

# Human-Computer Interaction

- how to acquire design knowledge -

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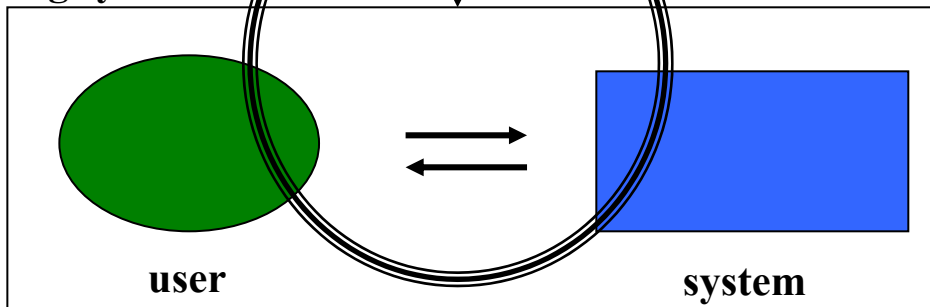
The Netherlands

# What is Human-Computer Interaction about?

Working domain



Working system



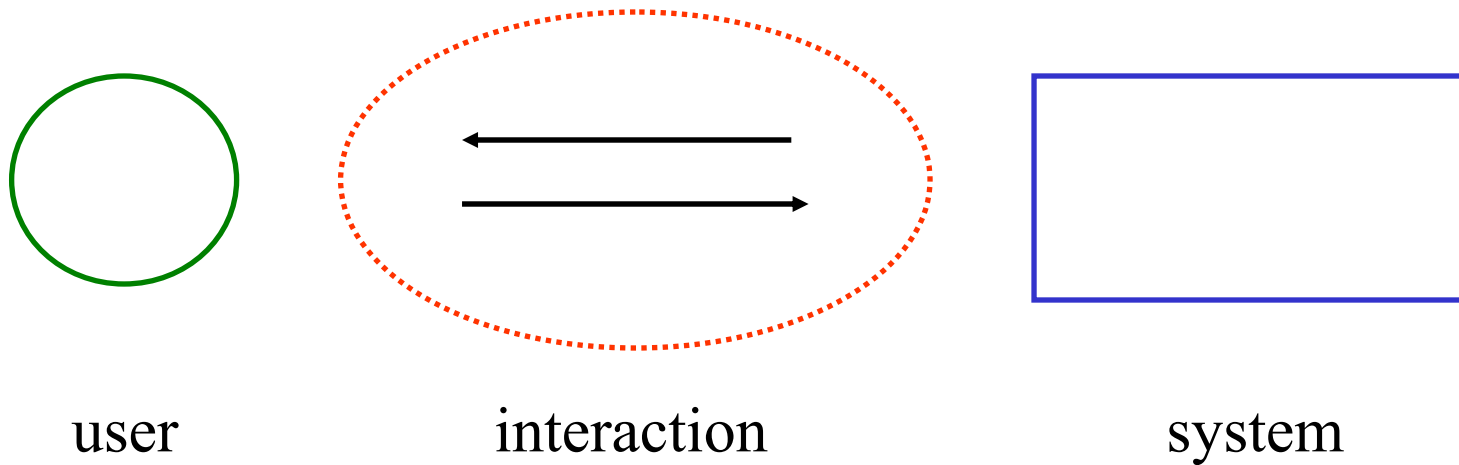
**Goal:**

Actual Performance

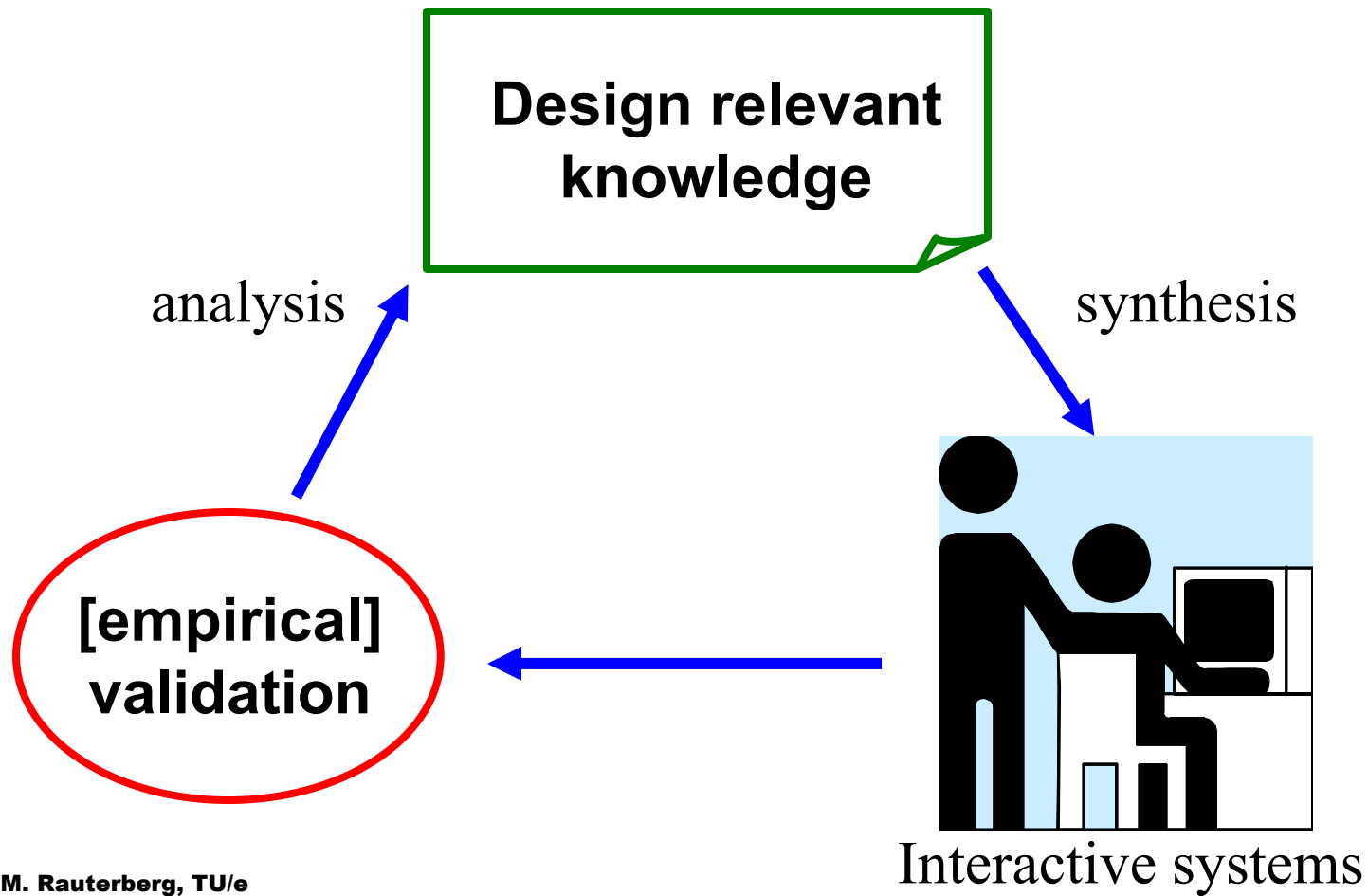
=>

Desired Performance

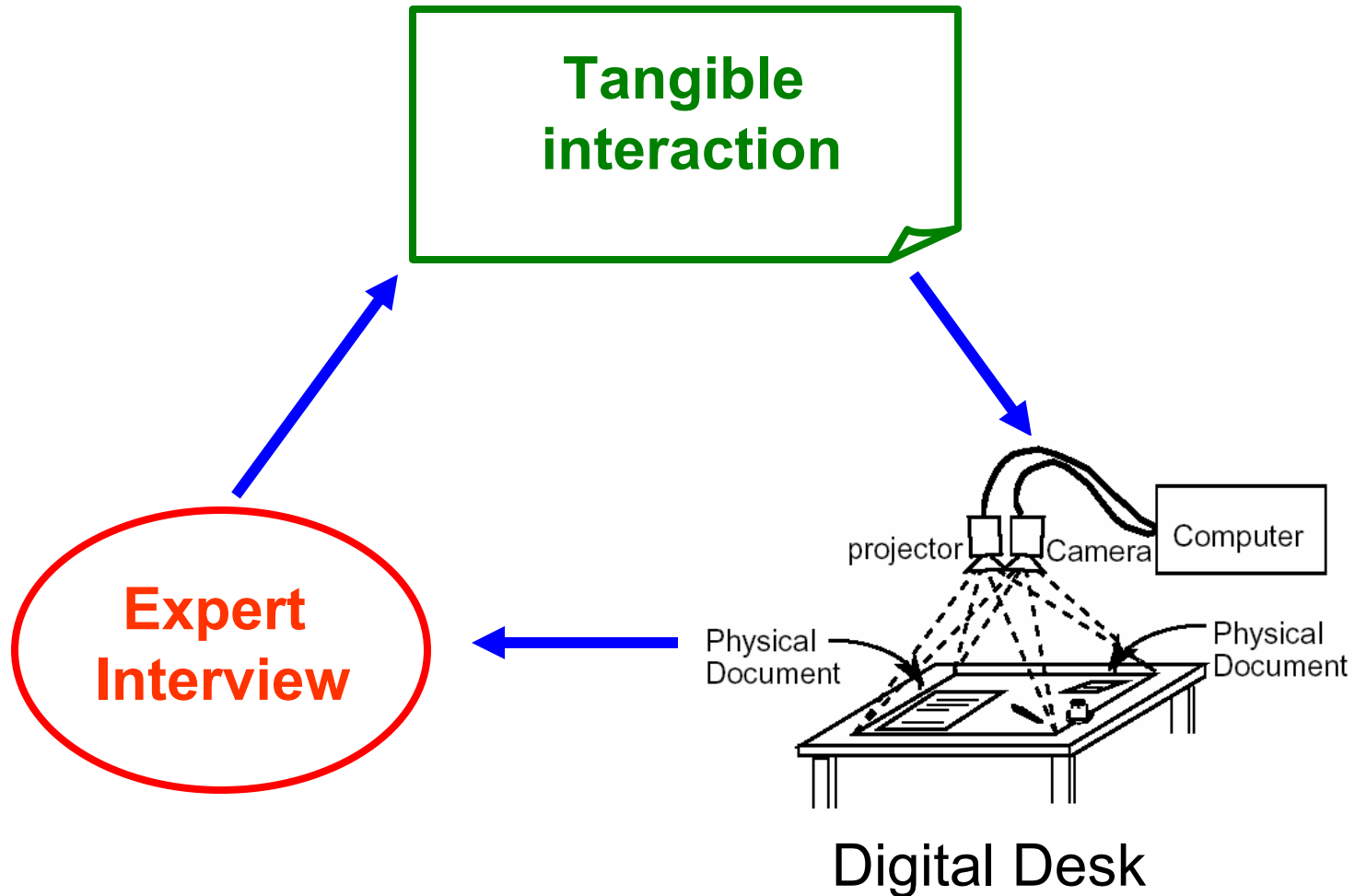
# Interface Design or Interaction Design?



