Tangible, Physicality and Coursework

2

Human Computer Interaction

COMS21301

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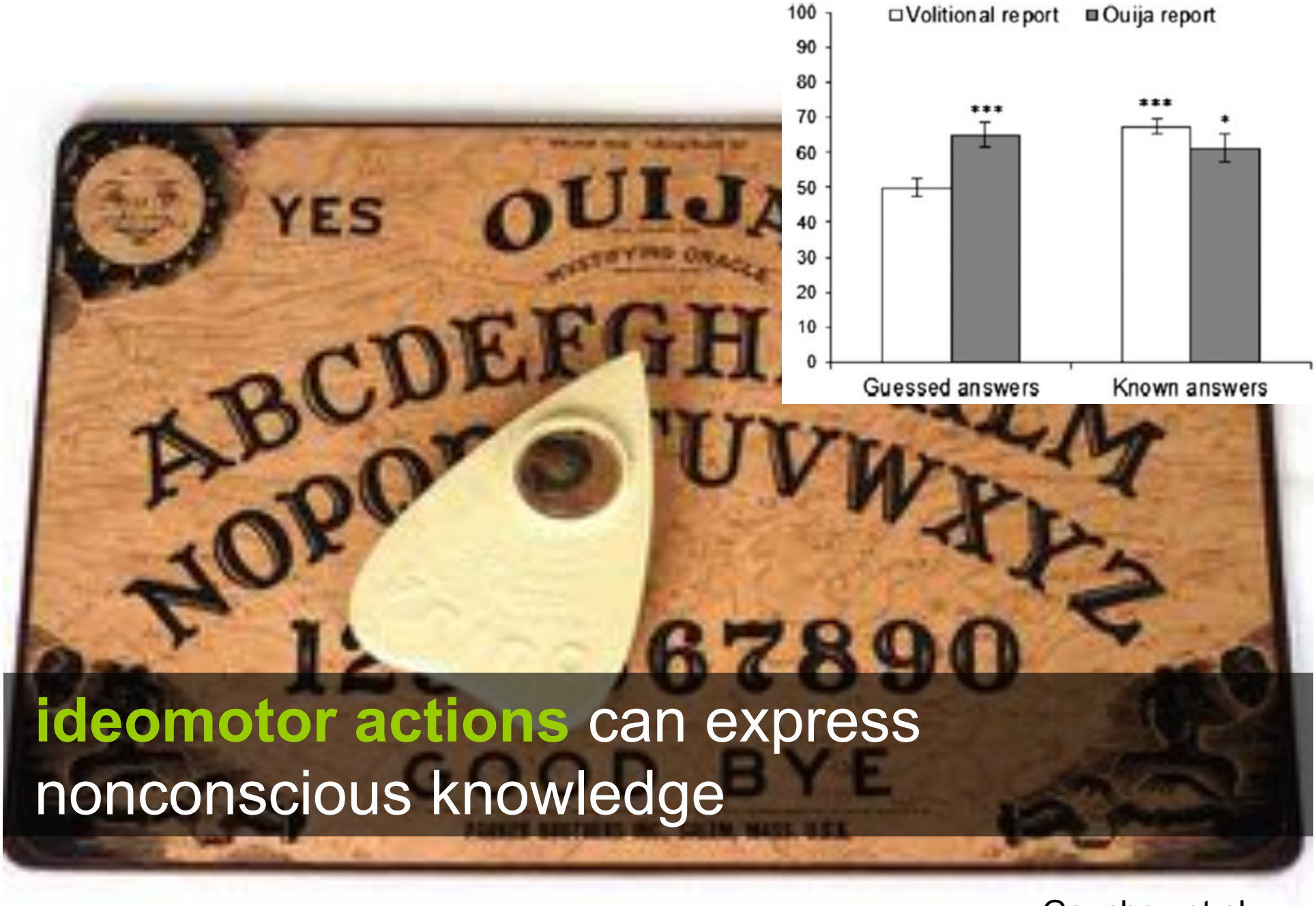
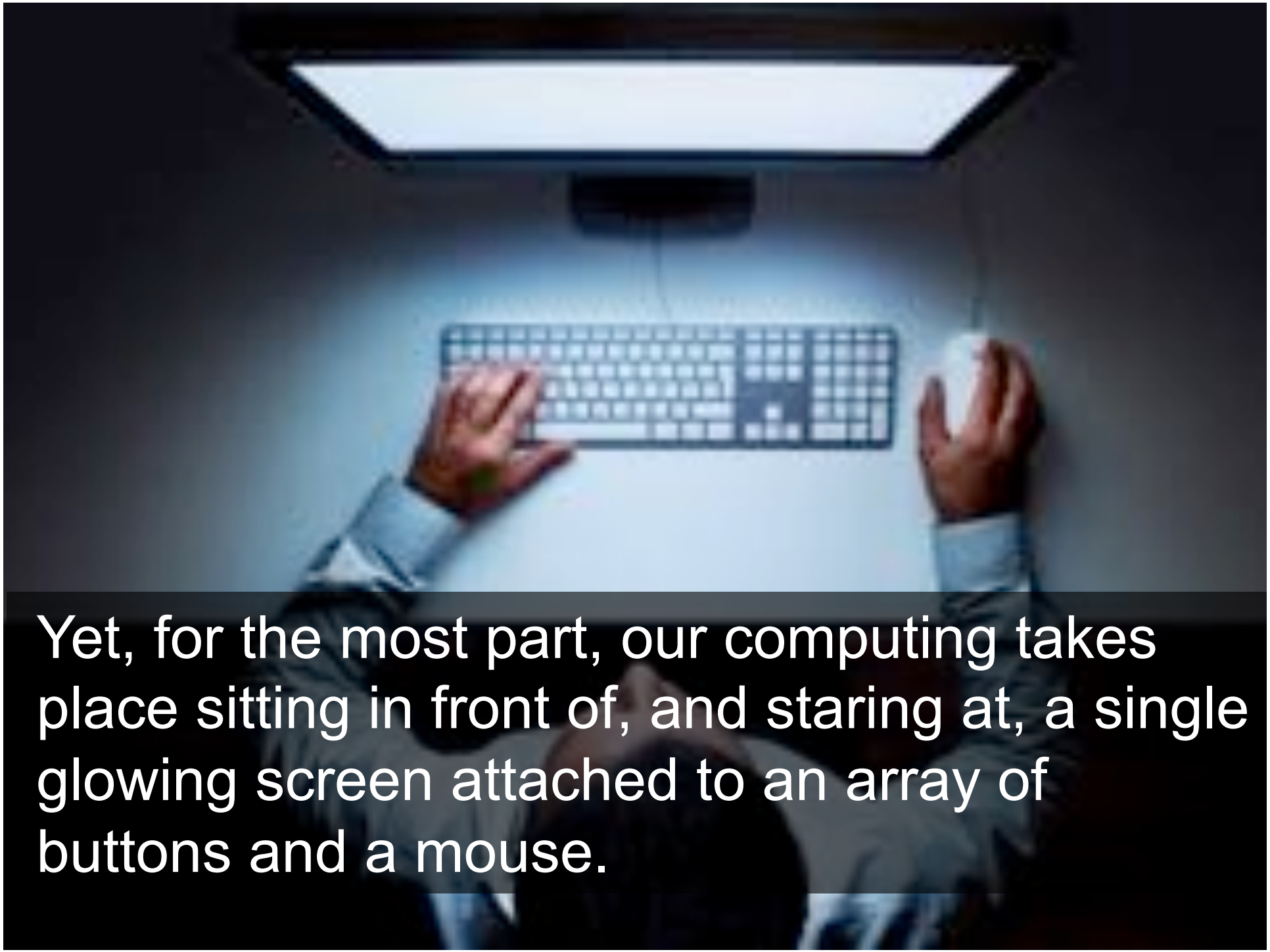


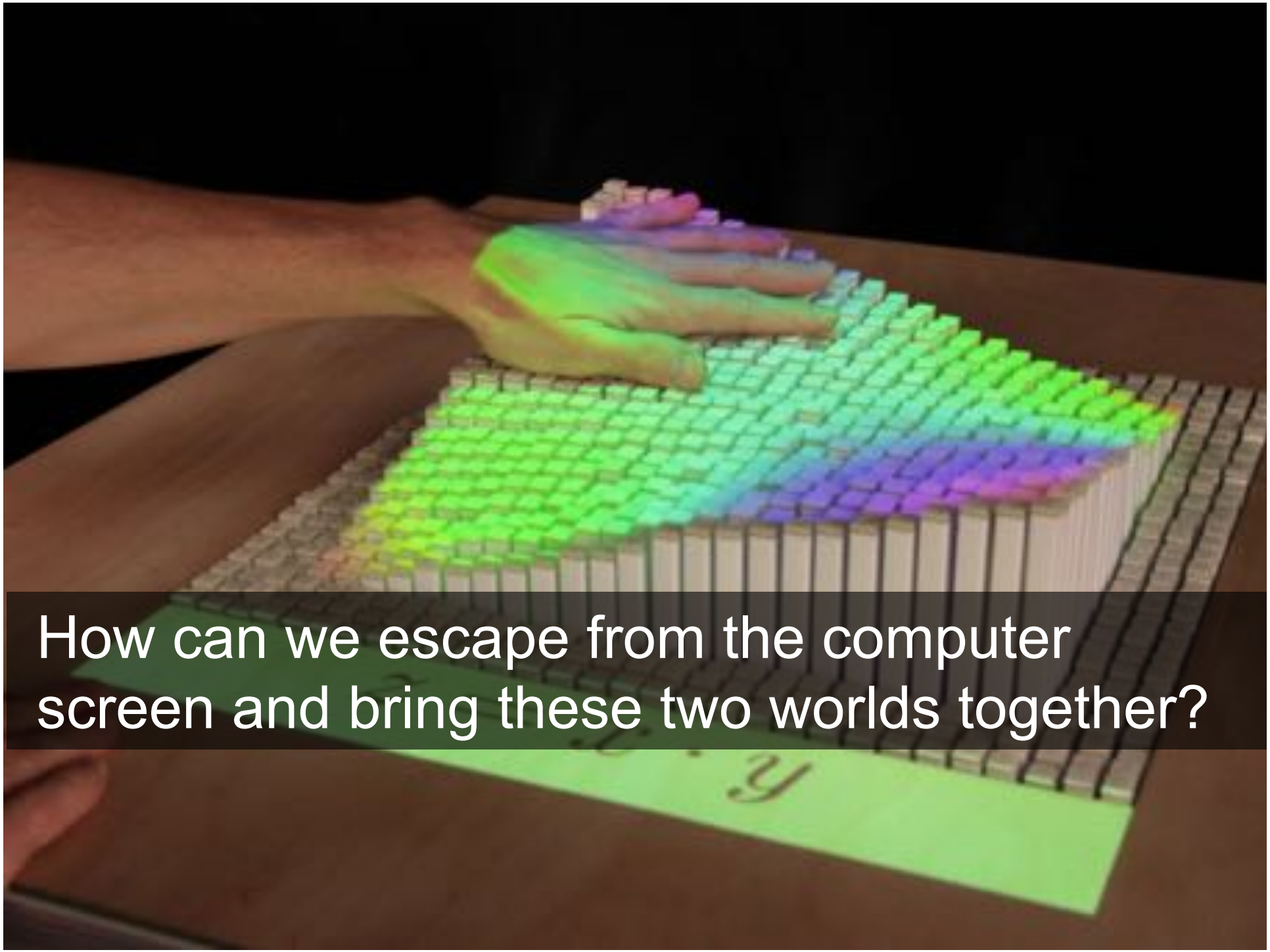
ideomotor actions can express nonconscious knowledge

Gauchou et al

We live in a complex world, filled with myriad objects, tools, toys, and people.


