Applying Multitouch

CS 6457 and CS 4470 | Craig Tashman

- THEORY
- INTERACTIONS
- DEVELOPMENT

THEORY

INTERACTIONS

DEVELOPMENT

Parellelism

Expressiveness

THEORY

INTERACTIONS

DEVELOPMENT

Parellelism

Expressiveness

Independent

THEORY

INTERACTIONS

DEVELOPMENT

Parellelism

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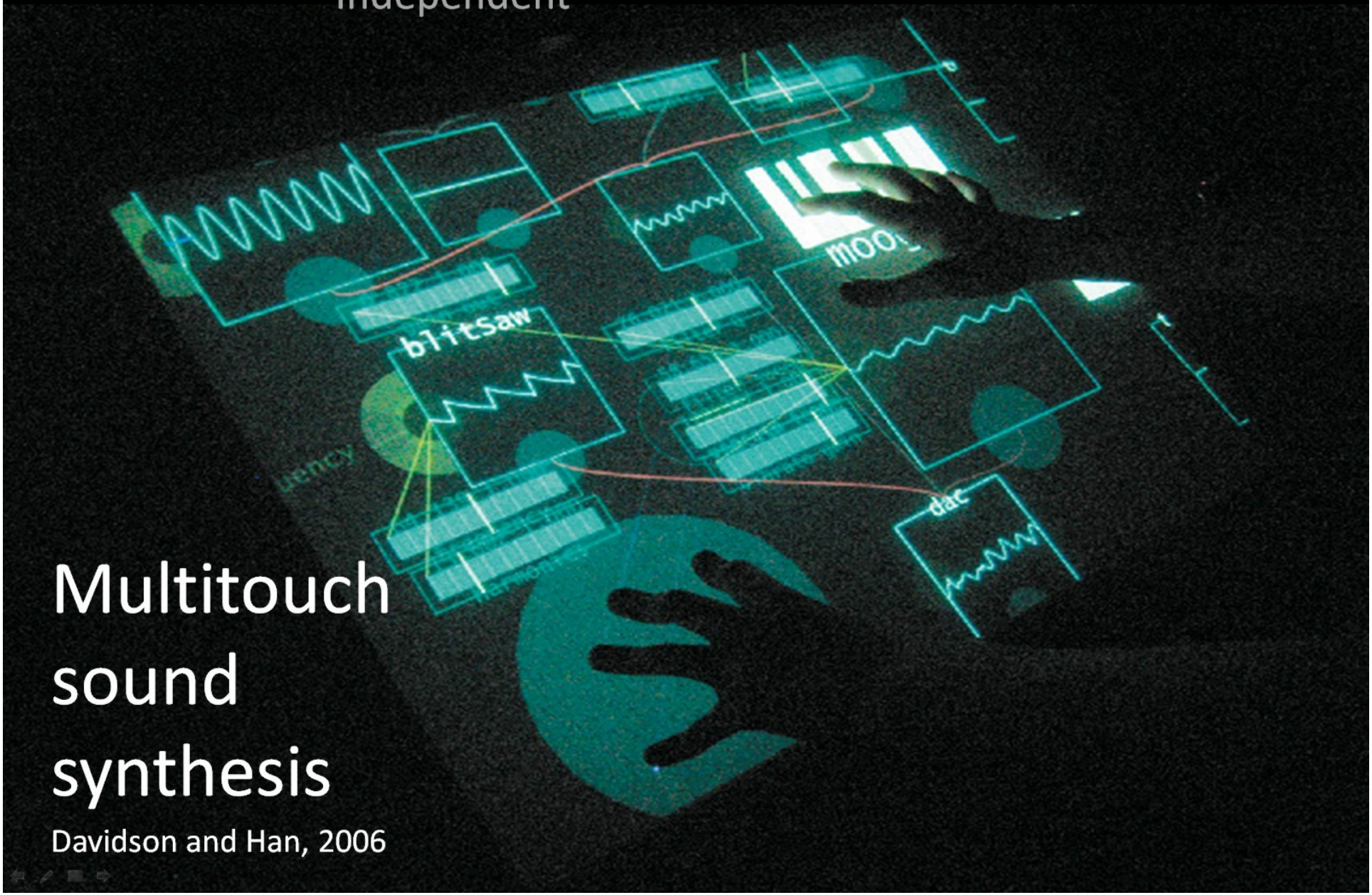
Independent

Cooperative

Parellelism

Independent



Multitouch sound synthesis

Davidson and Han, 2006


Parellelism
Independent
Multitouch Collaborative Design
Wu and Balakrishnan, 2003

THEORY

INTERACTIONS

DEVELOPMENT

Parellelism

Expressiveness

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Cooperative

Working together

Common low-level, spatial goal

THEORY

INTERACTIONS

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Parellelism

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Symmetric

Asymmetric

THEORY

INTERACTIONS

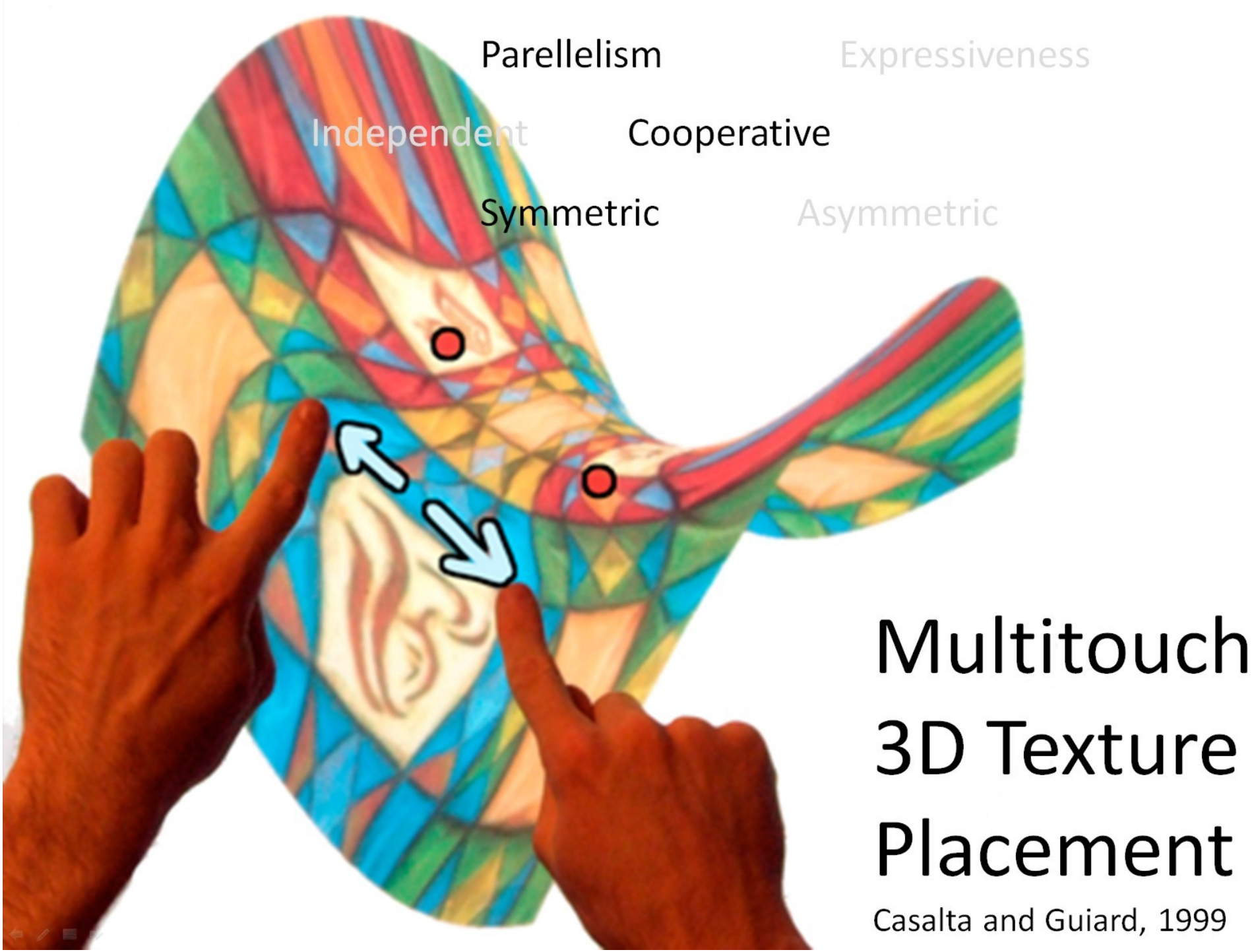
DEVELOPMENT

Parellelism Expressiveness

Independent Cooperative

Symmetric Asymmetric

Inputs working on same task…
in the same way!
Like stretching a rubber band.