# HCI Research Line: basic cycle

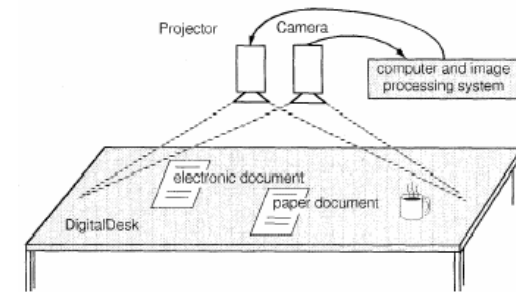


# NUI: The First Round



# The Digital Desk

from Pierre Wellner in 1991

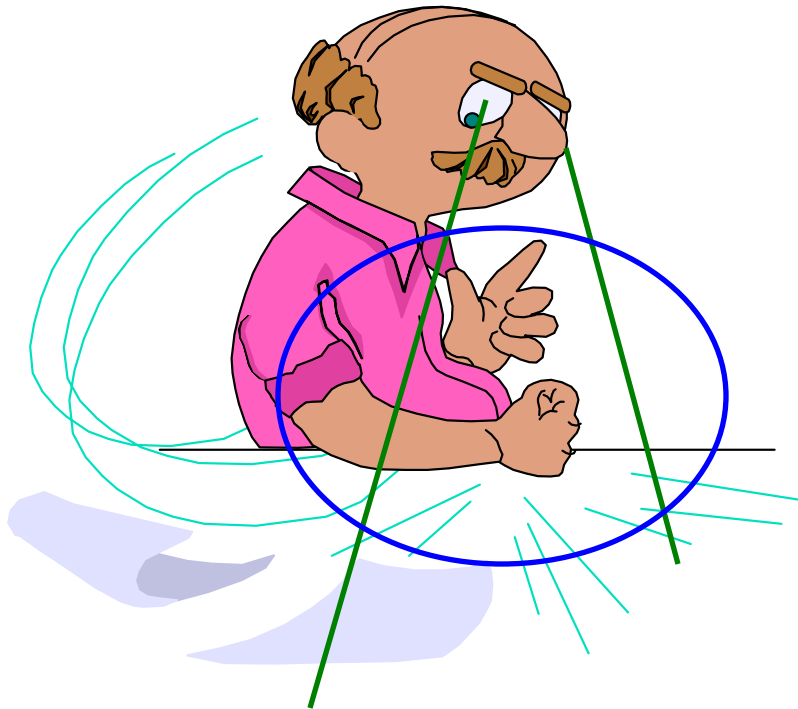


Pierre Wellner

The DigitalDesk is built around an ordinary physical desk and can be used as such, but it has extra capabilities. A video camera is mounted above the desk, pointing down at the work surface. This camera's output is fed through a system that can detect where the user is pointing (using an LED-tipped pen) and it can recognise the documents that are placed on it. The more advanced version also has a computer-driven projector mounted above the desk enabling electronic objects to be projected onto real paper documents -- removing the burden of having to switch attention between screen and paper and allowing additional user-interaction techniques. [invented and built by Pierre Wellner, Xerox EuroPARC]

[Video clip](#)

# What is a design principle?



- **Perception Space**
  - The physical space where the user's attention is.
- **Action Space**
  - The physical space where the user acts in.
- **Design Principle:**
  - perception space and action space must coincide!
  - “Interlacing the display and manipulation space”  
(Djajadiningrat, 1998)

# Natural User Interfaces (NUI): design constrains

## 1. design requirement

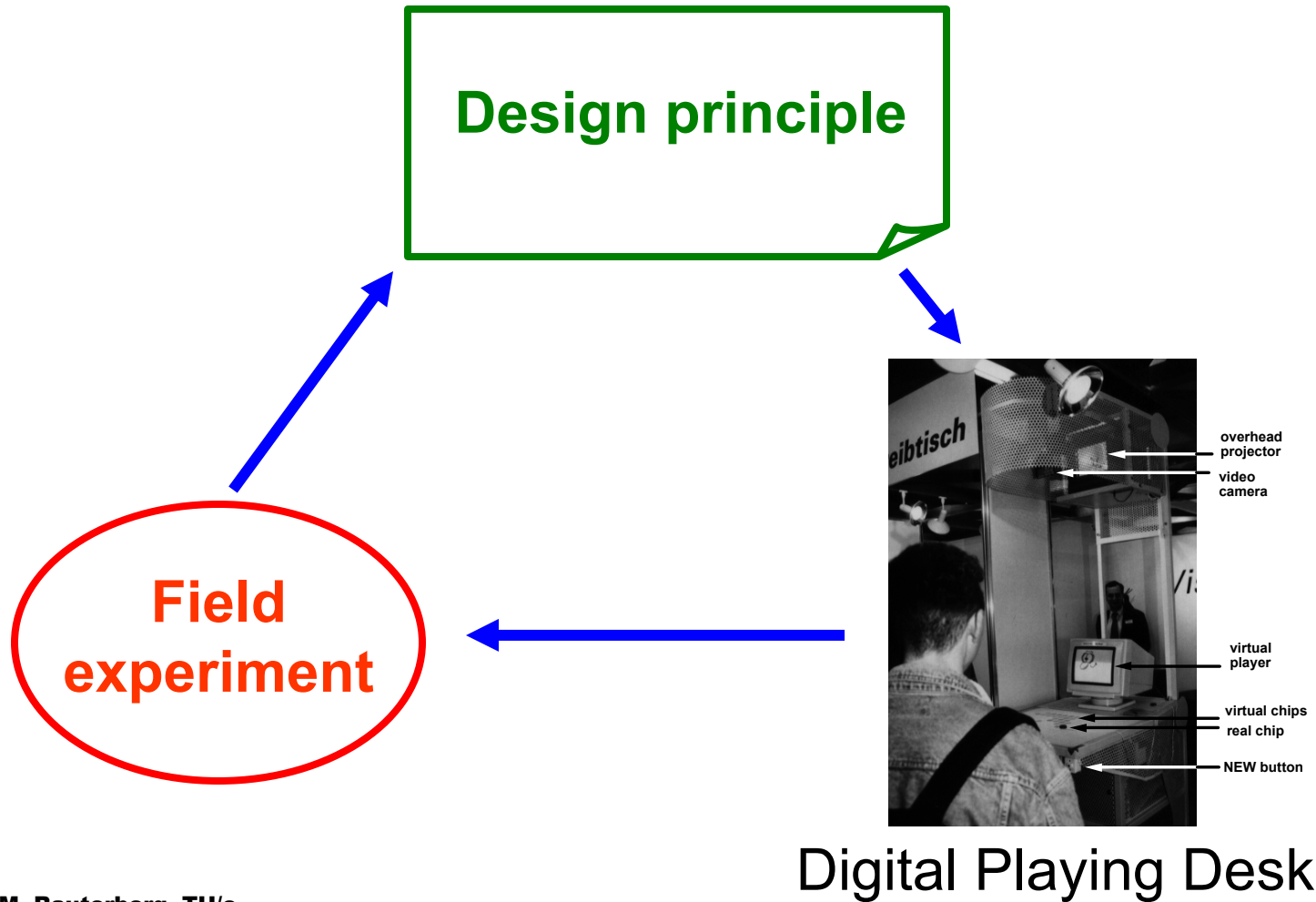
No technical equipment inside the  
body space of the user!

## 2. design requirement

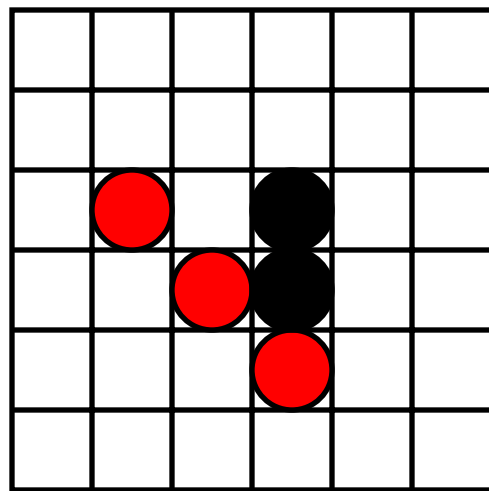
Perception space and  
action space must coincide!