Yet, for the most part, our computing takes place sitting in front of, and staring at, a single glowing screen attached to an array of buttons and a mouse.


From the isolation of our workstations we try to interact with our surrounding environment, but the two worlds have little in common.


How can we escape from the computer screen and bring these two worlds together?


Hiroshi Ishii (MIT) precursor of physicality in HCI (Tangible Bits)

PAPERS

CHI 97 • 22-27 March 1997

Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms

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ABSTRACT

This paper presents our vision of Human Computer Interaction (HCI): "Tangible Bits." Tangible Bits allows users to "grasp & manipulate" bits in the center of users' attention by coupling the bits with everyday physical objects and architectural surfaces. Tangible Bits also enables users to be aware of background bits at the periphery of human perception using ambient display media such as light, sound, airflow, and water movement in an augmented space. Tangible Bits is to bridge the gaps between both worlds by coupling the physical environment, as well as the graspable objects within it, with the digital information that pervades cyberspace.

This paper describes three key concepts of Tangible Bits: interactive surfaces; the coupling of bits with graspable physical objects; and ambient media for background awareness. We illustrate these concepts with three prototype systems – the metaDESK, transBOARD and ambientROOM – to identify underlying research issues.

BITS & ATOMS

We live between two realms: our physical environment and cyberspace. Despite our dual citizenship, the absence of seamless couplings between these parallel existences leaves a great divide between the worlds of bits and atoms. At the present, we are torn between these parallel but disjoint spaces.

Figure 1 Sketches made at Collection of Historical Scientific Instruments at Harvard University

connecting bits with atoms

At the Border

Where the land meets the sea,
there is a border.

Living at the Border

Harsh, but also fertile environment.

At the Border

between Physical and Digital

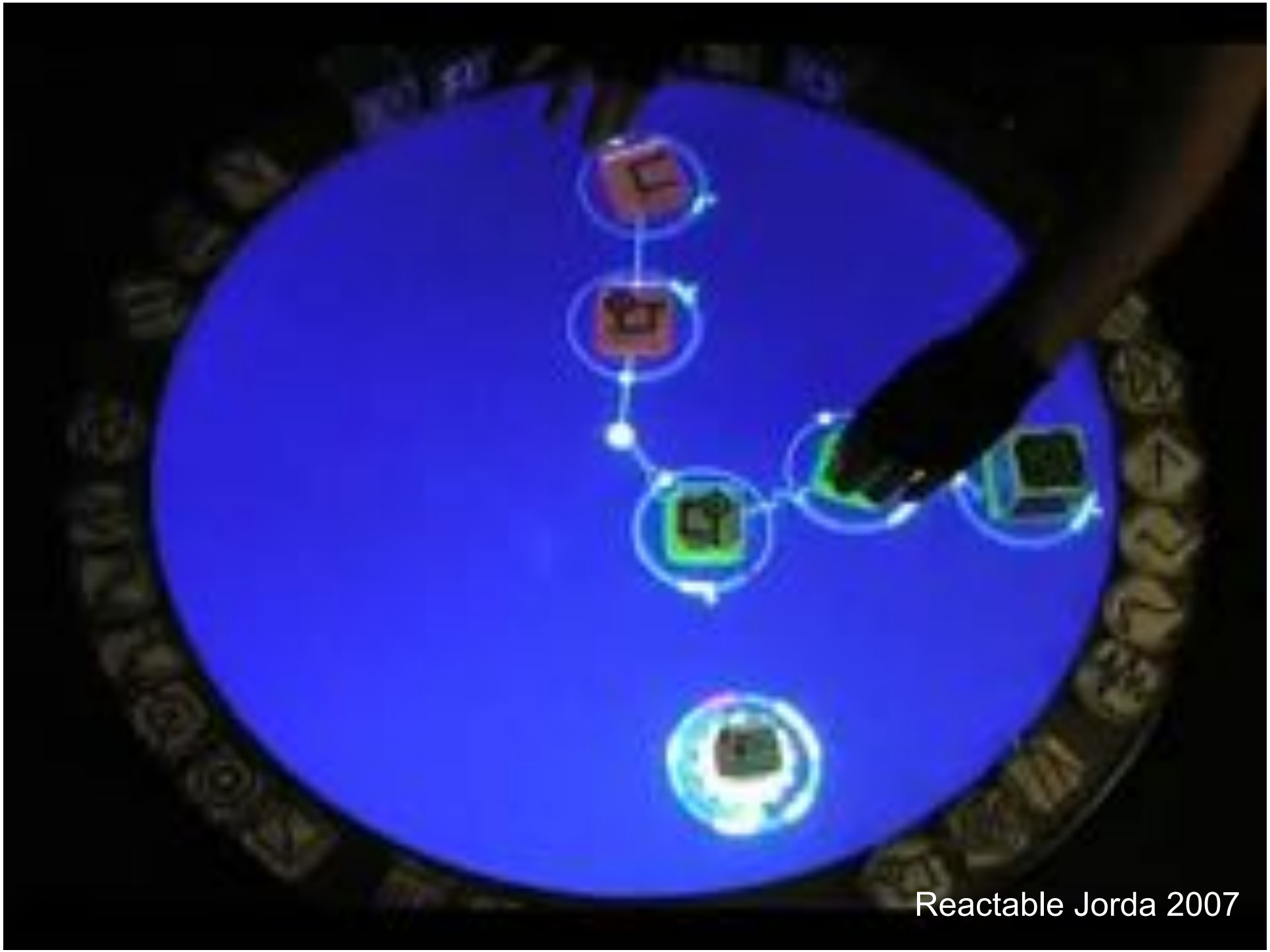
We live on the border where bits meet atoms. In the flood of pixels from the ubiquitous GUI screens, we are losing our sense of body and places. Pixels impoverish human senses.

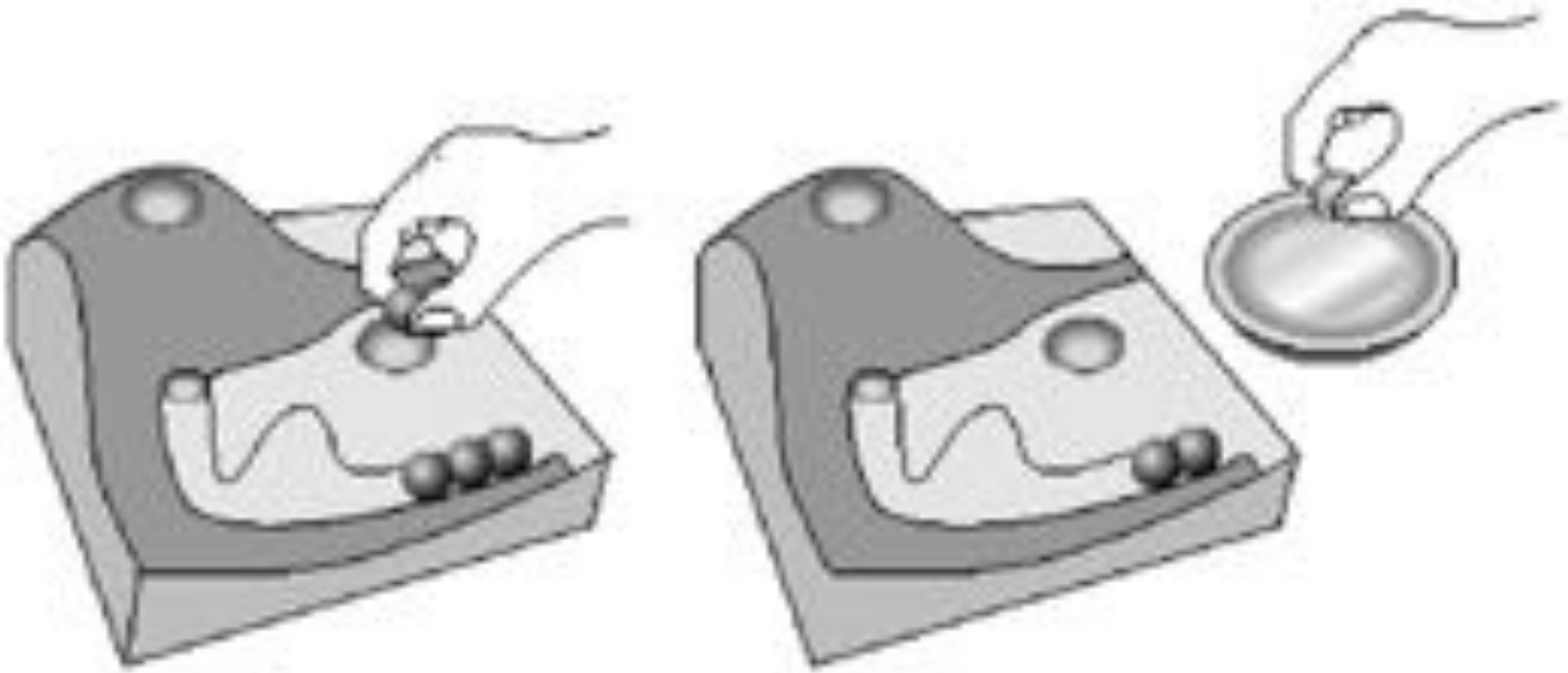
tangible

tangible UI::

