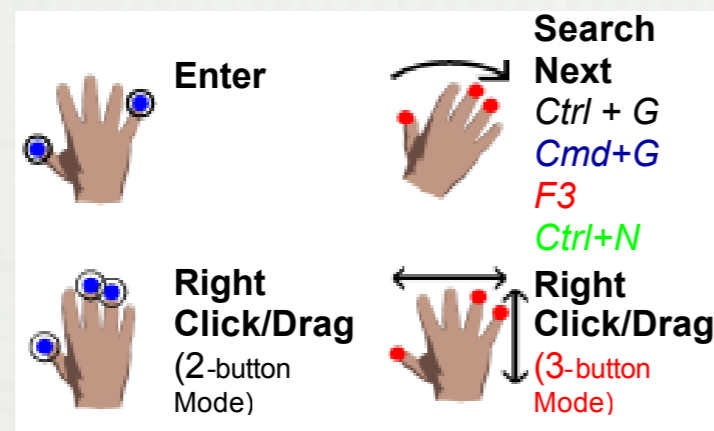
Damaraju et al., Tabletop ITS 2008

➔ but...vocabularies are often arbitrarily defined

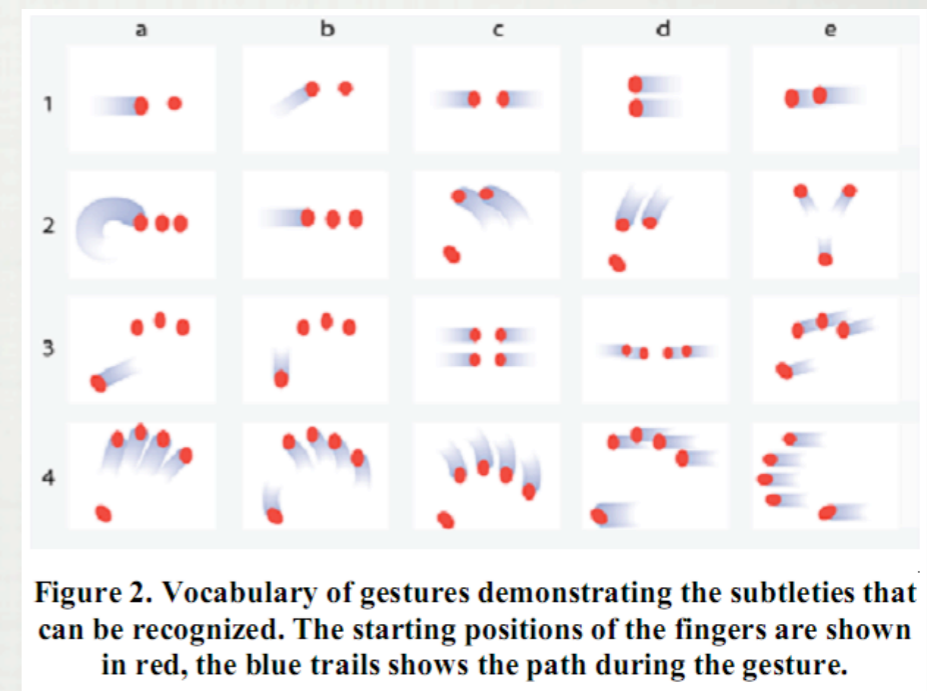
➔ Hard to learn (not revealing)