# NUI: The Second Round



# Tic-Tac-Toe with four interaction styles



Video clip



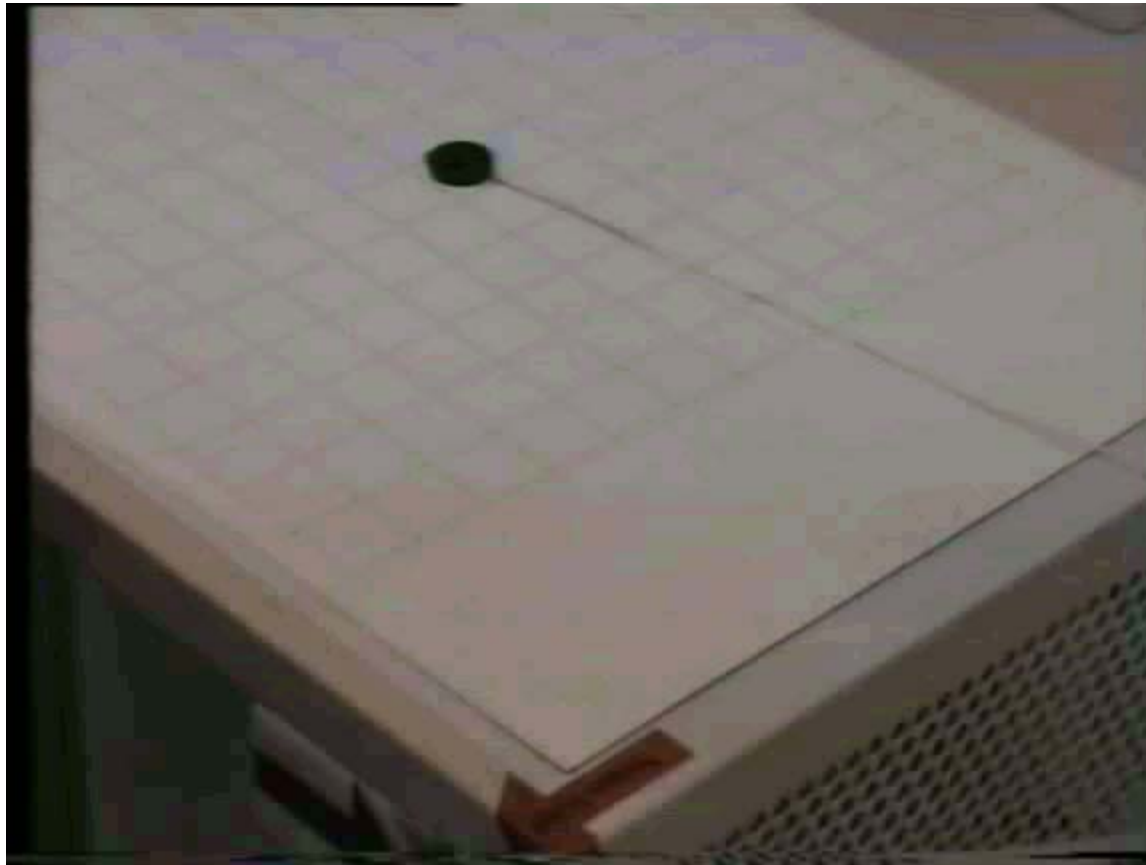
Video clip



Video clip



# Digital Playing Desk (DPD)



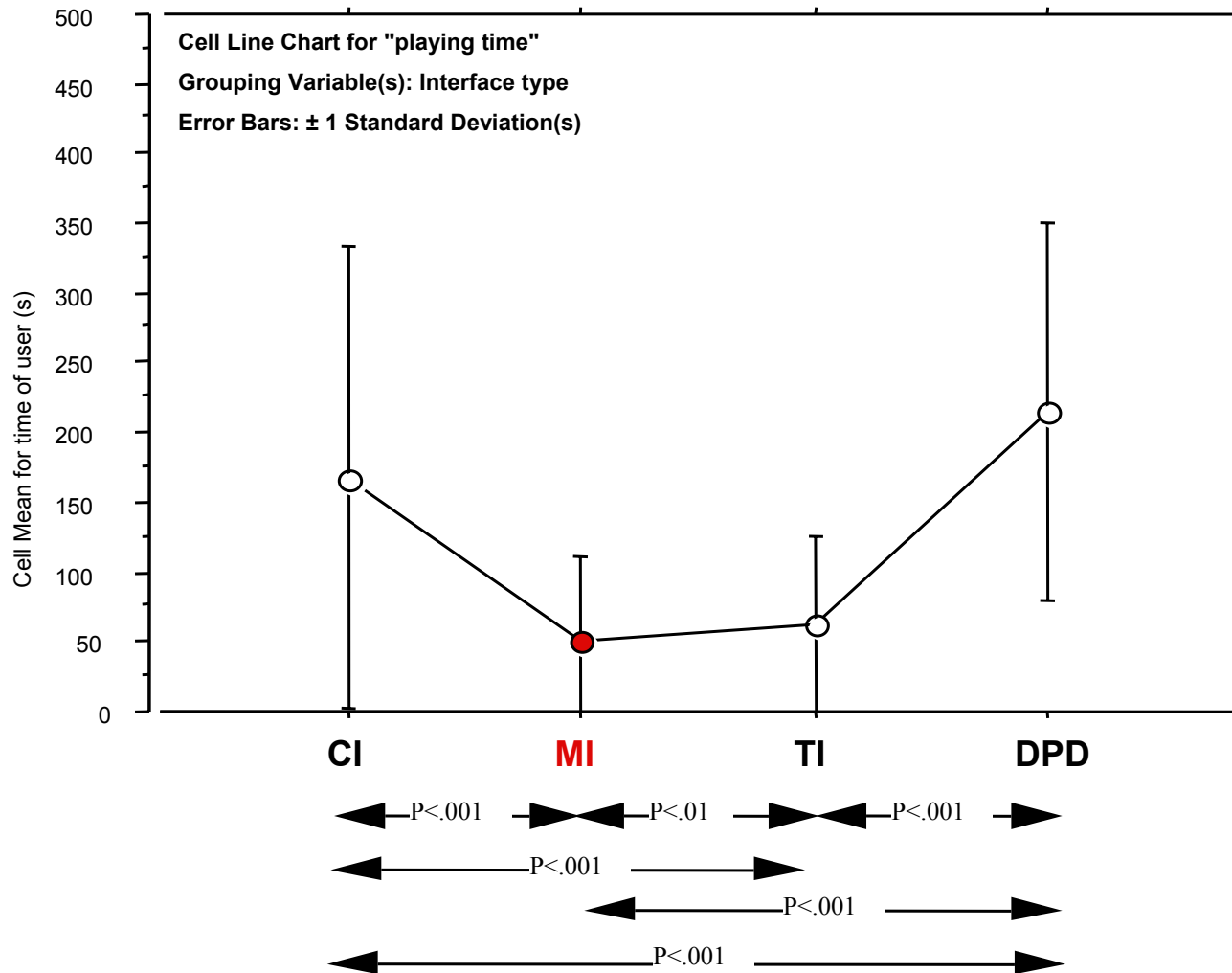
[Video clip](#)