couple physical with digital representations

users interact with **digital information**
through the **physical environment**

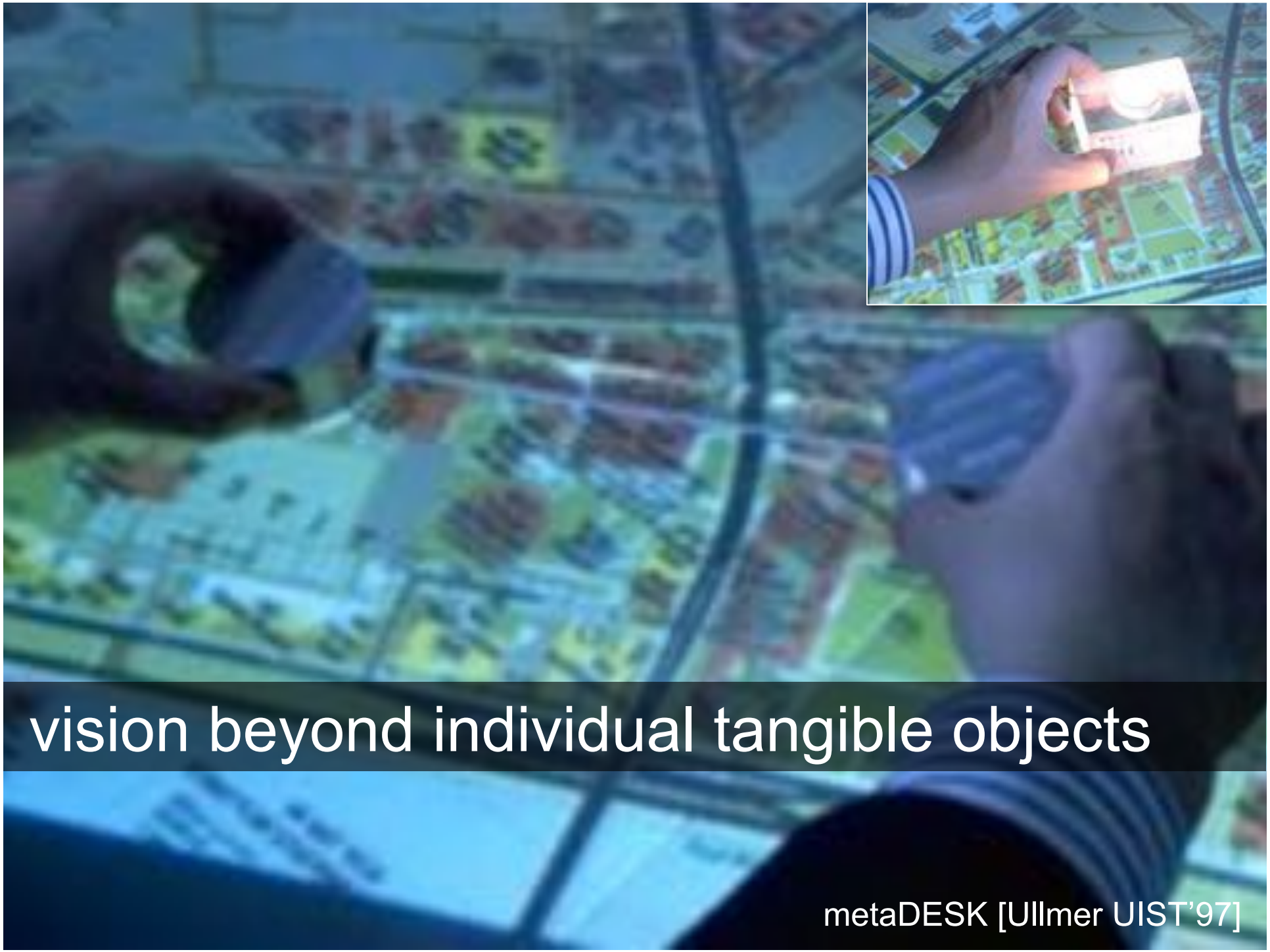

Reactable Jorda 2007

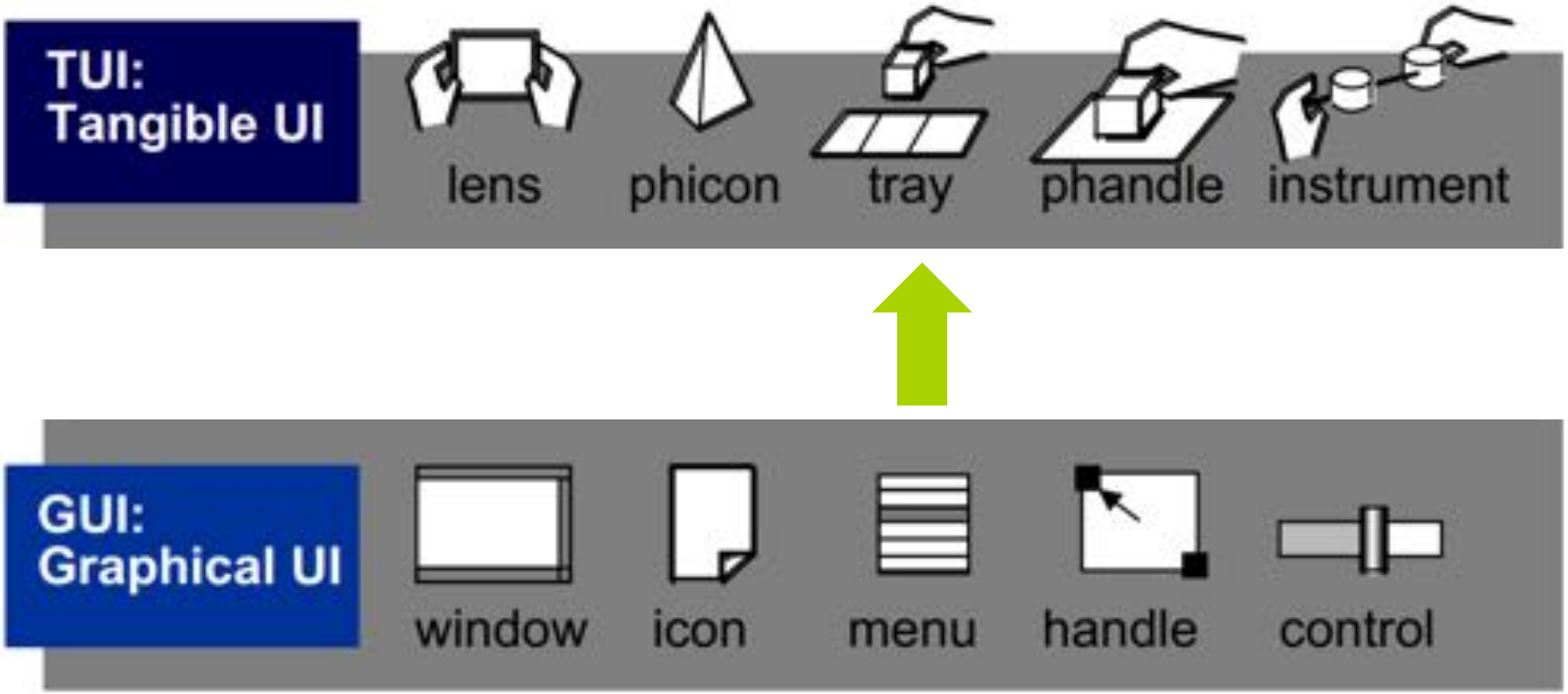


marble answering machine

[Bishop ‘92]


SIMON & IMOGEN'S HOUSE
© Darrell Bishop 1992

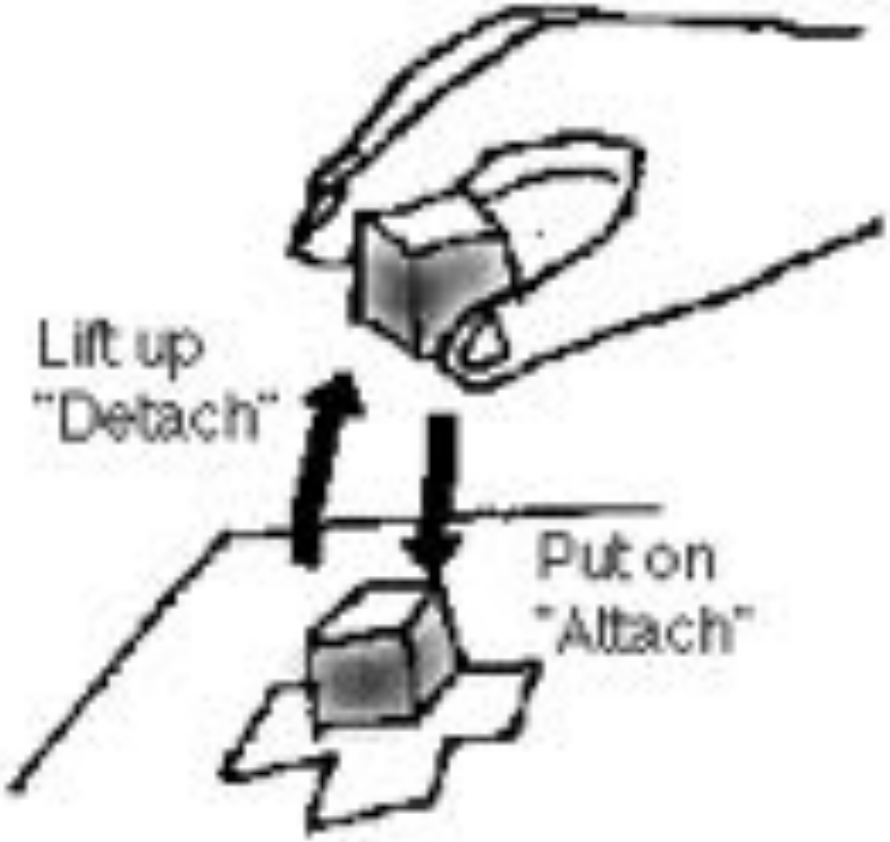

vision beyond individual tangible objects
metaDESK [Ullmer UIST'97]