Parellelism
Expressiveness
Independent
Cooperative
Symmetric
Asymmetric
Multitouch
3D Texture
Placement
Casalta and Guiard, 1999

THEORY

INTERACTIONS

DEVELOPMENT

Parellelism

Expressiveness

Independent

Cooperative

Symmetric

Asymmetric

Complementary, disparate roles.
Like opening a jar.
Or like writing.

THEORY

INTERACTIONS

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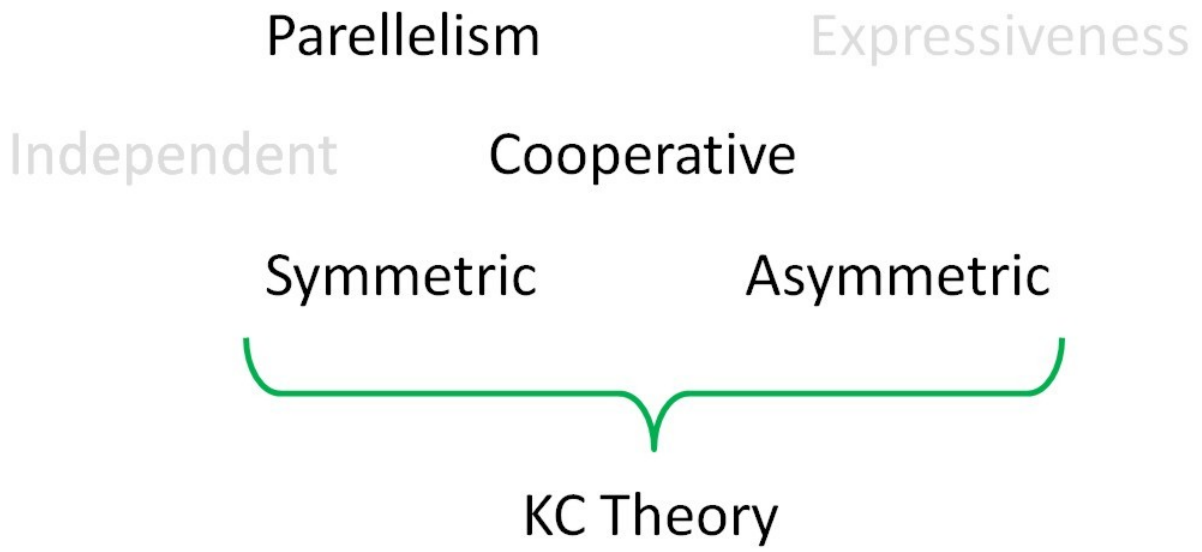
Asymmetric

KC Theory

THEORY

INTERACTIONS

DEVELOPMENT



- Kinematic Chain Theory.
- For kinematic systems like arms, near (proximal) parts behave differently from far (distal) parts.
- Analogy to bimanual behavior: dominant hand acts like distal component, non-dominant hand acts as proximal.
- So, non-dominant hand:
  - usually moves first
  - sets reference frame
  - Moves larger distances

THEORY

INTERACTIONS

DEVELOPMENT

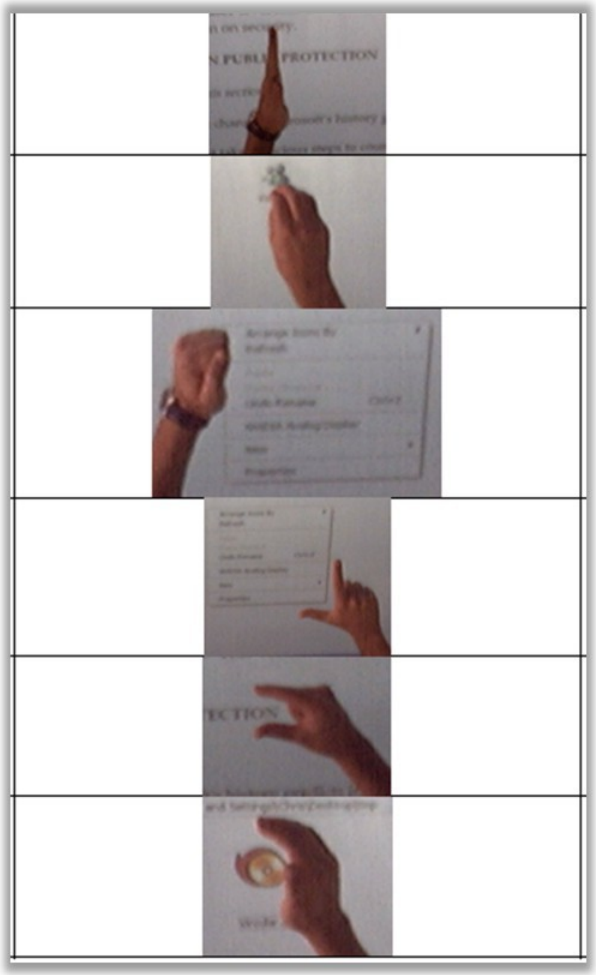
Parellelism

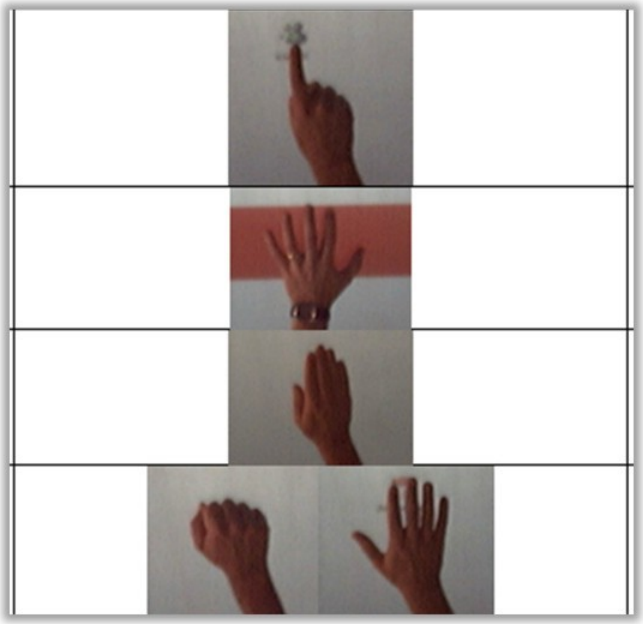
Expressiveness

Changes meaning of an input point
Makes each input point richer
Can use different hand gestures