# User Studies with the DPD

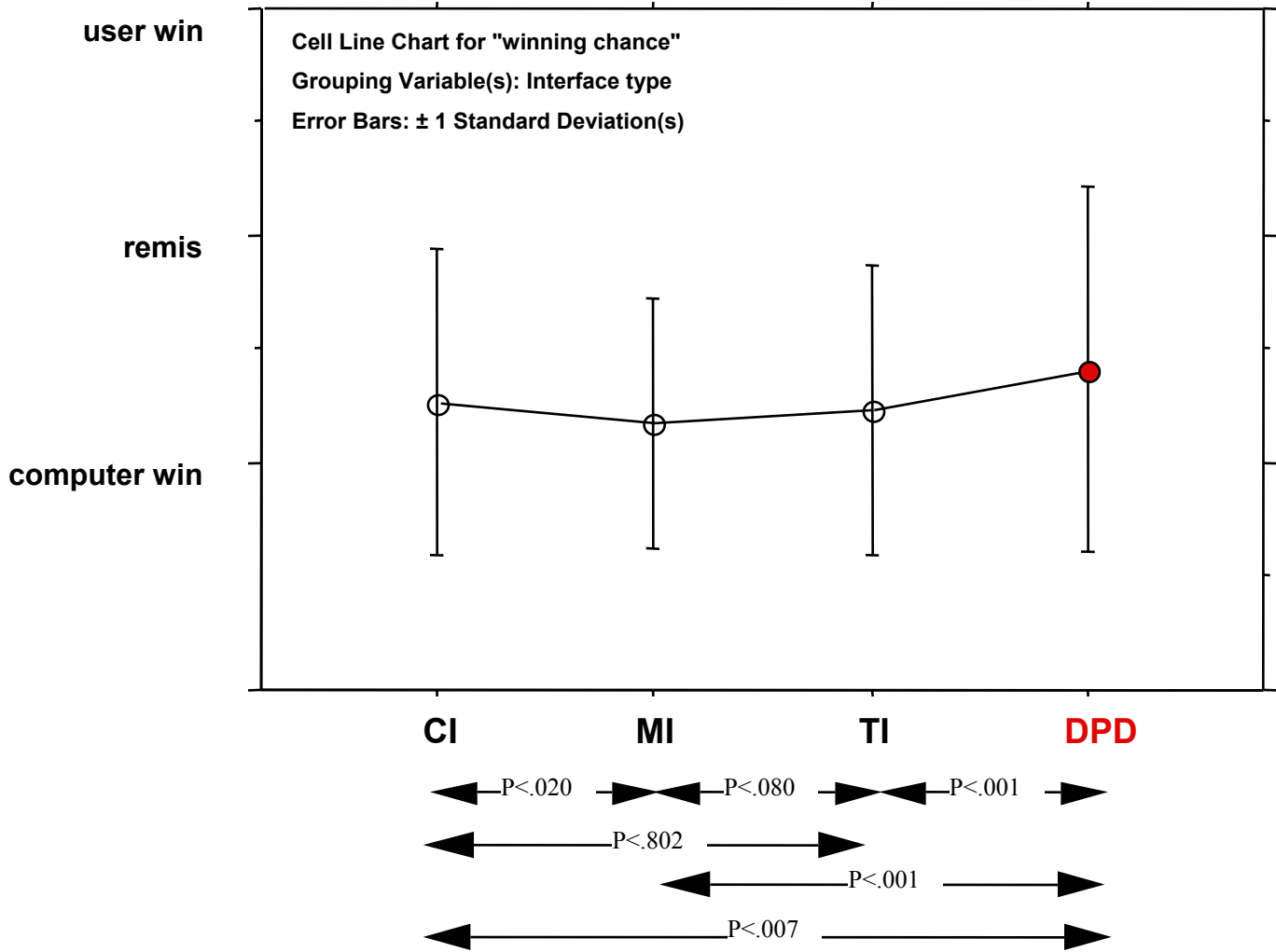


[Video clip](#)