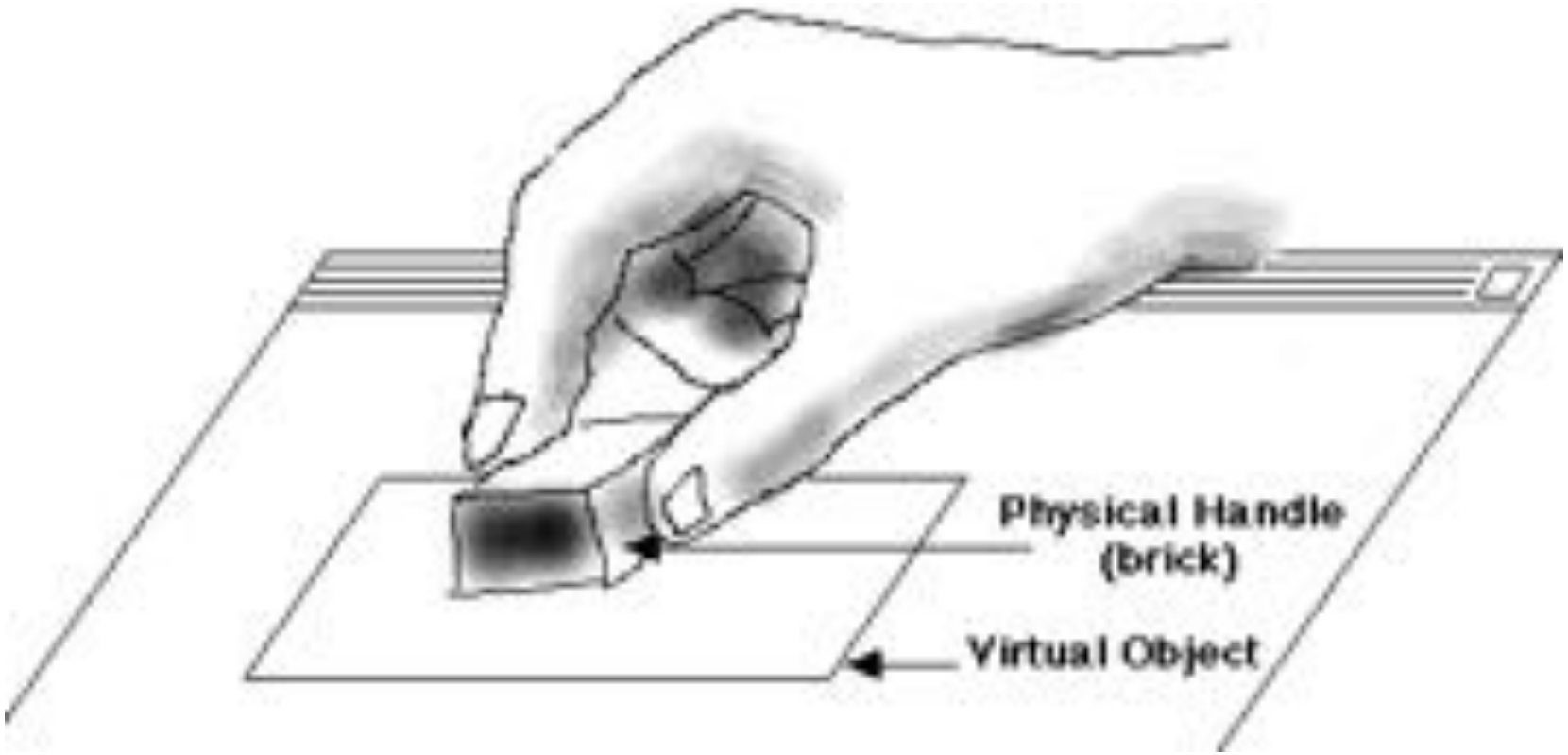
metaDESK [Ullmer UIST'97]

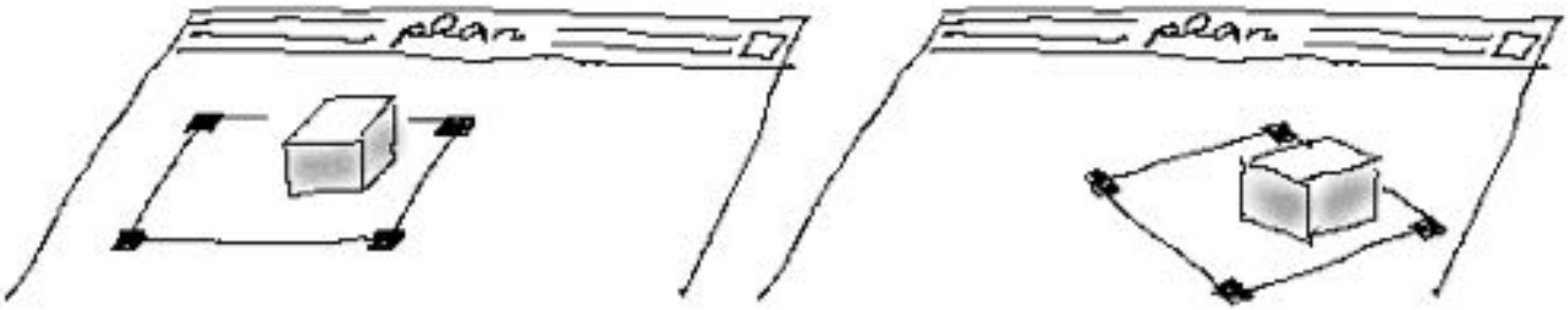

bricks: graspable UIs
[Fitzmaurice CHI‘95]