Related Work : Gestures

□ Abstract/iconic gestures vocabularies



FingerWorks[®], 2002



➔ Expressiveness, possibilities

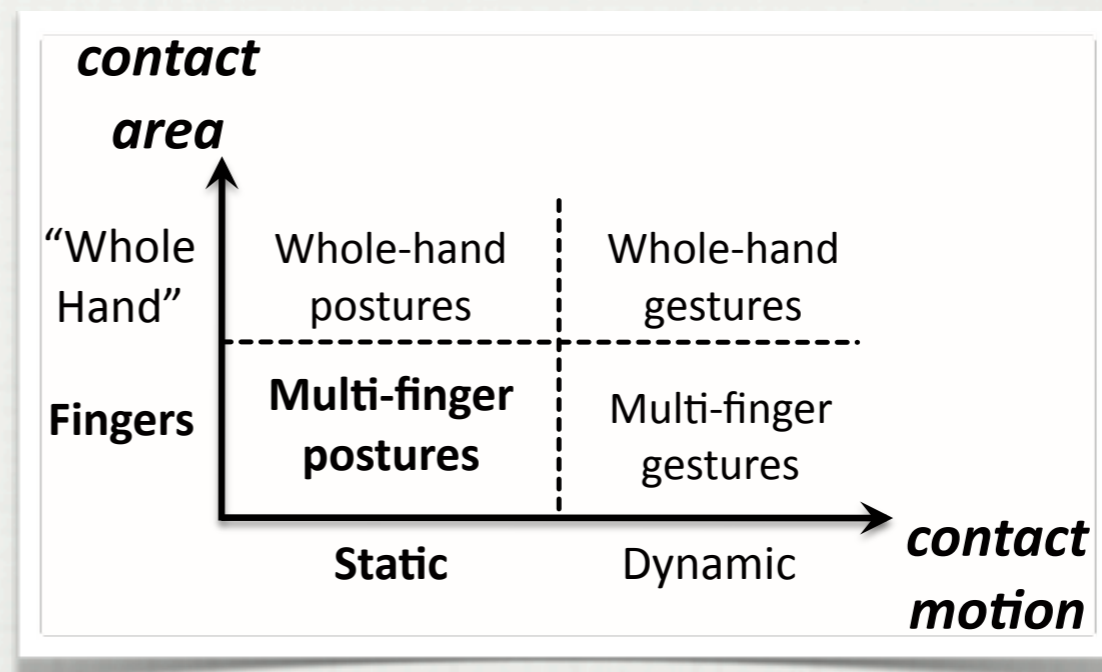
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➔ but.. vocabularies are often arbitrarily defined

➔ Hard to learn (not revealing)

Position : Multi-finger postures

□ Multi-finger postures



Contribution I : Design Guidelines

- Design Guidelines from motor studies
- ➔ Maximise freedom and available combinations
- ➔ Minimise discomfort

We start from the «natural» hand posture



Contribution 1 : Design Guidelines

□ Design Guidelines from motor studies

Lee et al., 1995, Model-based analysis of hand posture
(interdependance of fingers, angular constraints)

- ➔ 1: Exclude chord gestures that require lifting either the middle or ring finger from the table, without also lifting at least one of their neighbors.