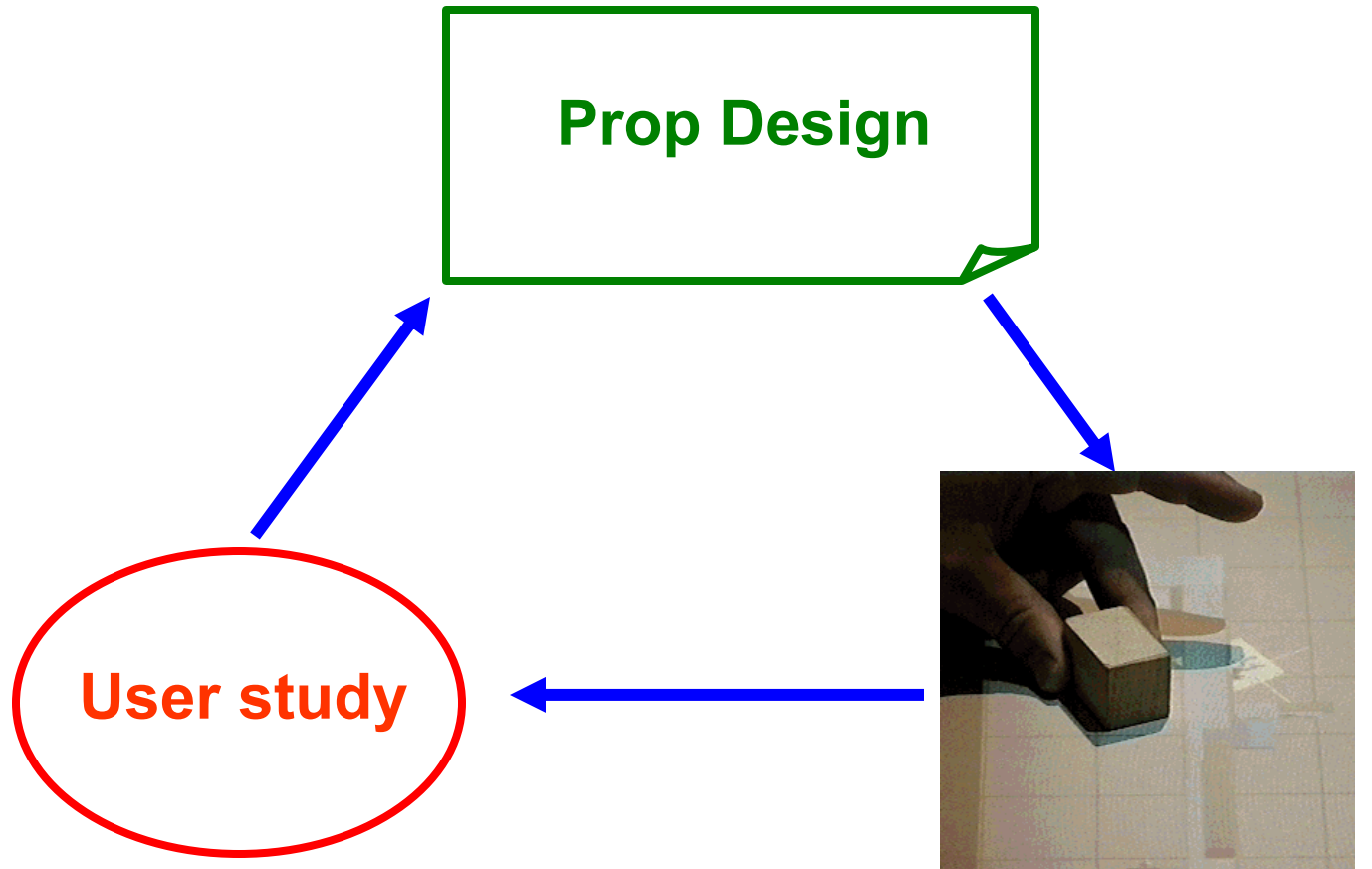
# Empirical Results: Playing time per game



# Empirical Results : winning chance per dialog technique



# NUI: The Third Round



Build-It systems

# The Build-It System

Bichsel, Fjeld & Rauterberg 1997

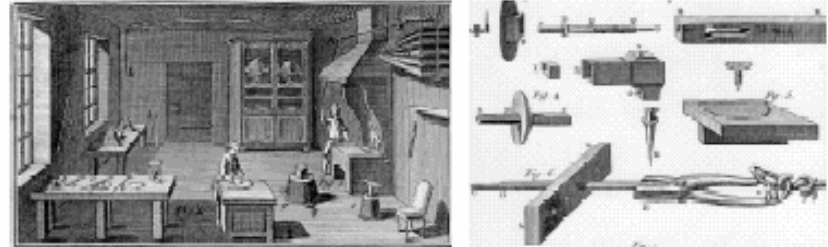


[Video clip](#)