A) Stretchable square

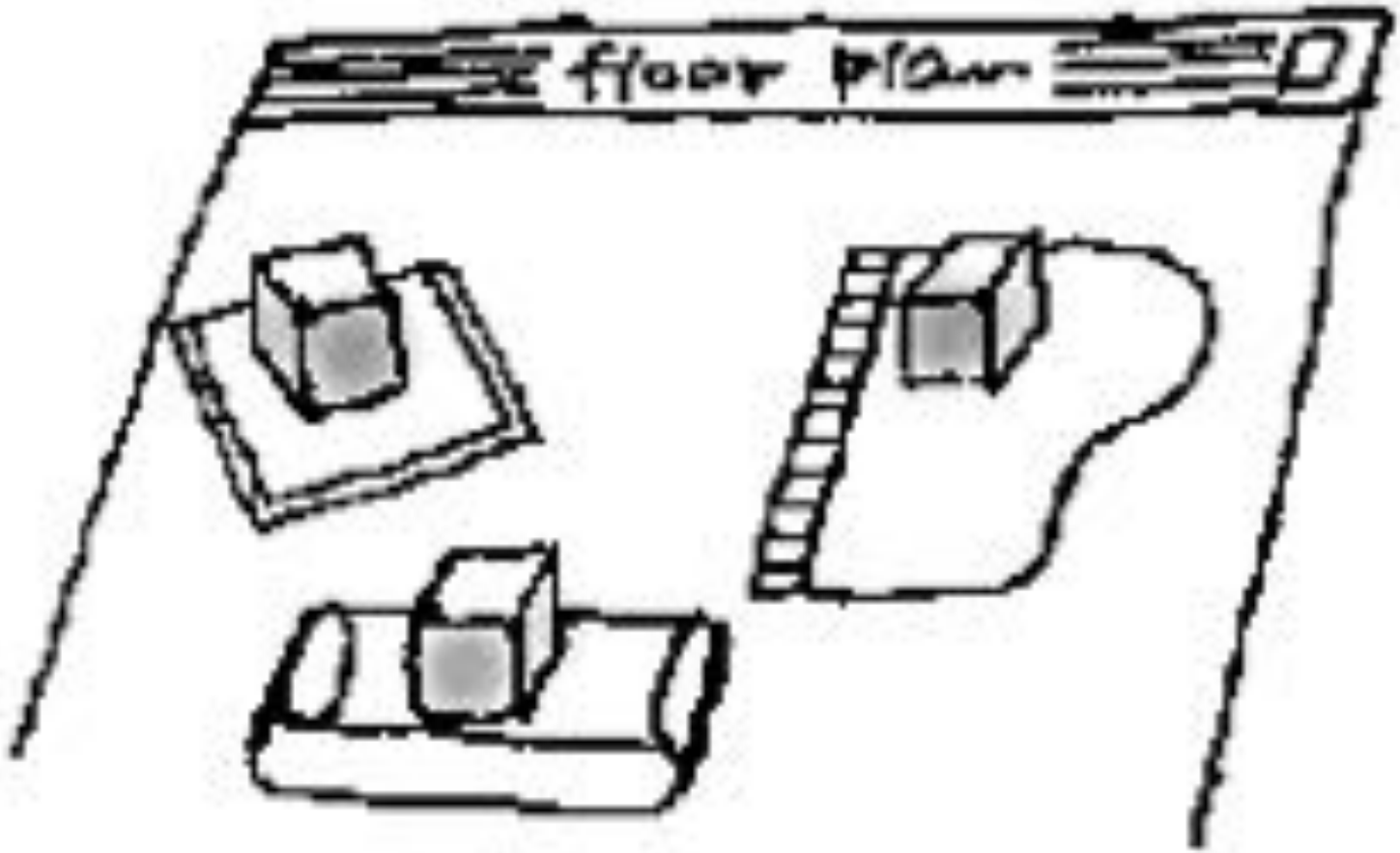


physical handles are coupled to digital objects

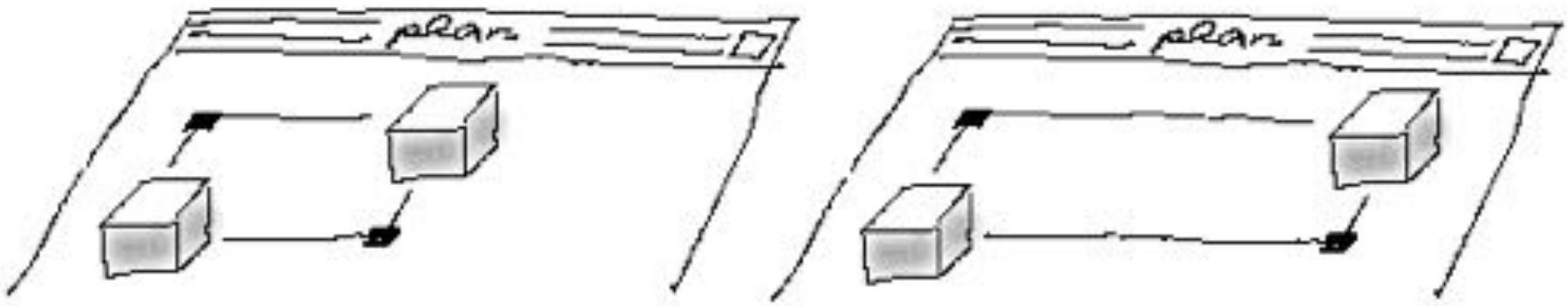

Physical Handle
(brick)
Virtual Object



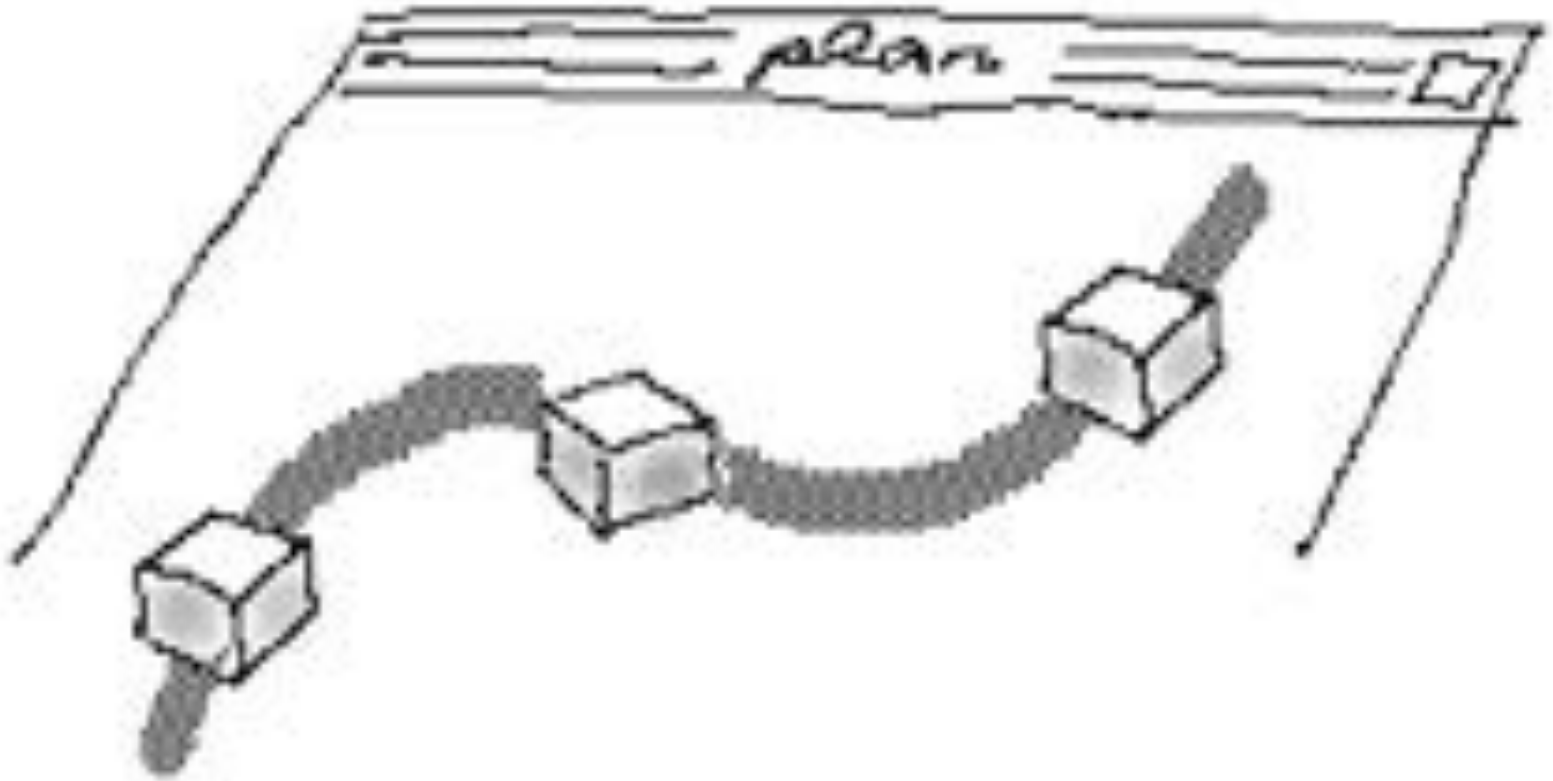
users can translate and rotate



multiple controls in parallel



bimanual control for resizing



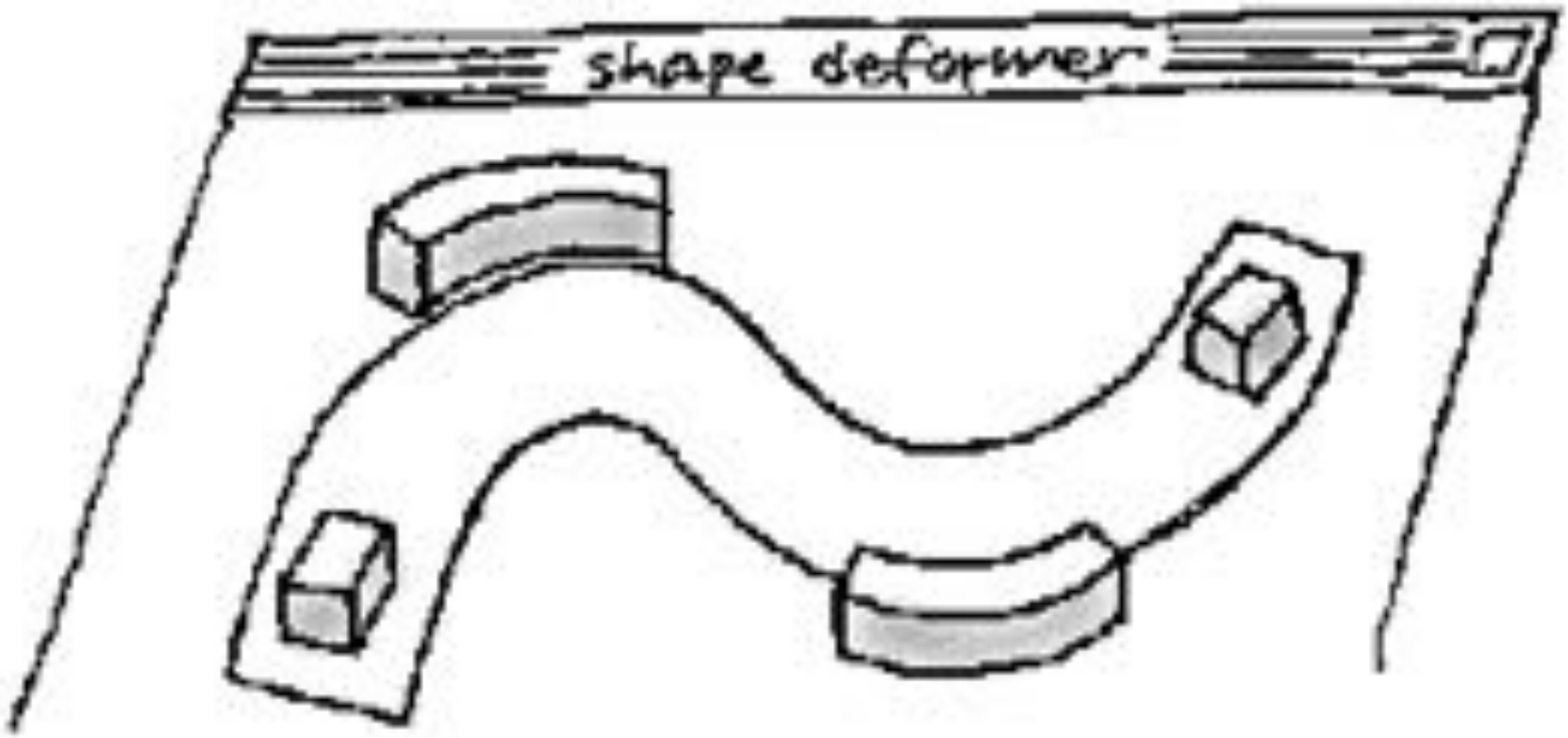
multiple control points

many of these are today done **simply using multitouch** (i.e., without the bricks)