Parellelism

Expressiveness



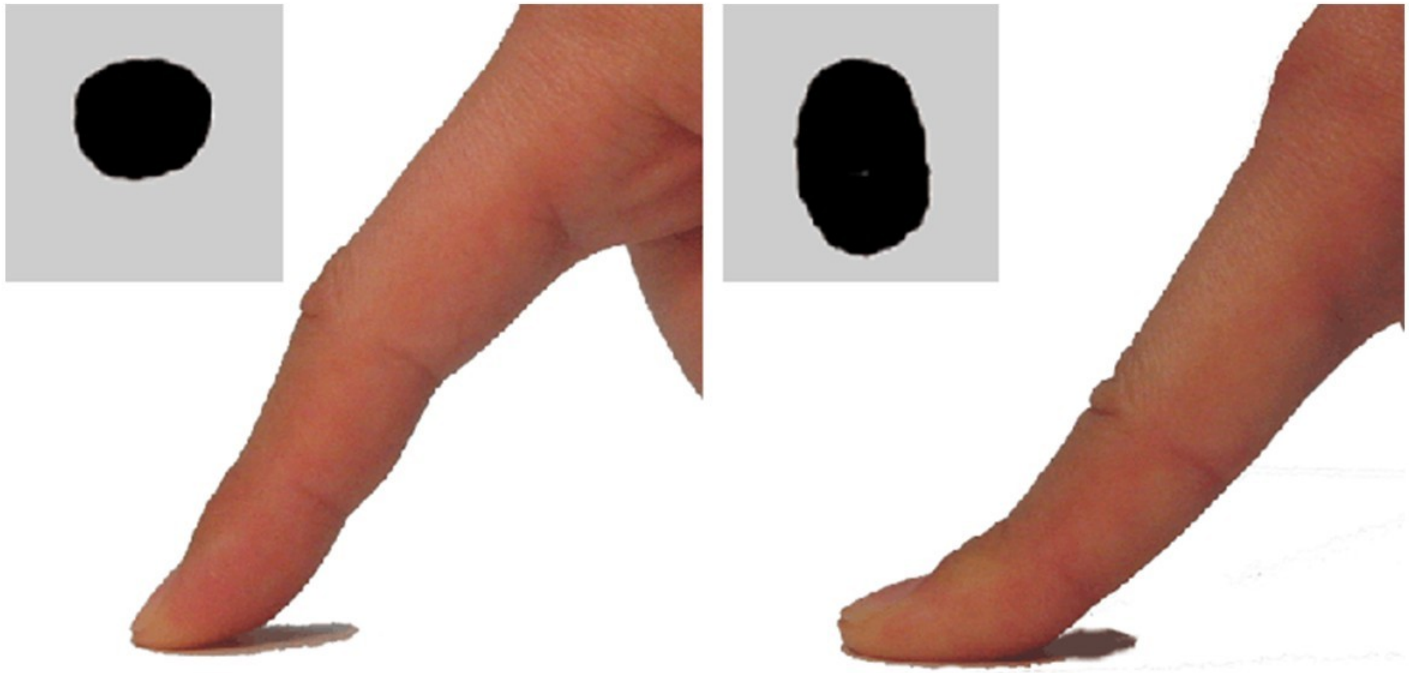


Hand shapes in multitouch

Epps, Lichman, Wu, 2006

Parellelism

Expressiveness



Precise Selection Techniques

Benko, Wilson, Baudisch, 2006

Parellelism

Expressiveness

Hands-on Math

Zeleznik, et al., 2010

THEORY

INTERACTIONS

DEVELOPMENT

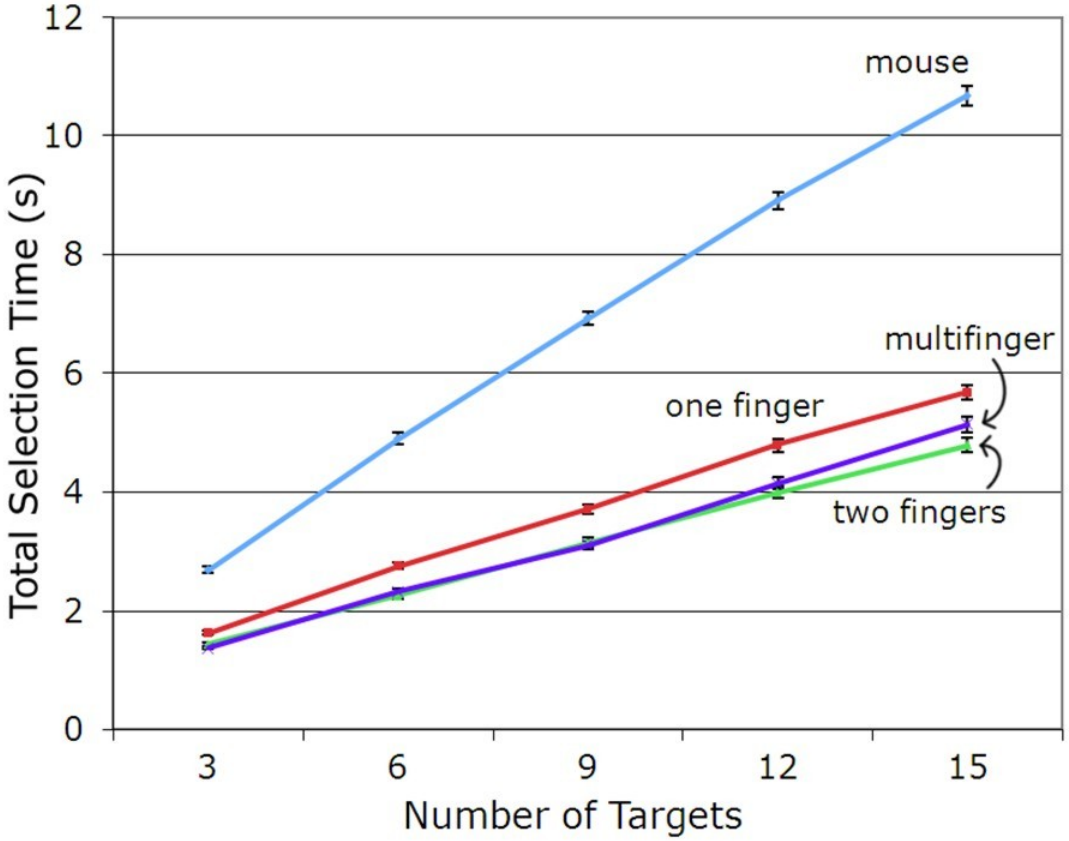
Some General Thoughts

THEORY

INTERACTIONS

DEVELOPMENT

First:
Touch can be better



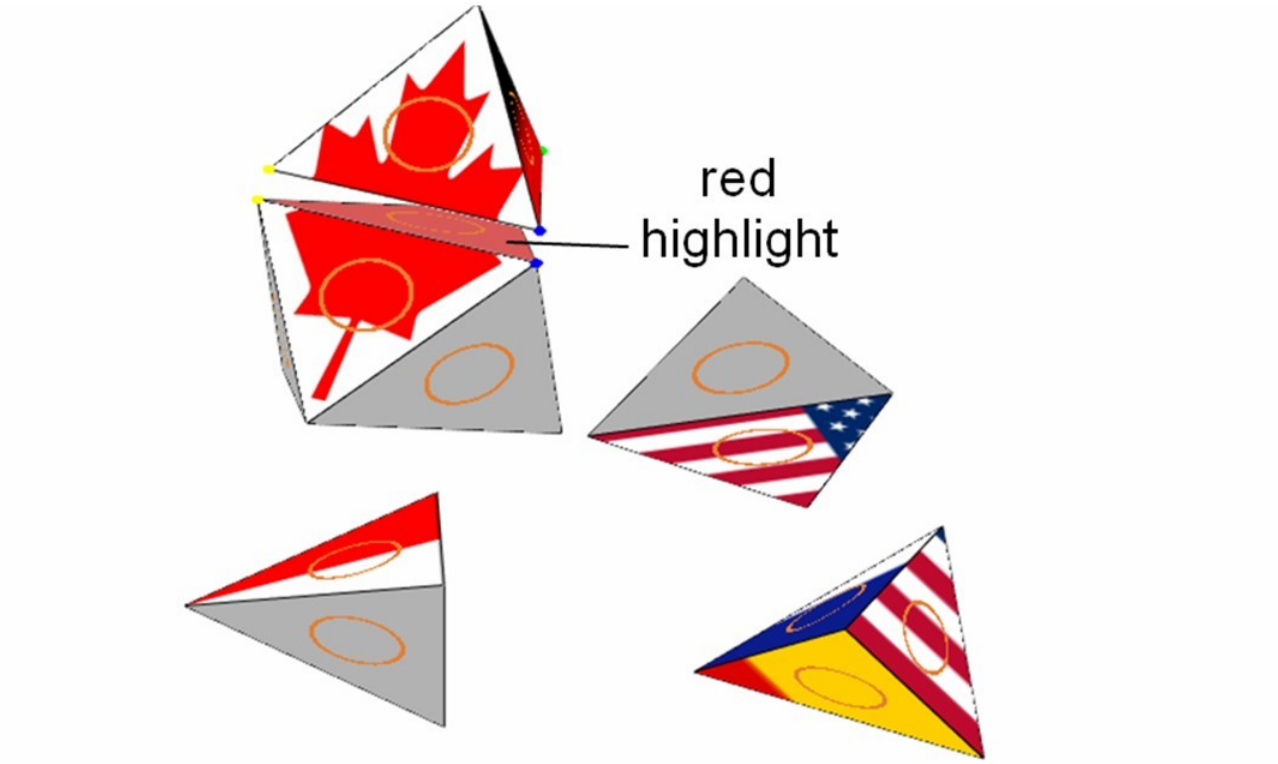
Determining the Benefits of Direct-Touch, Bimanual, and Multifinger Input on a Multitouch Workstation, Kin, Agrawala, DeRose