Contribution I : Design Guidelines

□ Design Guidelines from motor studies

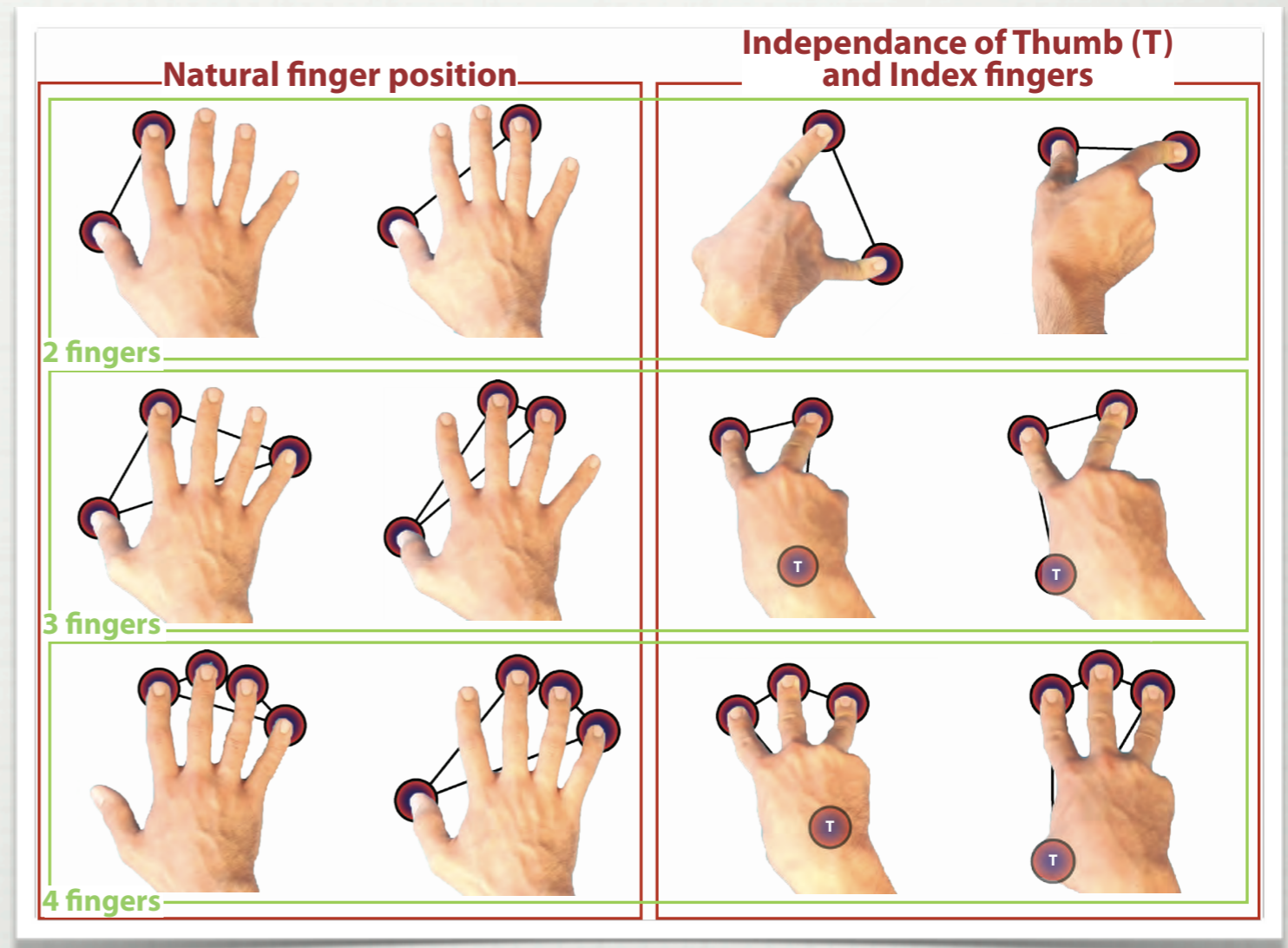
Hager-Ross et al., 2000, Quantifying the independence of human finger movements

(move without accompanying movement, not to follow other fingers' movements)

- ➔ 2: Create additional chord gestures by moving the most independent fingers, i.e. the thumb, index finger and pinky, away from their natural position.

Contribution I : Design Guidelines

Test vocabulary



Contribution 1 : Design Guidelines

- Controlled experiment 1 (with 12 simulated experts) :

Tactile tool palette vs. multi-finger posture

Contribution I : Design Guidelines

□ Controlled experiment 1 (with 12 simulated experts) :

Tactile tool palette vs. multi-finger postures

➔ Smaller completion time

➔ Participants are confident in their performance

➔ but...Much more errors

Contribution I : Design Guidelines

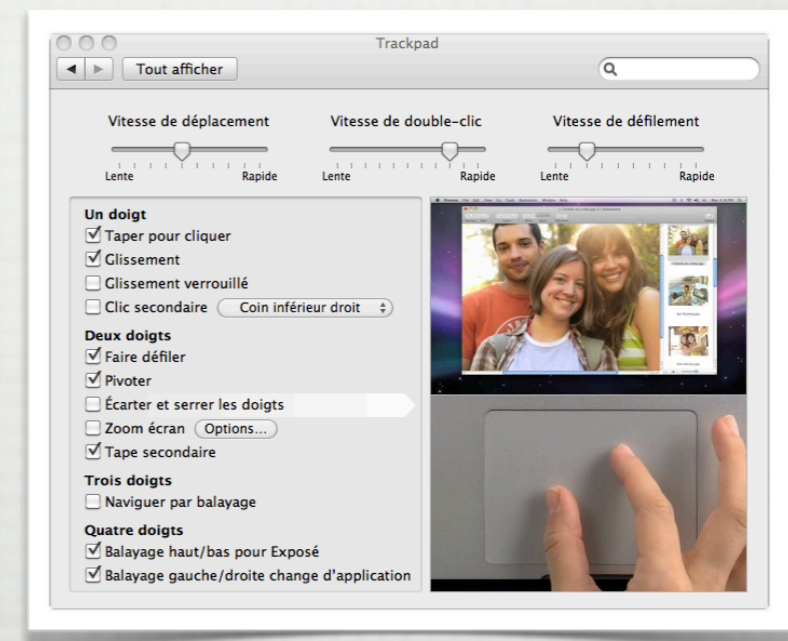
- ➔ Even if the users know what gesture to perform, they must learn, how to perform it
- ➔ Systems for learning or guidance ?