what are the advantages of tangibles

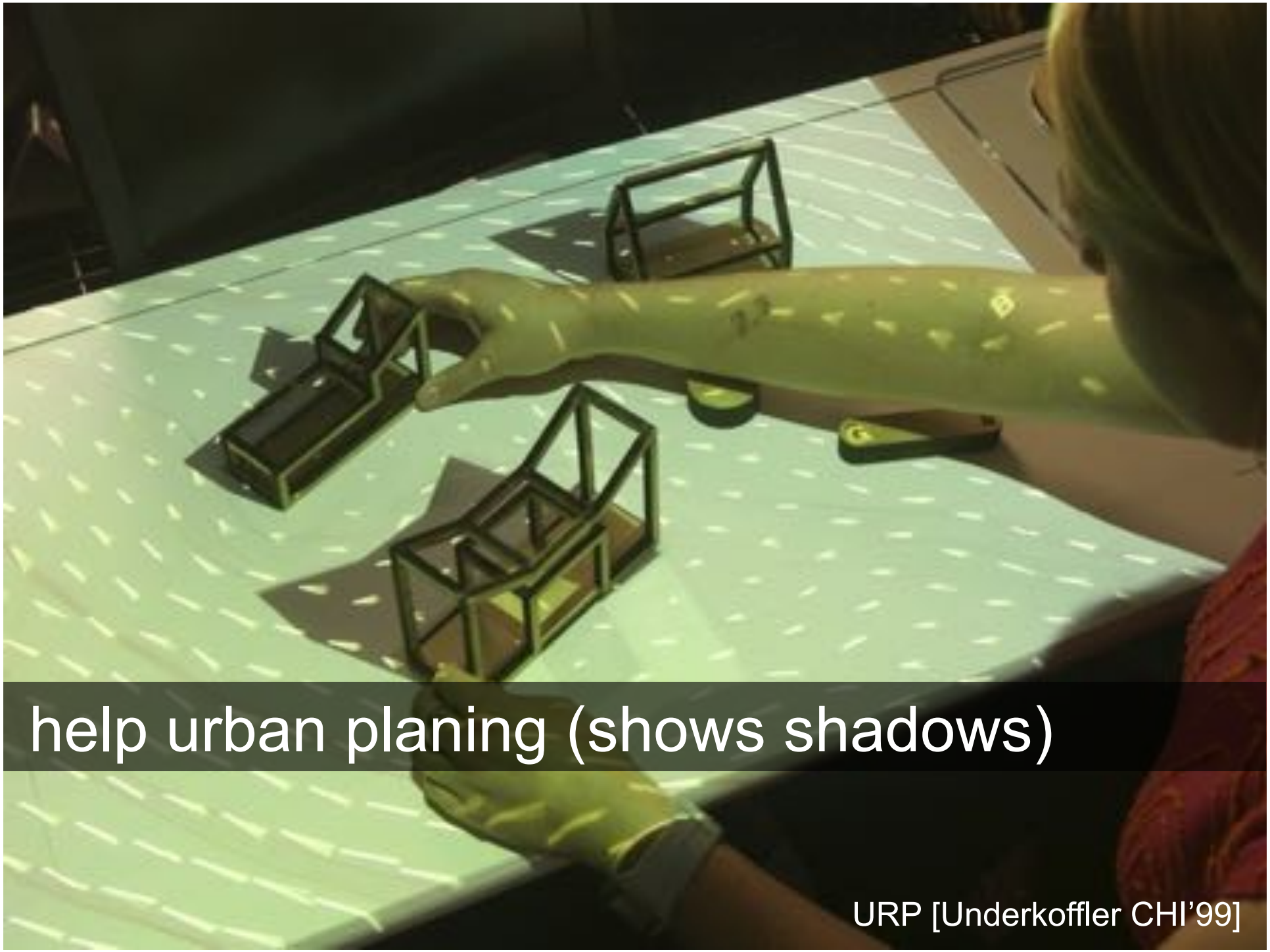
<5mn brainstorming with neighbor>

advantages

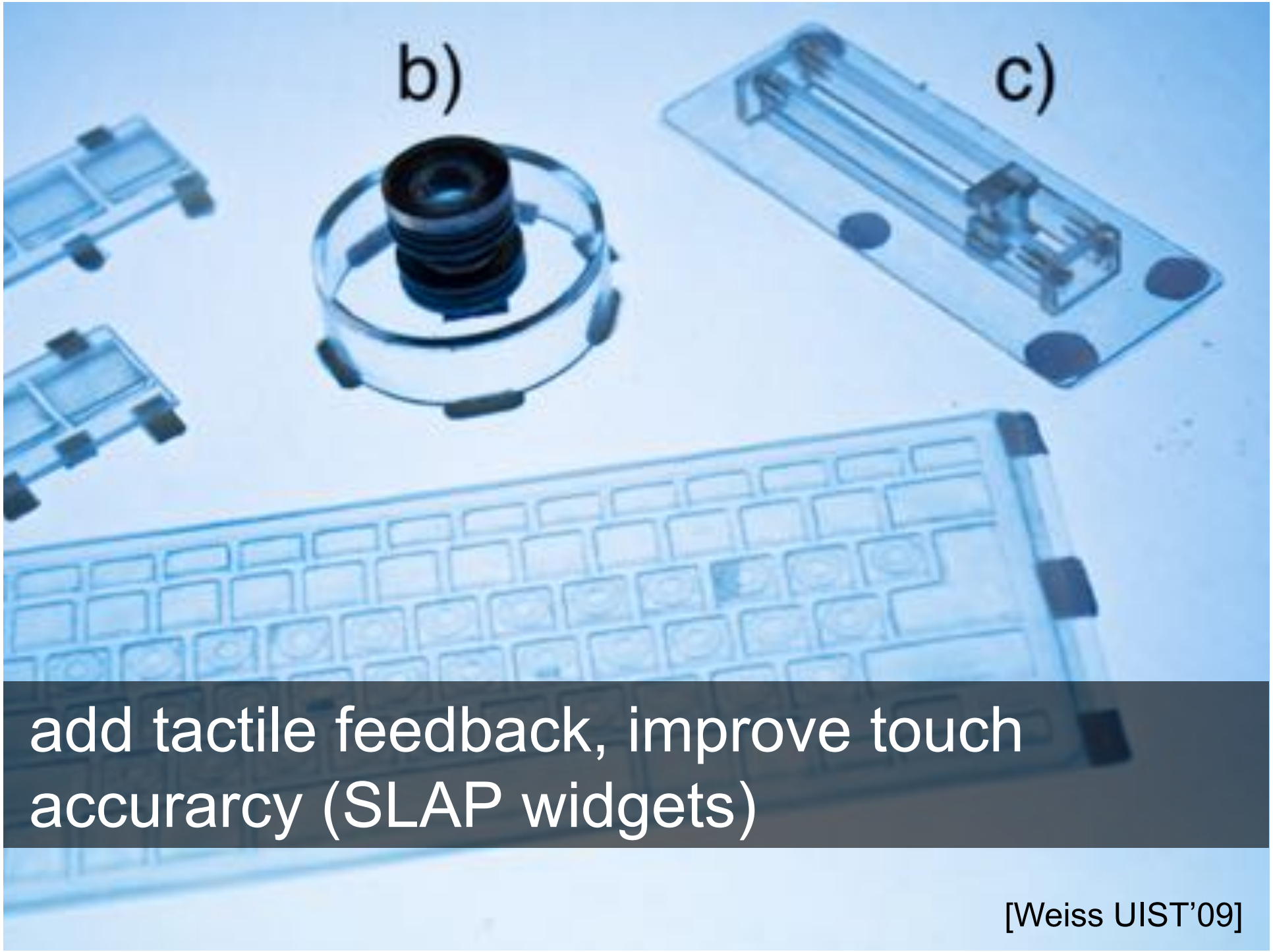


tangibles enable (physical) constraints
tangibles are easier to acquire


tangible/grasp: we learn faster (e.g. programming) with tangible interfaces
Manches TEI 2009
AlgoBlocks [Suzuki CSCL '95]

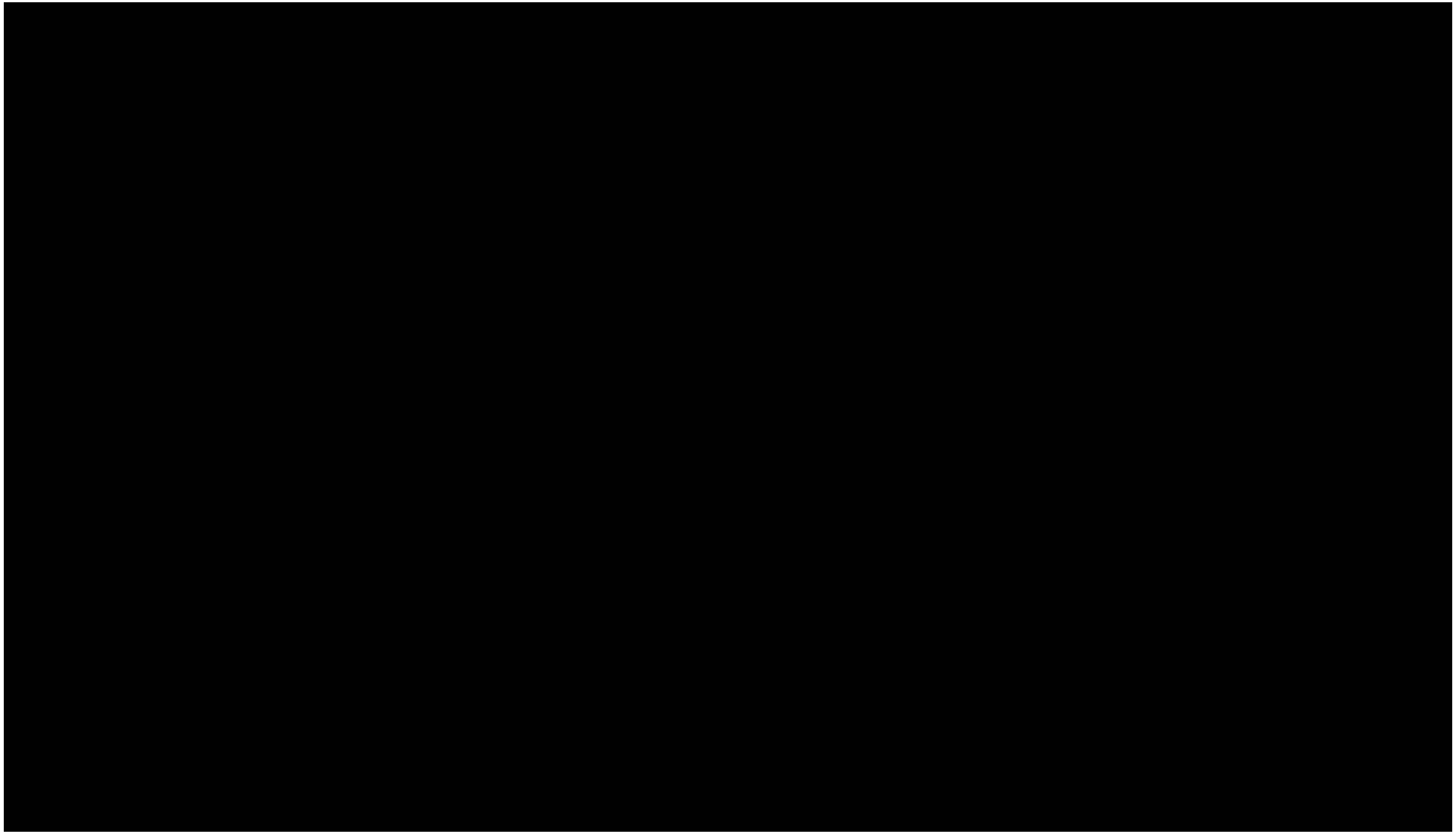

help urban planing (shows shadows)
URP [Underkoffler CHI'99]


support collaboration for more
abstract information tasks
senseboard [Jacob CHI'02]



add tactile feedback, improve touch accurarcy (SLAP widgets)