THEORY

INTERACTIONS

DEVELOPMENT

Second:
Consider degrees of freedom



People used 3 fingers to control many degrees of freedom.

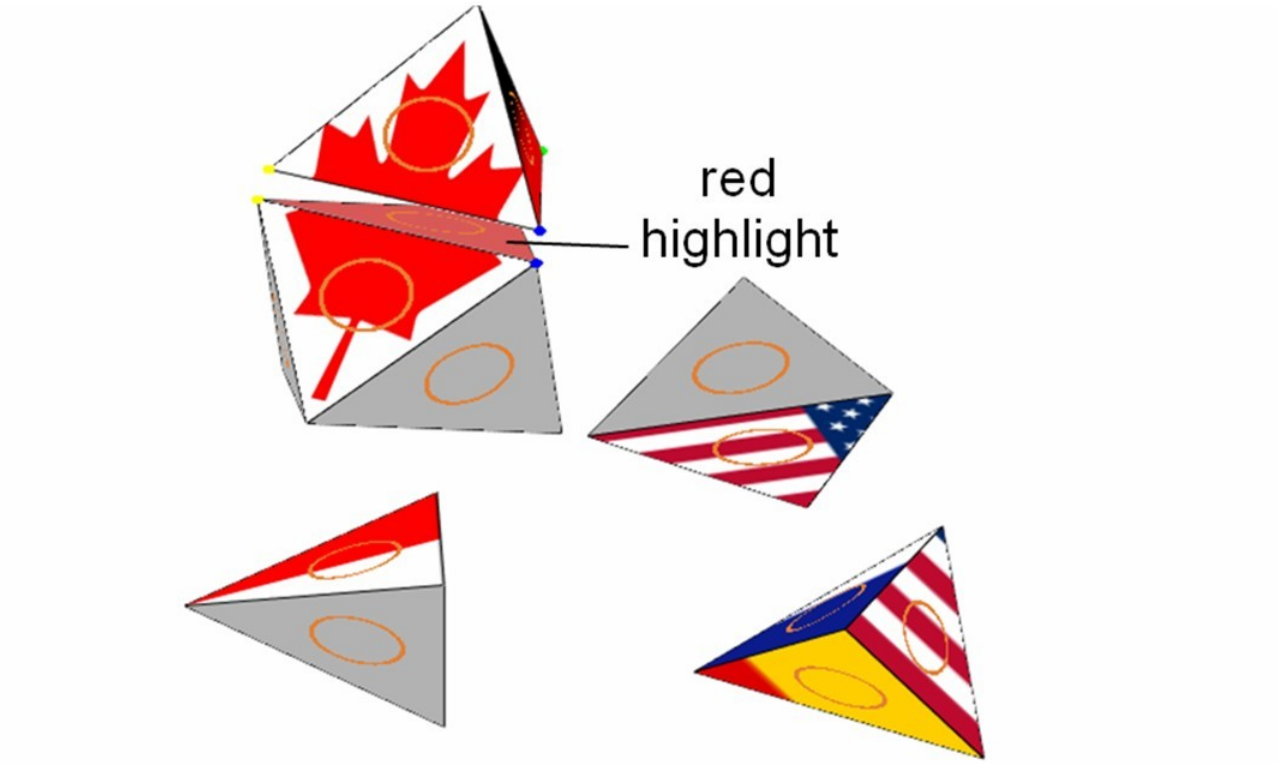
Shallow-Depth 3D Interaction: Design and Evaluation of One-, Two- and Three-Touch Techniques, Hancock, Carpendale, Cockburn