Related Work : Learning

- Available systems for guidances
 - Out-of-context (Touchghost, Apple...)
 - Contextual static cheat sheet (ShadowGuides, ...) / vocabulary
 - Widgets (Bailly et al., Wu et al., ...) / Commands



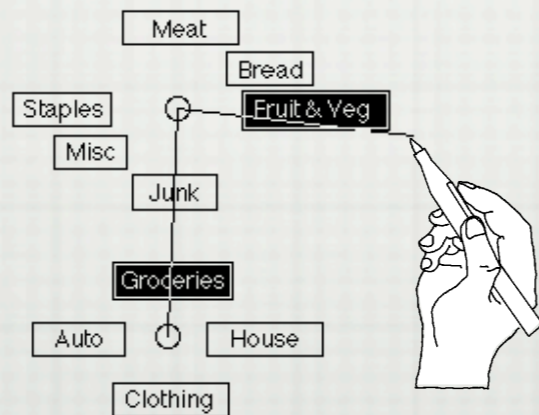
Bailly et al., IHM 2008



Apple Trackpad

Position : Dynamic, contextual, in-situ

- Dynamic / contextual / in-situ guiding techniques (vocabulary)
 - feedback + feedforward
 - no additional room needed
 - fluid novice/expert transition



Kurtenbach's
Marking menus

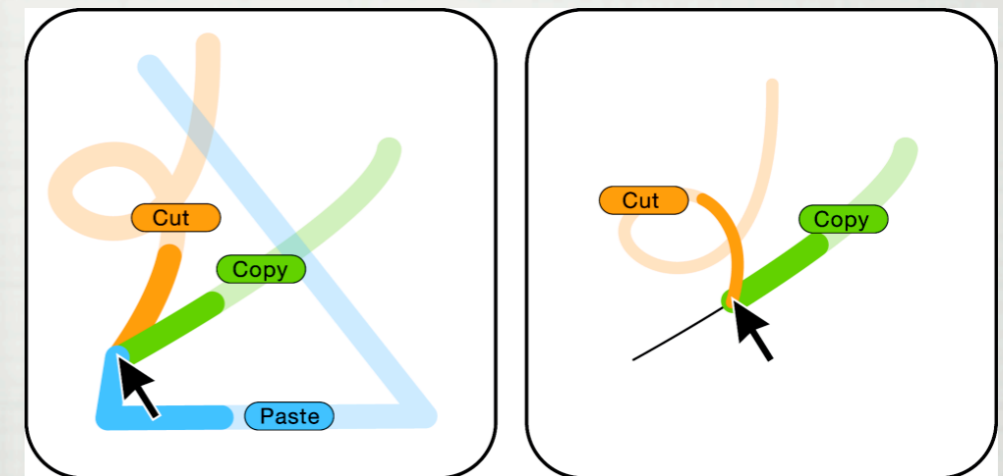


Fig. 3: OctoPocus displays three gestures and commands. Tracing **copy** causes **paste** to disappear and **cut** to get thinner.