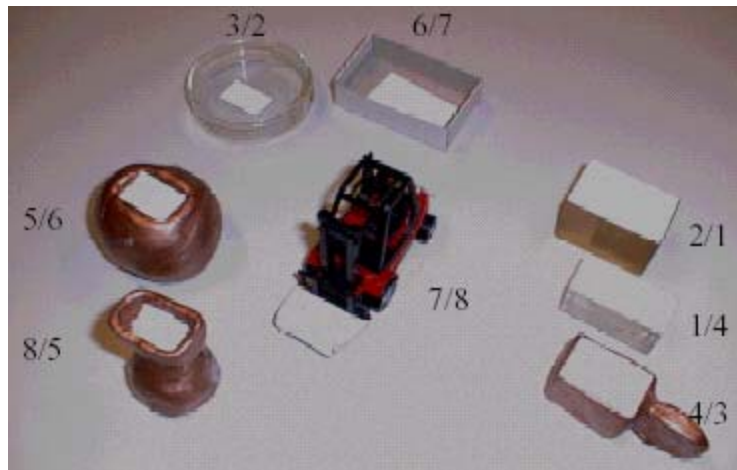


# The Build-It tangible props

18th Century: tool production



# NUI interaction props: user study

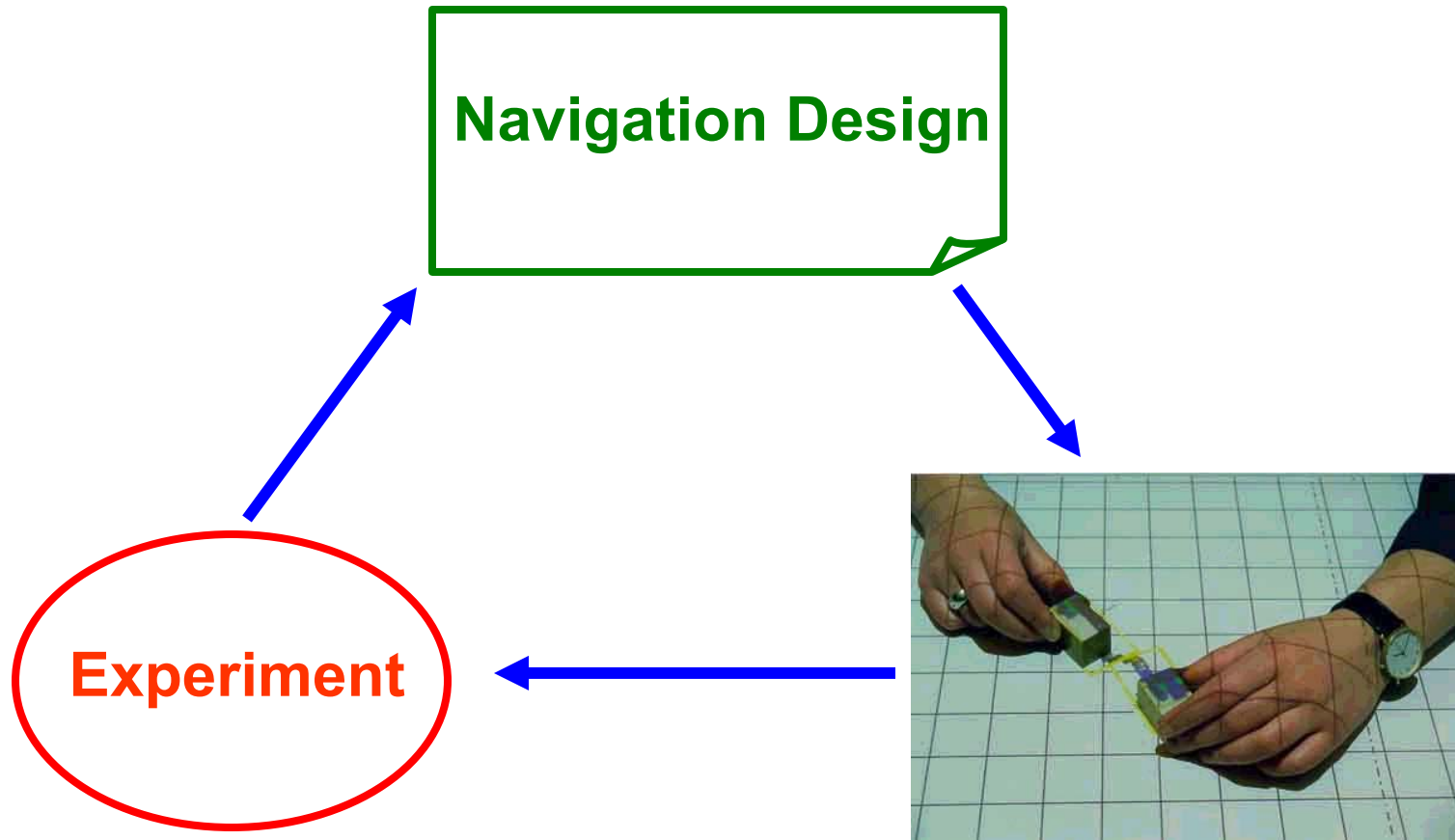


## Props design factors:

form, size, material and metaphor:

- An experiment was carried out to explore different design strategies.
- Tasks were based on initial *planning* of an *interior architecture*.
- Focus of the experiment was *subjective opinion* (n=12) about the bricks.
- The bricks were ranked by user performance *before* (first number) and *after* (second number) task solving activity.

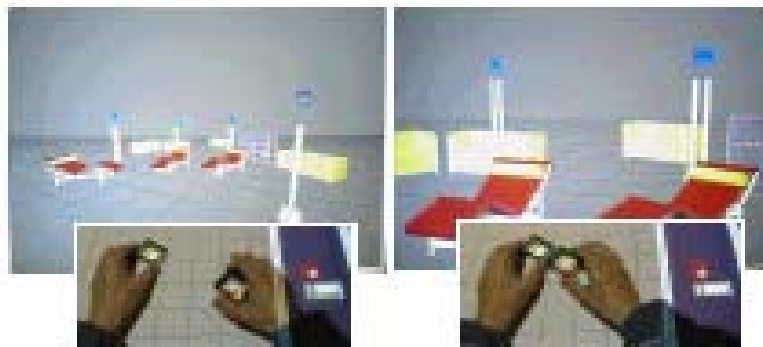
# NUI: The Fourth Round









Build-It systems

# The Build-It System

Fjeld, Bichsel & Rauterberg 2001