THEORY

INTERACTIONS

DEVELOPMENT

Second:
Consider degrees of freedom



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THEORY

INTERACTIONS

DEVELOPMENT

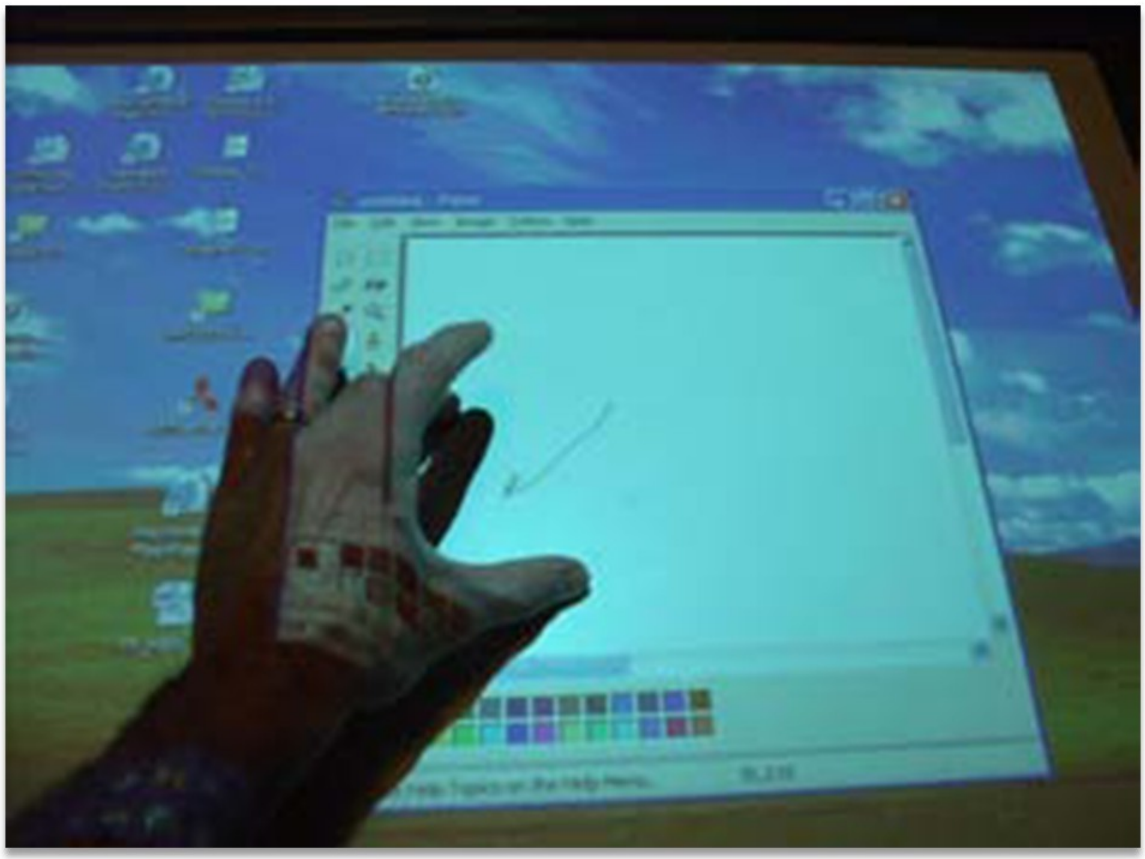
Some Cool Interactions

THEORY

INTERACTIONS

DEVELOPMENT

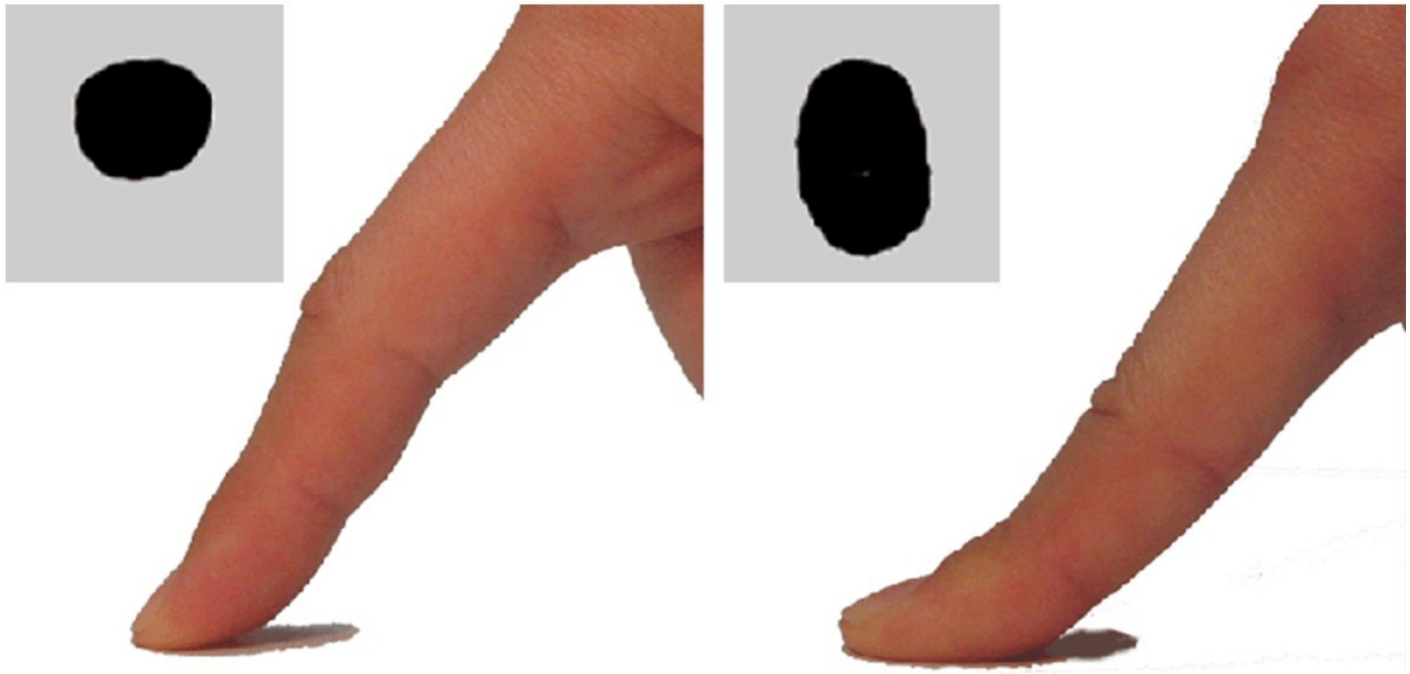
Raising Precision



Cursor sits between fingers.

Fluid DTMouse: Better Mouse Support for TouchBased Interactions, Esenther, Ryall

Raising Precision



Push finger down harder for “click.”

Precise Selection Techniques for Multi-Touch Screens, Benko, Wilson, Baudisch

THEORY

INTERACTIONS

DEVELOPMENT

Raising Precision

Distance between fingers controls granularity of adjustment.

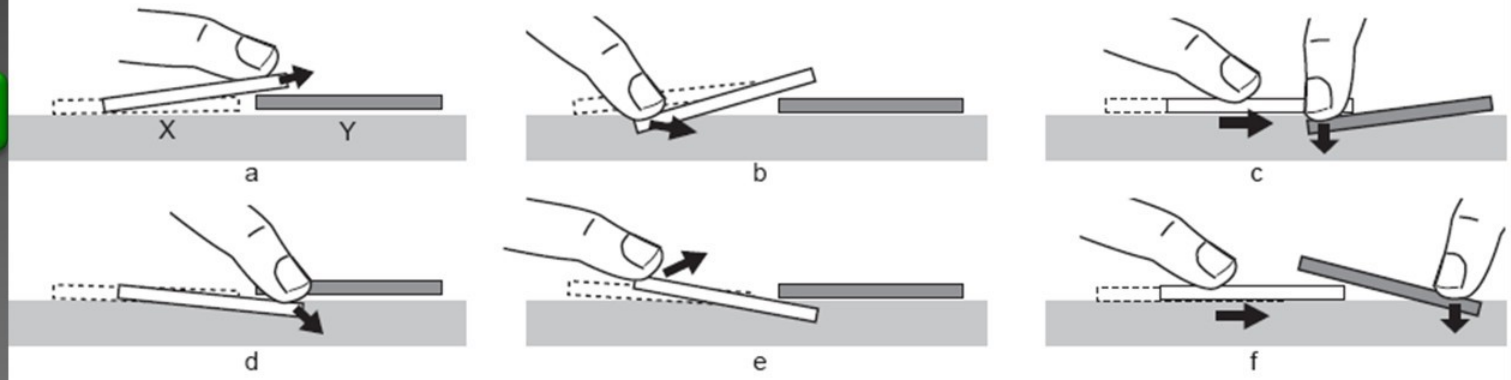
Multi-Finger and Whole Hand Gestural Interaction Techniques for Multi-User Tabletop Displays, Wu, Balakrishnan

Expressiveness

THEORY

INTERACTIONS

DEVELOPMENT



Layering in 3D using multitouch.

Extending 2D Object Arrangement with Pressure-Sensitive Layering Cues, Davidson, Han

THEORY

INTERACTIONS

DEVELOPMENT

Expressiveness

Edge of hand brings up “secret” dialog box.

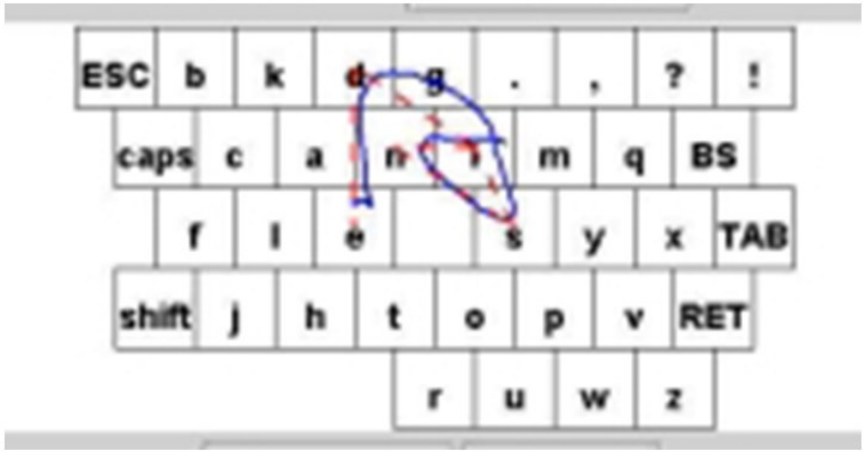
Multi-Finger and Whole Hand Gestural Interaction Techniques for Multi-User Tabletop Displays, Wu, Balakrishnan

THEORY

INTERACTIONS

DEVELOPMENT

Text Input



Draw shape corresponding to word.
(no, it's not touch, but still very cool)