Contribution 2 : Dynamic Guide

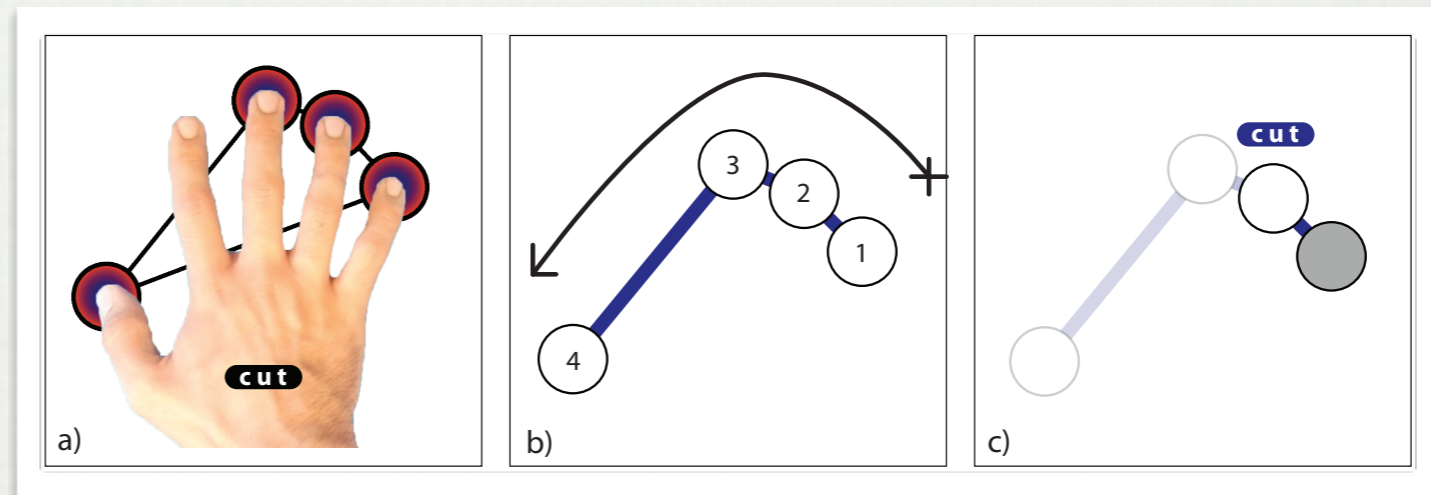
□ Arpege :

➔ step-by-step

➔ dynamic

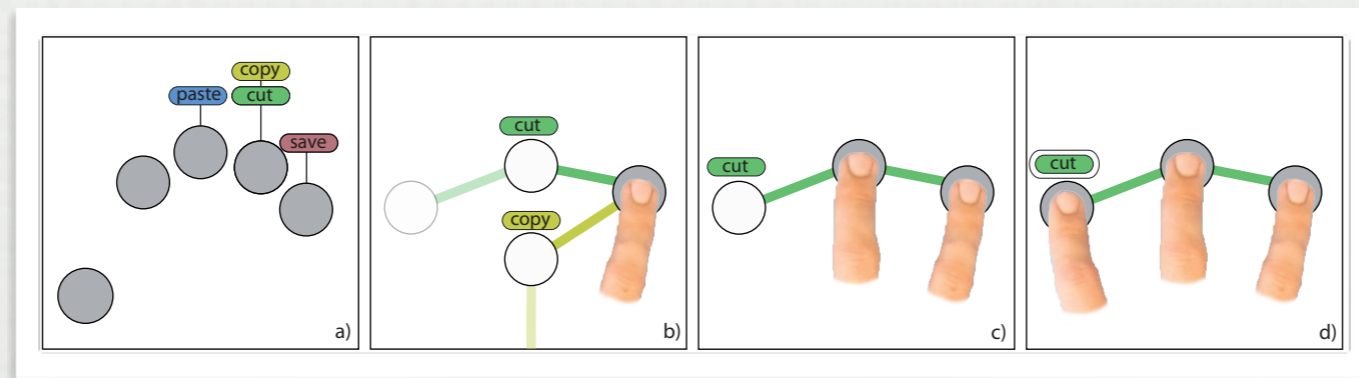
➔ interactive

➔ from little finger to thumb (occlusion)