	Scene Handling	Viewpoint Handling
<b>Plan view control</b> 	<i>GroundCatcher (2)</i> 	<i>FrameCatcher (2)</i> 
<b>Side view control</b> 	<i>Camera</i>  <i>zoom</i>	<i>ViewFrame zoom</i> 

[Video clip](#)

# Navigation Design: experimental results

Experimental condition	Plan view		Side view	
	SH: <i>Ground Catcher</i>	VH: <i>Frame Catcher</i>	SH: <i>Camera</i>	VH: <i>View Frame</i>
1st	x		x	
2nd	x			x
3rd		x	x	
4th		x		x

Dependent variable: Trial completion time (tct)

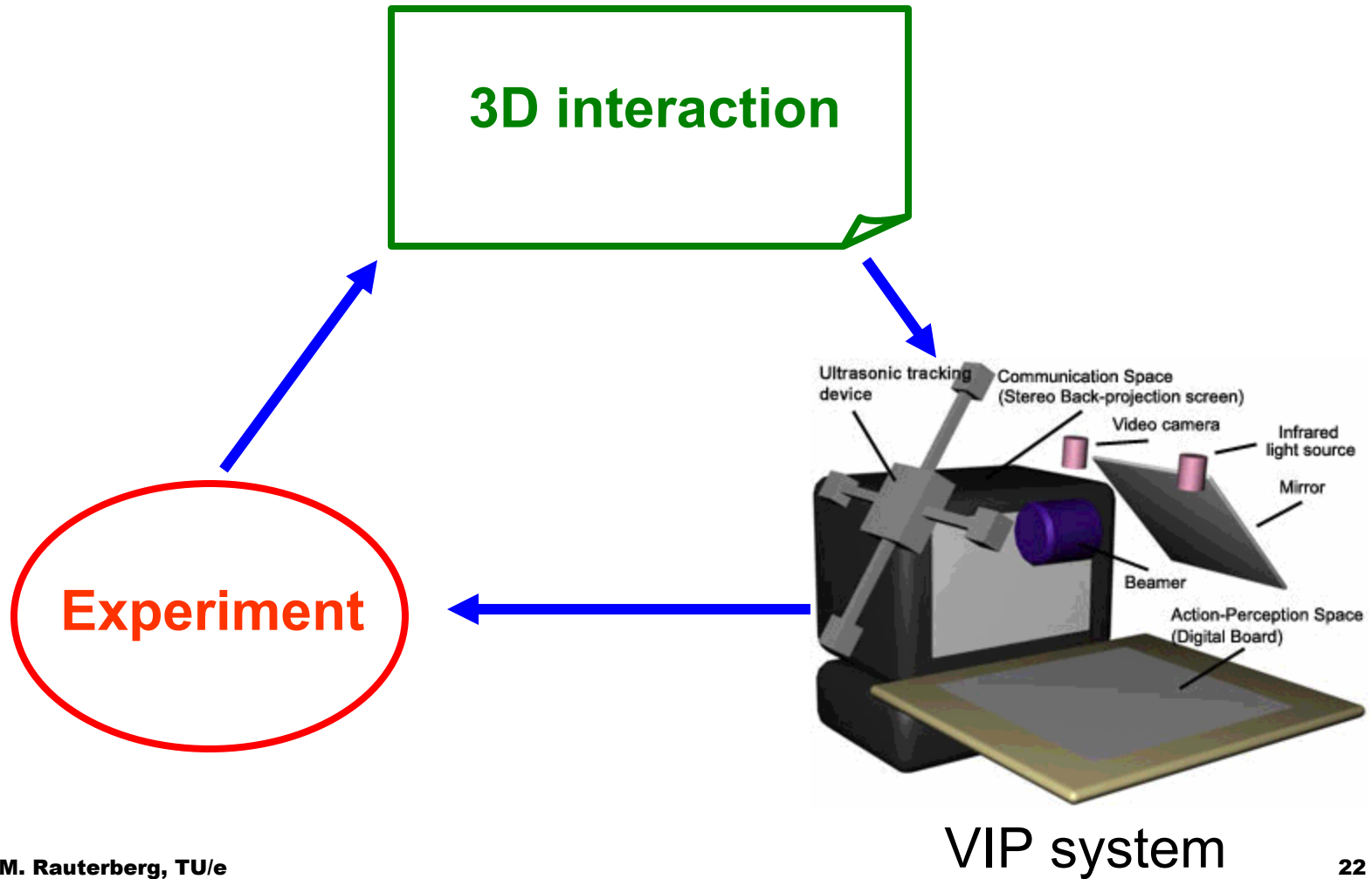
Source	df	F-ratio	p
Plan view method	1	0.391	p = 0.533
Side view method	1	8.144	p = 0.005 *
Trial	7	5.210	p < 0.001 *
Task	7	3.146	p = 0.005 *
User	15	2.063	p = 0.018