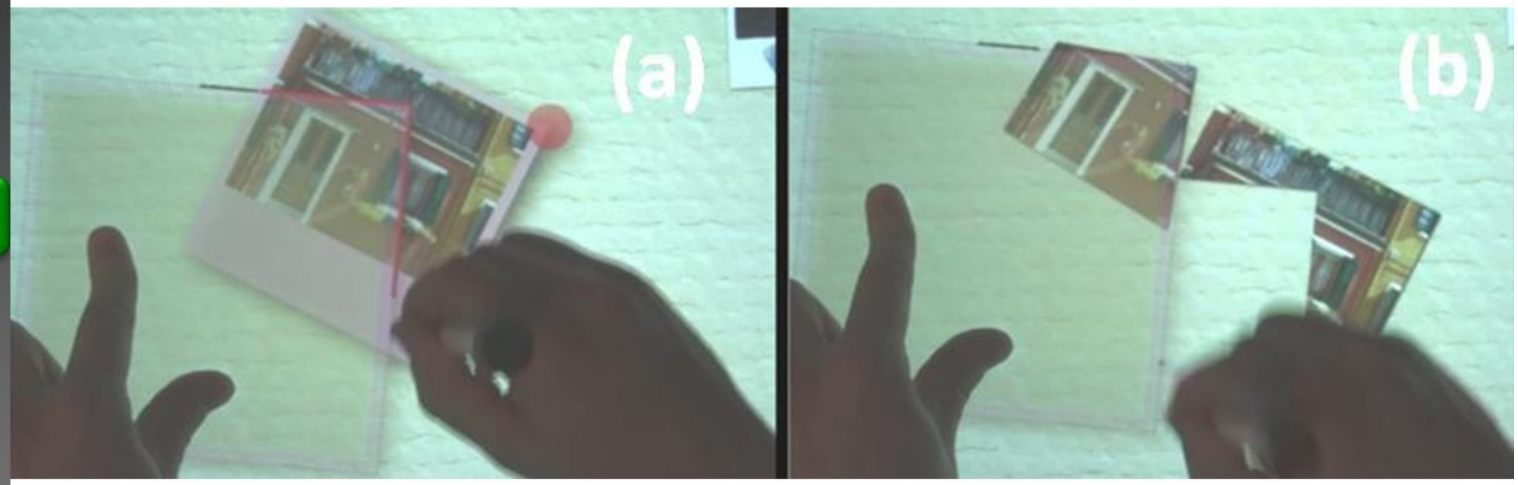
Shorthand Writing on Stylus Keyboard, Zhai, Kristensson

THEORY

INTERACTIONS

DEVELOPMENT

Pen+Touch



Hold things with fingers, cut with pen

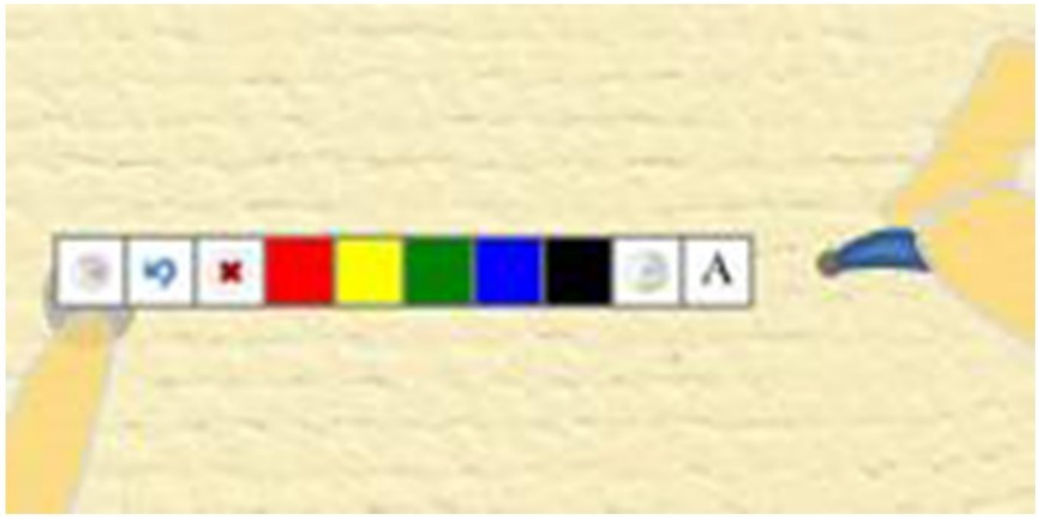
Pen + Touch = New Tools, Hinckley, et al.

THEORY

INTERACTIONS

DEVELOPMENT

Menus



Use pen to open menu at finger.

Shorthand Writing on Stylus Keyboard, Zhai, Kristensson

THEORY

INTERACTIONS

DEVELOPMENT

Menus

Put down palm and 5 fingers to open a menu.

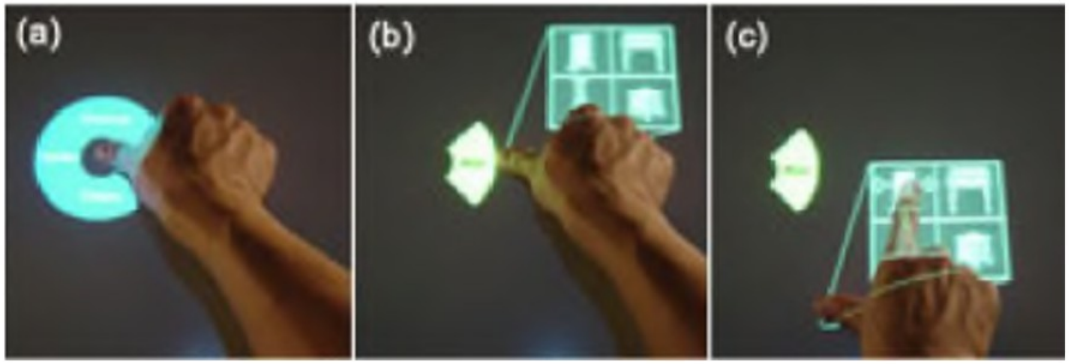
Hands-On Math: A page-based multi-touch and pen desktop for technical work and problem solving, Zeleznik, et al.

THEORY

INTERACTIONS

DEVELOPMENT

Menus



2x Tap brings up a touch-based pie menu.

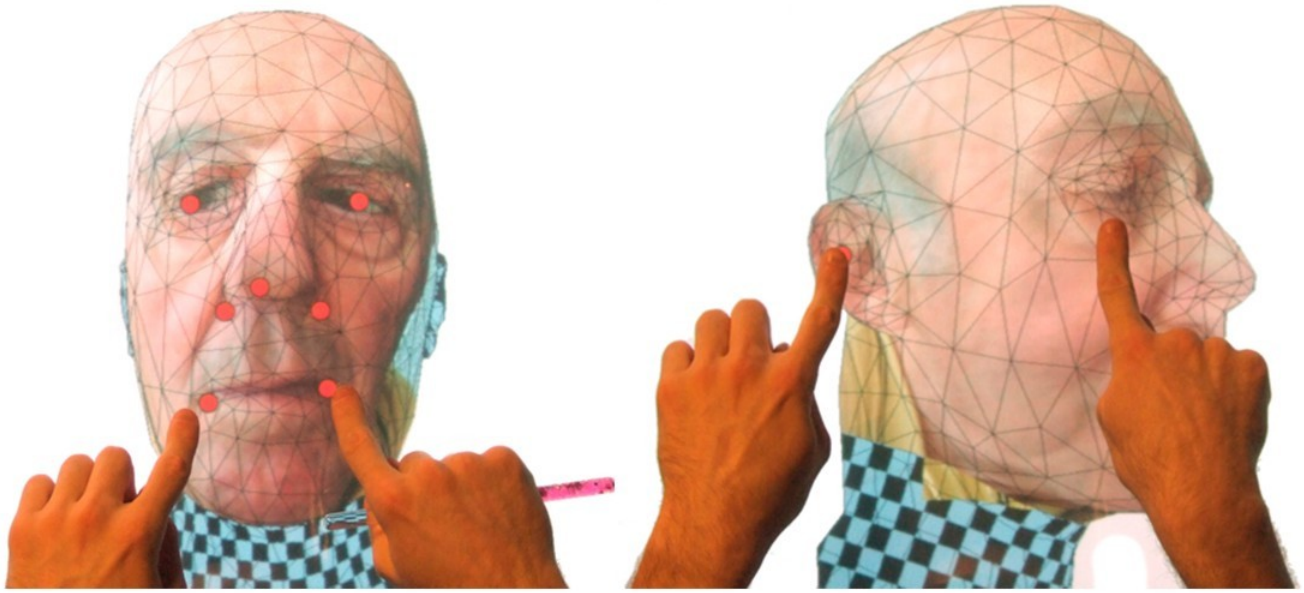
Multi-Finger and Whole Hand Gestural Interaction Techniques for Multi-User Tabletop Displays, Wu, Balakrishnan

THEORY

INTERACTIONS

DEVELOPMENT

Many Degrees of Freedom



Using fingers (and pen) to arrange texture map.