Contribution 2 : Dynamic Guide

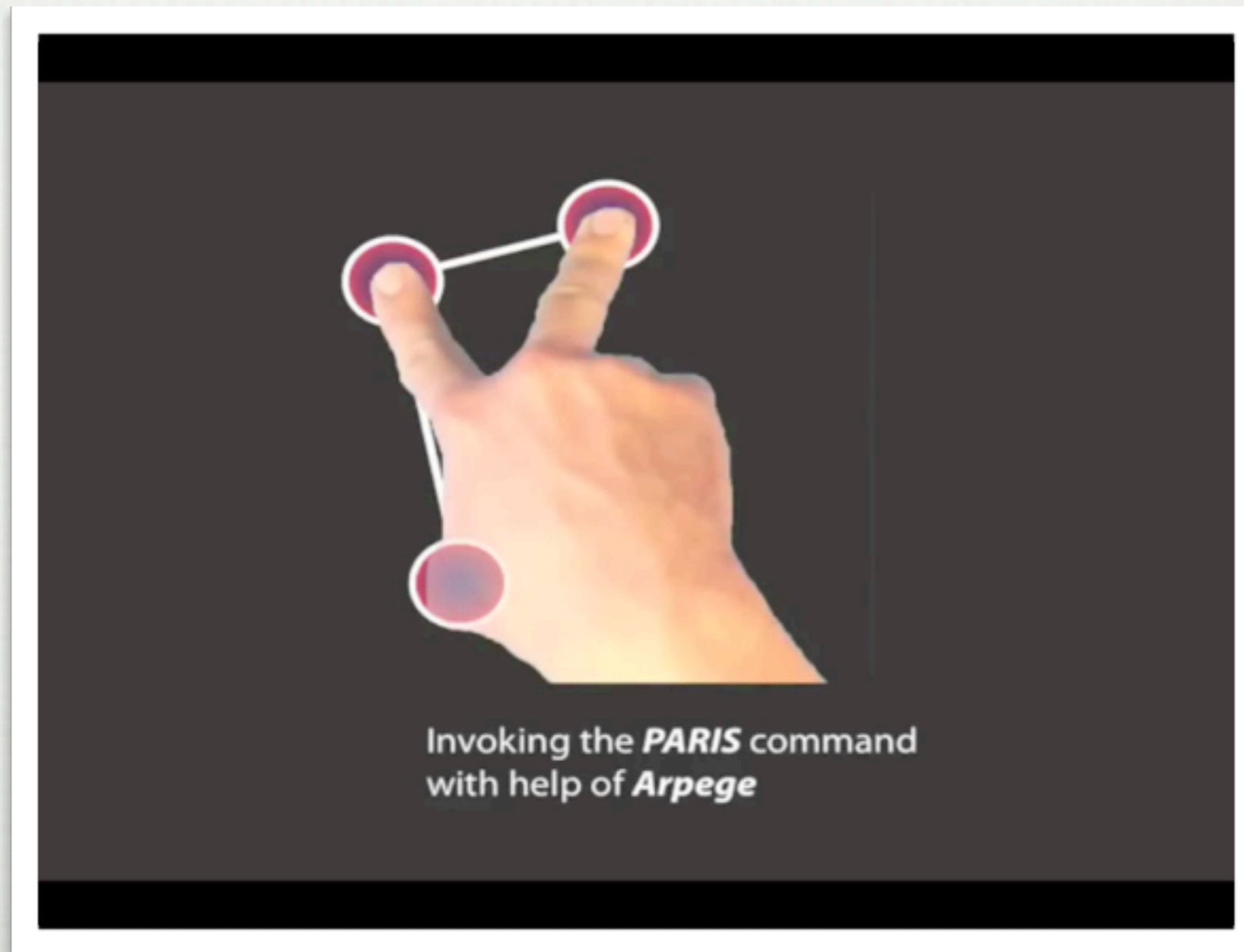
□ Arpege guide



-> Movie

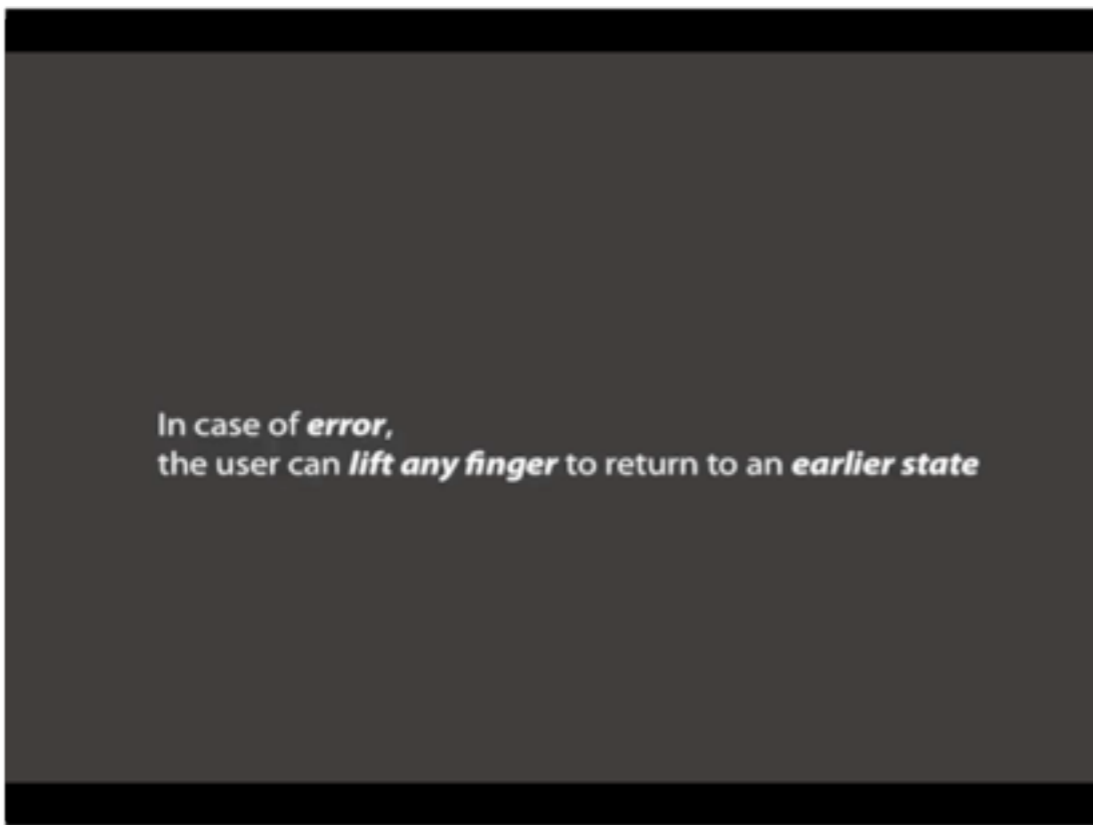
Contribution 2 : Dynamic Guide

- *Arpege guide*

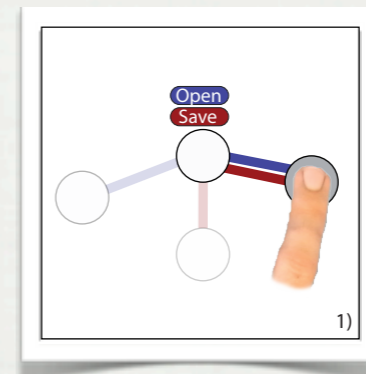


Contribution 2 : Dynamic Guide

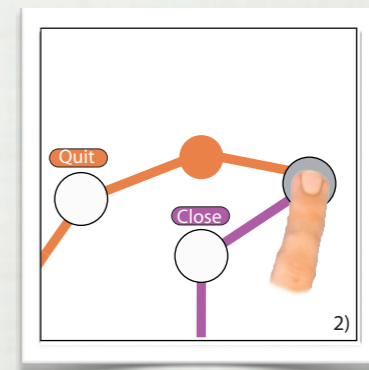
□ Arpege Special Cases



Error -> Undo



Joint Paths

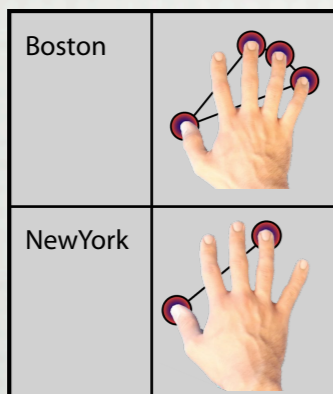


Disjoint Paths +
Non-involved finger

Contribution 2 : Dynamic Guide

- Controlled experiment 2 (with 12 participants) :