[Weiss UIST'09]



allow constructions/stackable

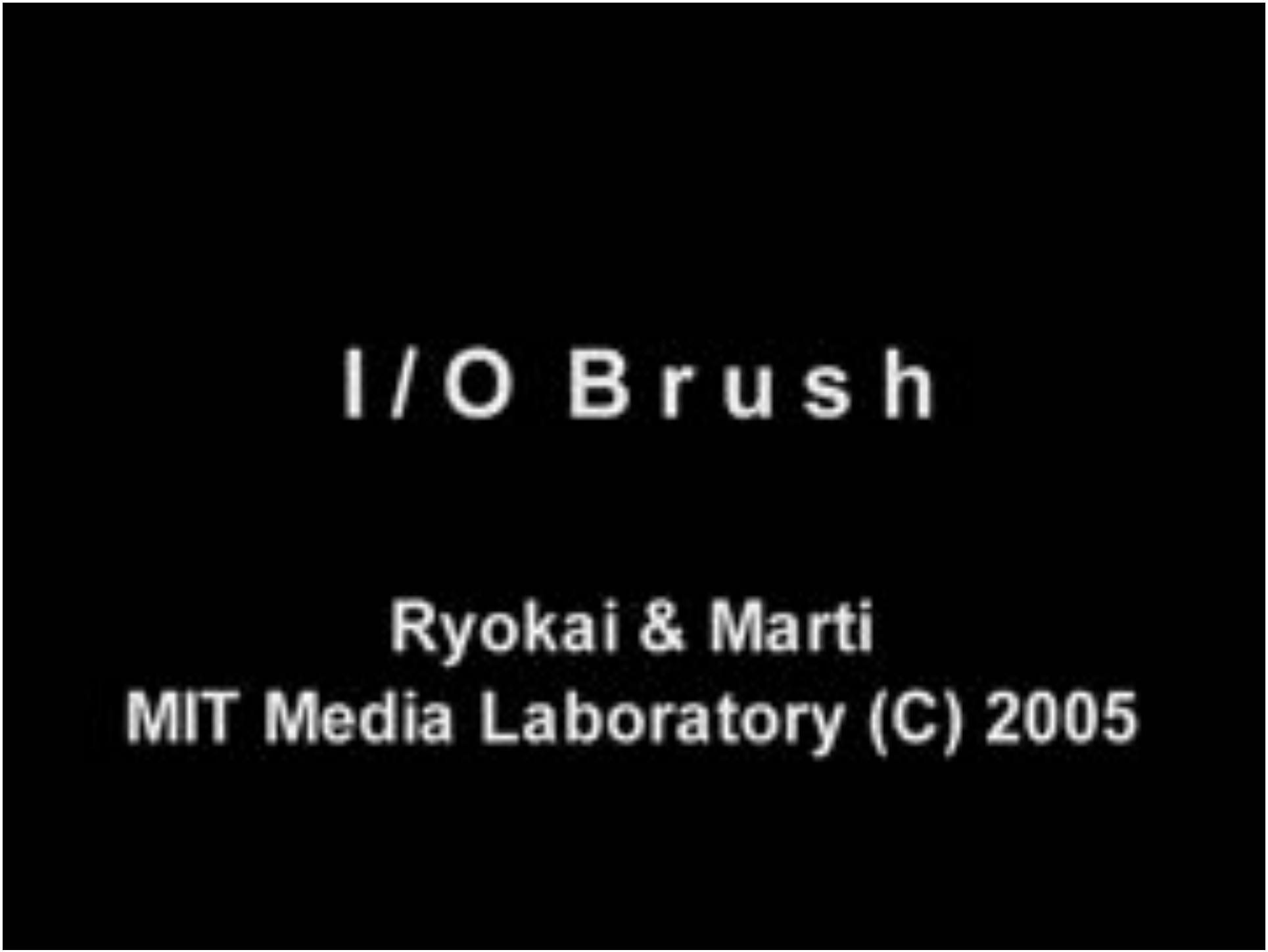
[Lumino Baudisch CH10]

allow constructions/stackable

[Lumino Baudisch CH10]


direct embodiments of digital information
Siftables [Merrill TEI'07]


i/o brush: blending graphics with physical environment
[Ryokai,CHI'04]

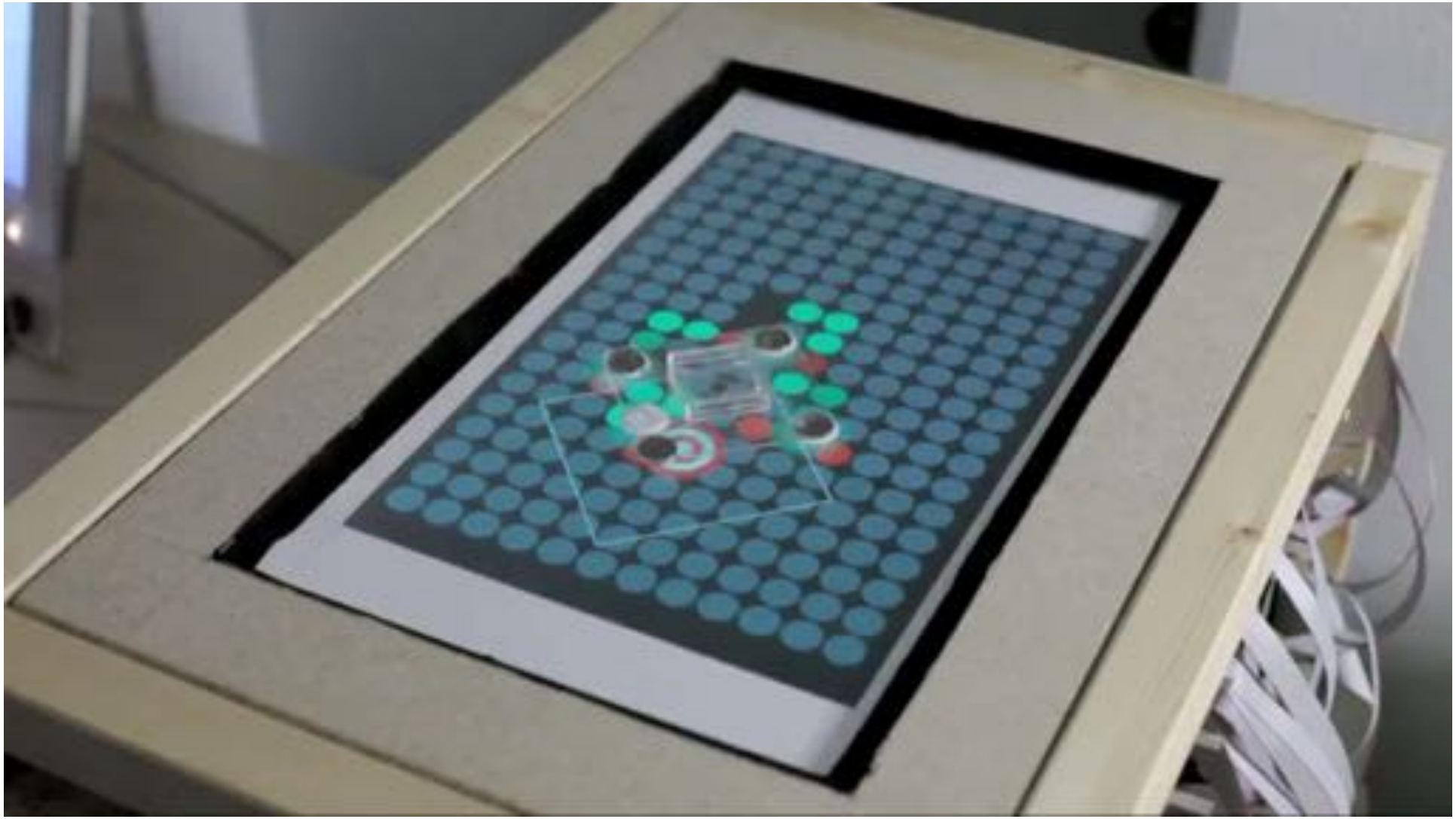

I/O Brush
Ryokai & Marti
MIT Media Laboratory (C) 2005

ok but what is the digital content change?


actuated workbench helps to resolve inconsistencies
[Pangaro UIST'02]

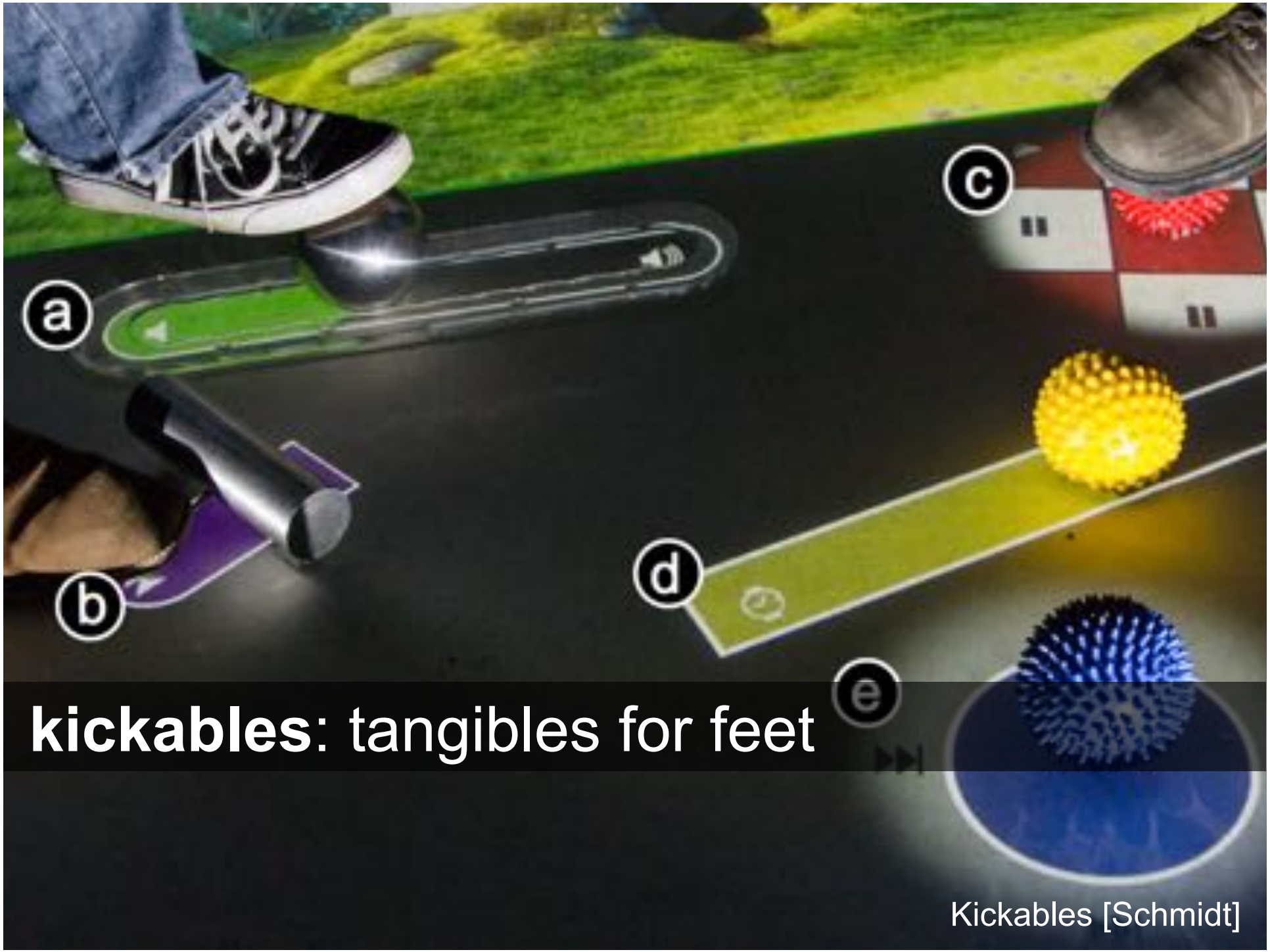

6
14
8
tangible bots: motorized tangibles
[Pederson CHI'11]


different states within control + touch input
madgets [Weiss UIST'10]