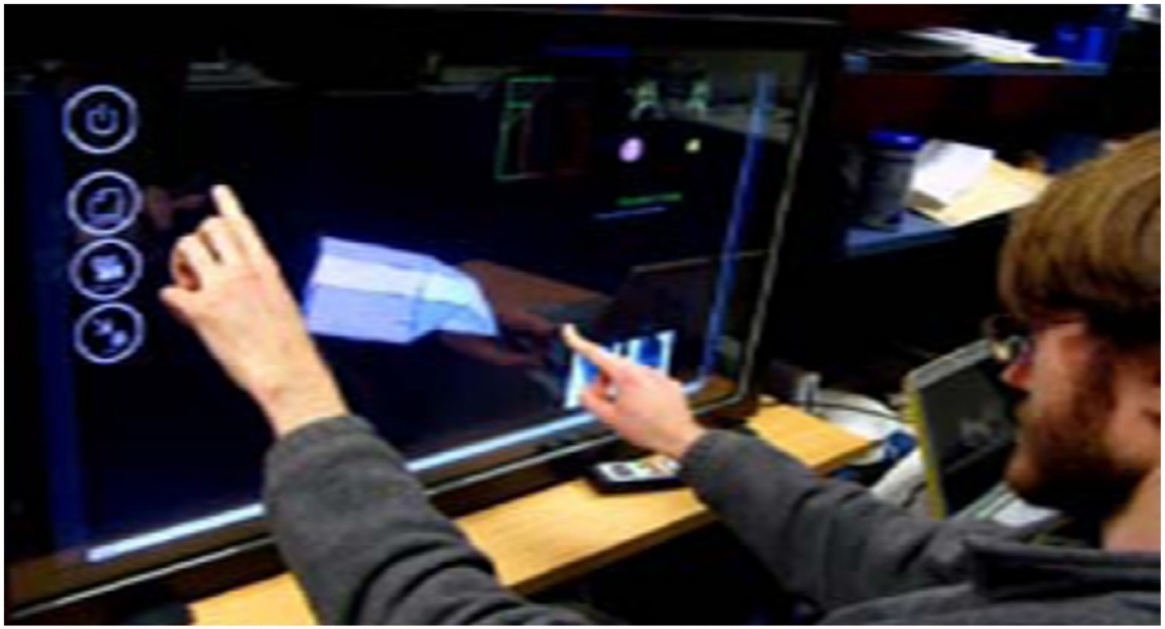
A Direct Texture Placement and Editing Interface, Yotam I. Gingold, Philip L. Davidson, Jefferson Y. Han, Denis Zorin

THEORY

INTERACTIONS

DEVELOPMENT

Many Degrees of Freedom



Use fingers to pinch/fold origami.

Origami Simulator: a Multi-Touch Experience, Hsiao-Heng Chang, et al.

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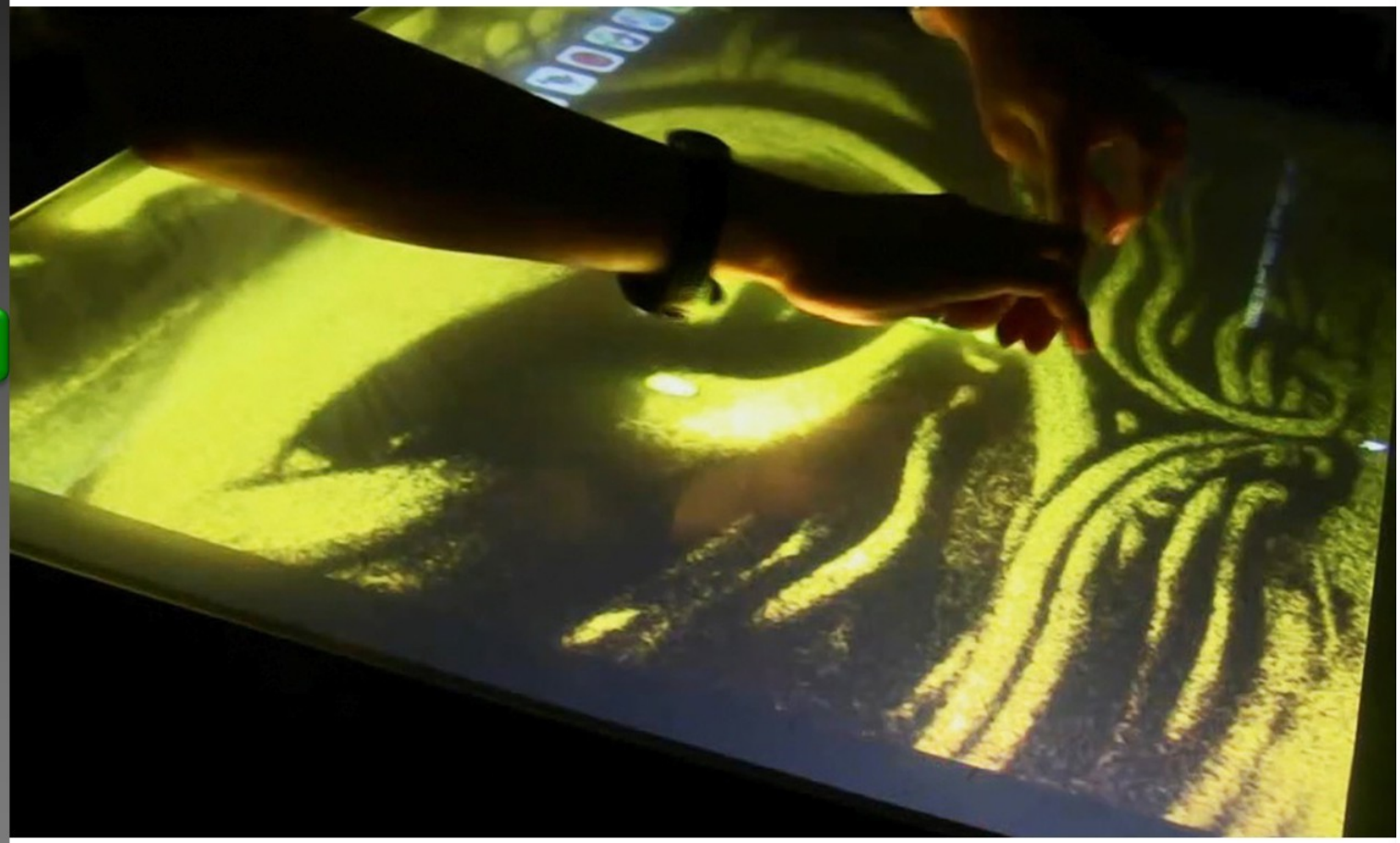
INTERACTIONS

DEVELOPMENT

Many Degrees of Freedom



Use fingers paint with virtual sand.

SandCanvas: A Multi-touch Art Medium Inspired by Sand Animation, Kazi, et al.

THEORY

INTERACTIONS

DEVELOPMENT

A Self-Serving Demo…

LiquidText: A Flexible, Multitouch Environment to Support Active Reading, Tashman, Edwards

THEORY

INTERACTIONS

DEVELOPMENT

Some Reflections on Developing Multitouch Software

THEORY

INTERACTIONS

DEVELOPMENT

On the App level, you get points and ID's.

THEORY

INTERACTIONS

DEVELOPMENT

On the App level, you get points and ID's.

Writing multitouch software is weird.

THEORY

INTERACTIONS

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On the App level, you get points and ID's.