Cheat-Sheet vs. Arpege



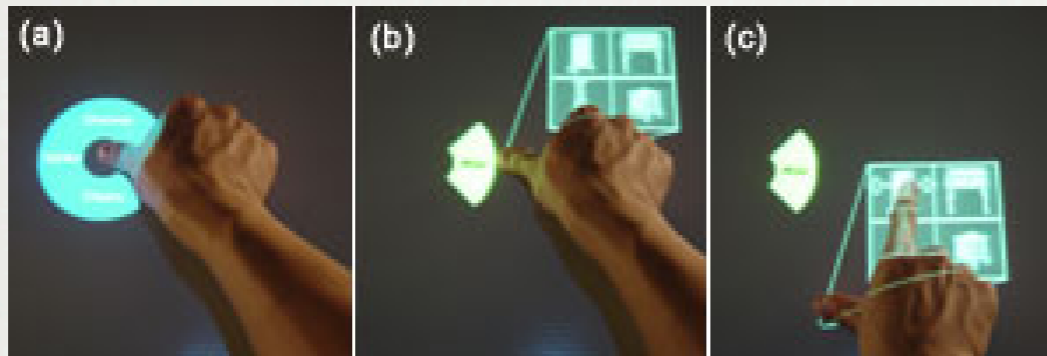
Contribution 2 : Dynamic Guide

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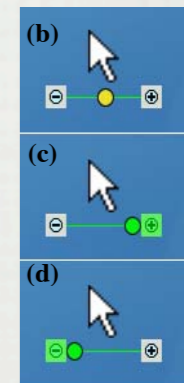
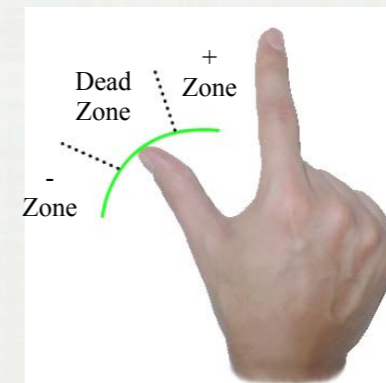
- ➔ Equal for completion time / use of help / learning

- ➔ 3 times less errors with Arpege

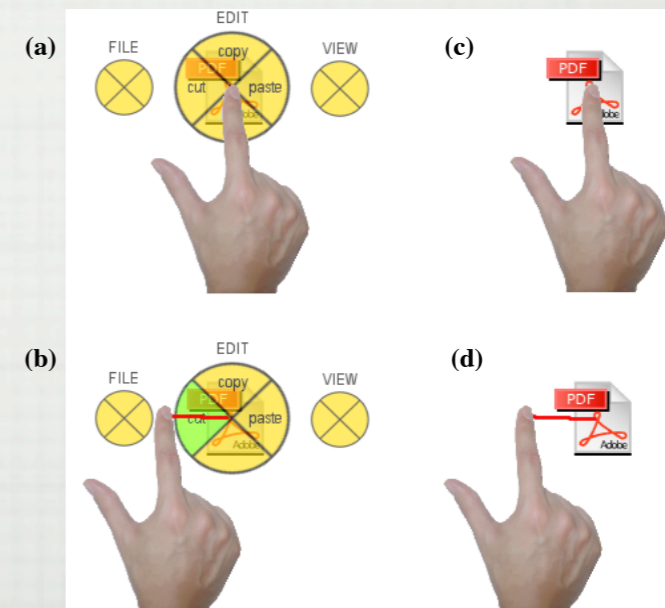
Current work : Multi-Finger Widgets



Wu et al.



- Categorisation
- ➔ inspired by existing widgets
- ➔ reified usual gestures
- ➔ motor studies



Malik et al.

Current work : Multi-Finger Widgets

- Multi-finger widgets



Conclusion

□ Multi-finger gestures

➔ Polymorphic learning (commands ? gestures ? mappings ?)

➔ We need a categorisation of learning techniques

static / interactive / reified guides

gestures categorisation (existing and possible)