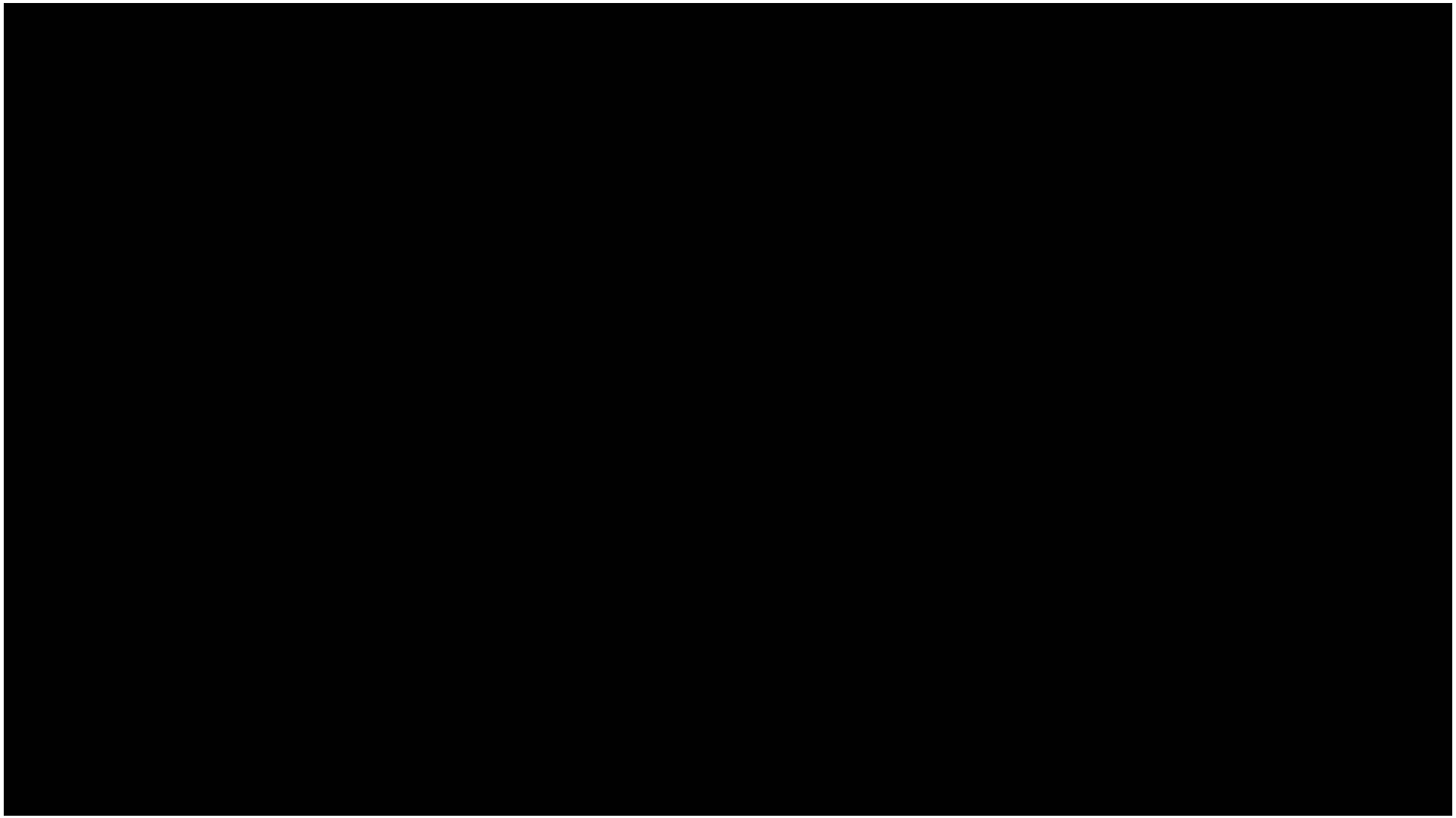
madgets [Weiss UIST’10]

why hands only?



kickables: tangibles for feet

Kickables [Schmidt]



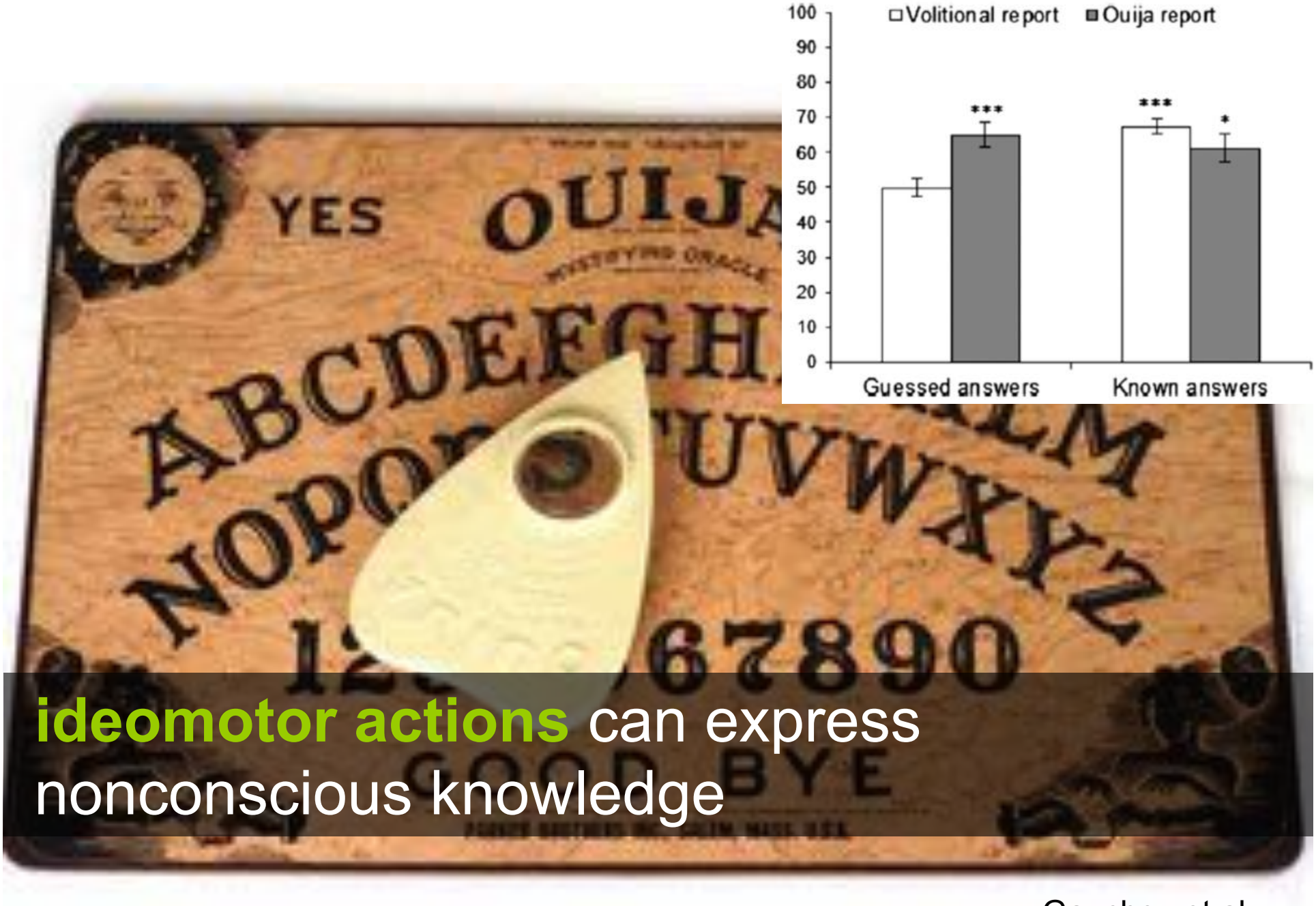
benefits:

1. better affordance
2. benefit from familiarity of physical interactions
3. passive tactile feedback for eyes-free use
4. multi-user
5. not-limited to the hand
6. can be actuated (e.g. force feedback)
7. Improve learning
8. Improve accuracy

Etc.

beyond tangible …


tangible/grasp: we learn faster (e.g. programming) with tangible interfaces
Manches TEI 2009
AlgoBlocks [Suzuki CSCL '95]



ideomotor actions can express nonconscious knowledge

Gauchou et al

vestibular/proprioception: we navigate better with a real map / real exploration than using virtual environments

Richardson 1999


Proprioception/social: we expend more energy when playing with others than alone
Donovan 2012


exertion: encourage physical activities
http://exertioninterfaces.com/

physicality::

Physicality has become an important feature of computing design

areas of mixed reality, tangible bits, and exergaming are exploring how to incorporate, and better simulate, physicality

coursework

12th October

form teams, discuss study topics

19th/21th October

presentations of ideas (5 slides) & feedback

16th/18th November

building complete (software, procedure), run studies

30 November/1st December

presentations of results (graph) & feedback

You will design and run a controlled experiment with **human participants** which tests the **role of physicality in an interactive setting**

Your control group will experience a virtual setting (assuming you hypothesise that physicality is more valuable, not less)

You can exactly **replicate an existing study** to verify its results, **or you can design an innovative study** based on an existing one

Example values of physicality which are hard to simulate:

Ideomotor response

Vestibular effects

Concurrent manipulation
(although multi- touch may reduce the value of this)

Proprioceptive effects, e.g. on craft skills, sports (not just ‘fitness’)

Read the example papers

- Gauchou et al, Expression of nonconscious knowledge via ideomotor actions, in Consciousness & Cognition 2012
- Richardson et al, Spatial knowledge acquisition from maps and from navigation in real and virtual environments, Memory & Cognition 1999
- Donovan et al, Energy expended playing Xbox KinectTM and WiiTM games: a preliminary study comparing single and multiplayer modes, Physiotherapy 2012
- Manches et al, Physical manipulation: evaluating the potential for tangible designs, Proc. TEI 2009 http://dl.acm.org/citation.cfm?id=1517688

Read Ishii's Tangible Bits paper http://dl.acm.org/citation.cfm?id=258715

Look at physicality.org

Explore the TEI conference series publication archive to find any controlled studies you find interesting http://dl.acm.org/event.cfm?id=RE271, then click on the 'publication archive' tab

<for next lecture>

Slides available at:

https://goo.gl/B1SZTe

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