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Don't just accommodate parallel controls, leverage it.

THEORY

INTERACTIONS

DEVELOPMENT

On the App level, you get points and ID's.

Writing multitouch software is weird.

Don't just accommodate parallel widgets, leverage it.

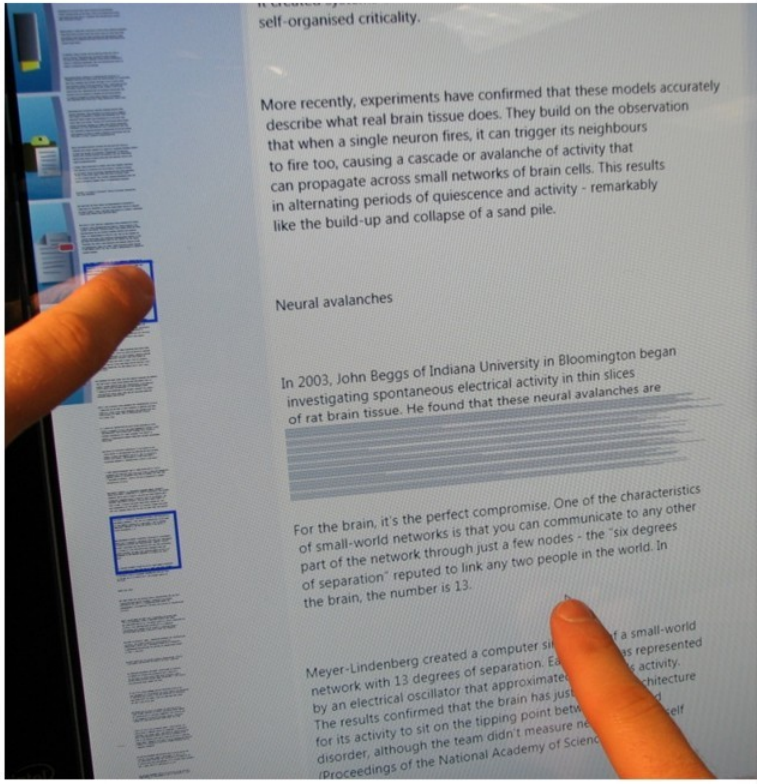
Things get complicated when semantics span widgets…

THEORY

INTERACTIONS

DEVELOPMENT

Gestures on one object changed meaning depending on gestures occurring on another object.



One of LiquidText's Collapse Interactions

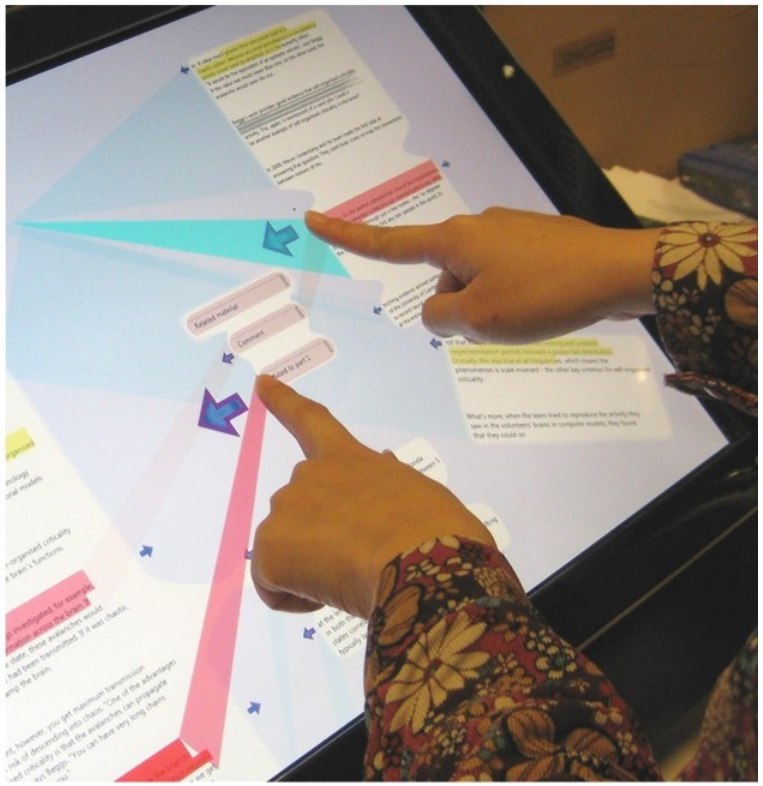
THEORY

INTERACTIONS

DEVELOPMENT

Gestures on one object changed meaning depending on gestures occurring on another object.

There can be many fingers on the display unrelated to a given gesture.



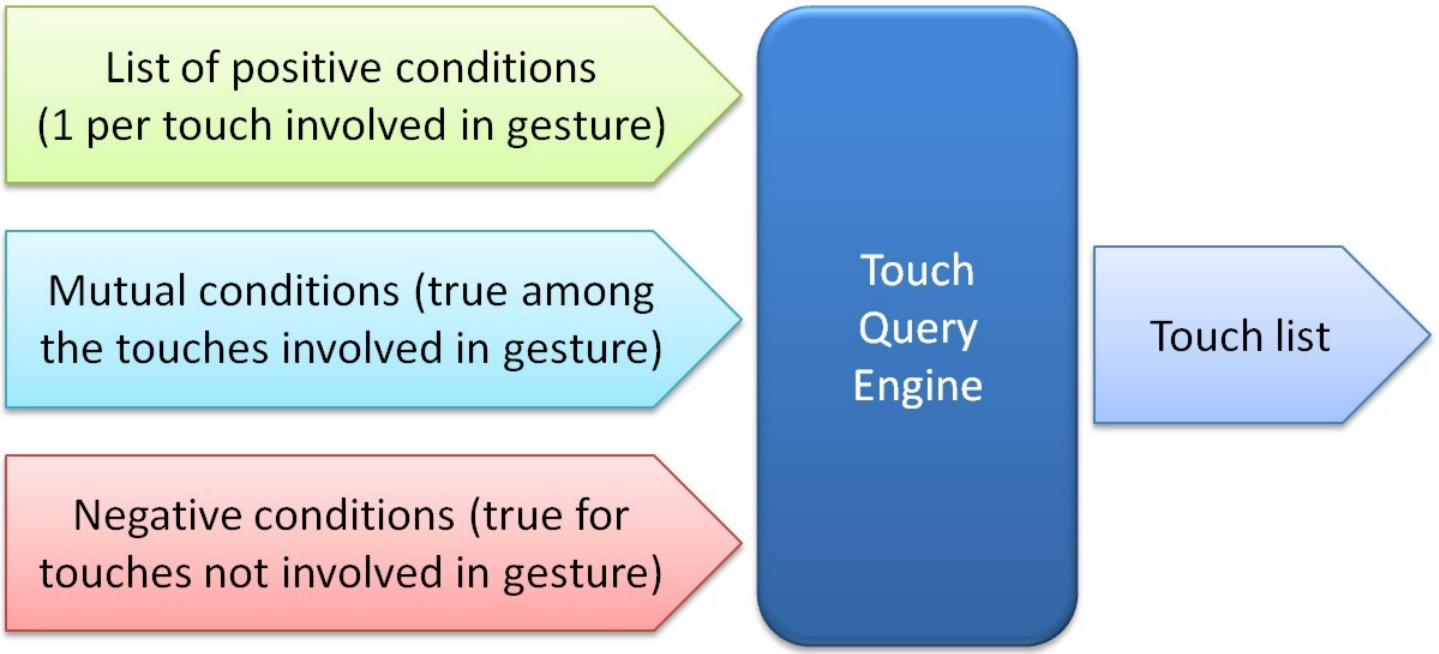
Performing multiple, unrelated gestures.

THEORY

INTERACTIONS

DEVELOPMENT

LiquidText's Touch Processing Approach
Lets each object identify touch configurations of interest.



THEORY

INTERACTIONS

DEVELOPMENT

There's more—like event propagation…!

But this is enough for now ☺

Thanks!
Any Questions?