**Plan view method:**  
No significant effect.

**Side view method:**  
Scene Handling (SH: tct=150 s)  
gave better performance than  
View Handling (VH: tct=183 s).

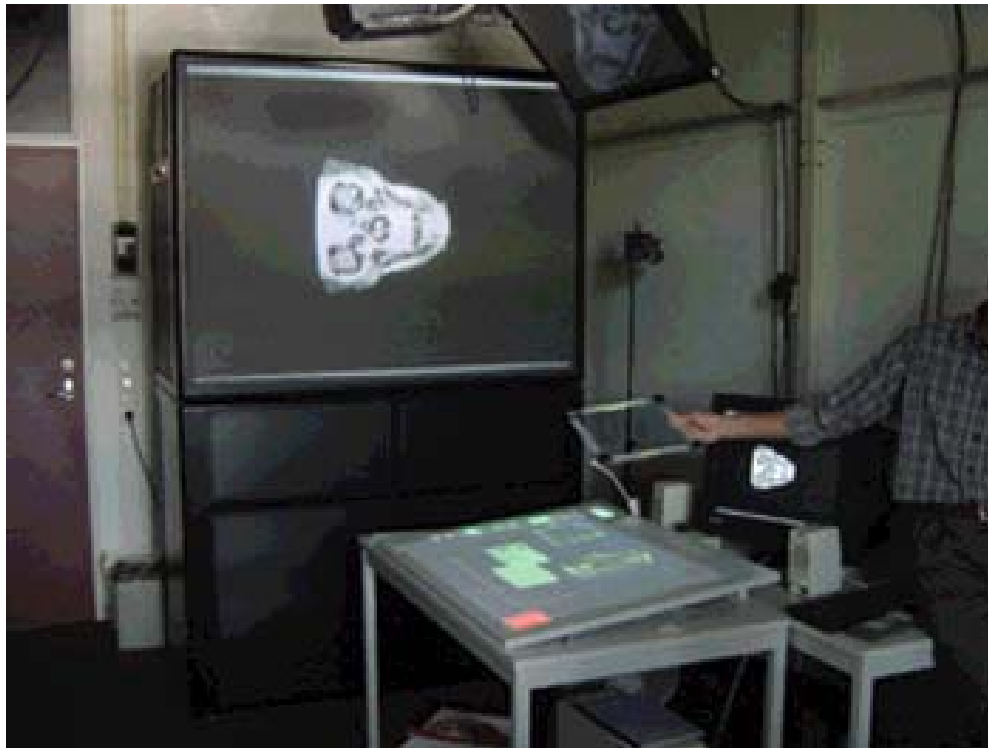
**Other effects:**  
Trial (learning effect) and task had  
a significant effect.

# NUI: The Fifth Round



# VIP: tangible interaction props

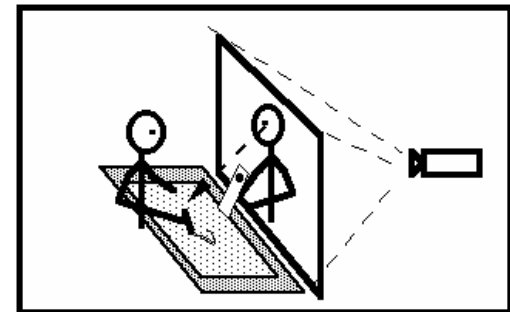
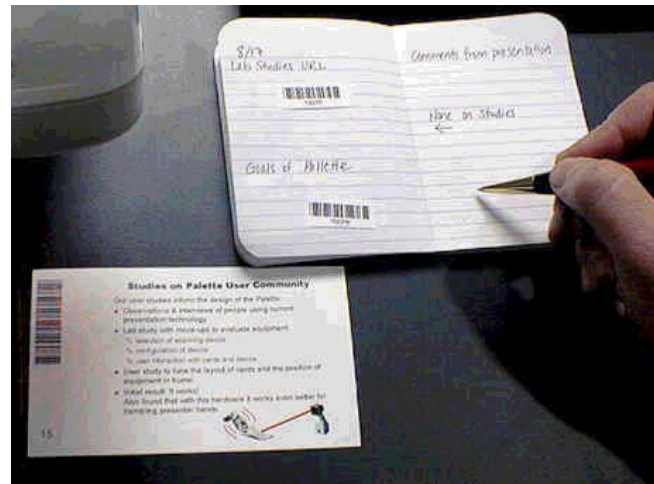
Aliakseyeu, Martens, Subramaniam & Rauterberg 2002



[Video clip](#)

# Further Developments

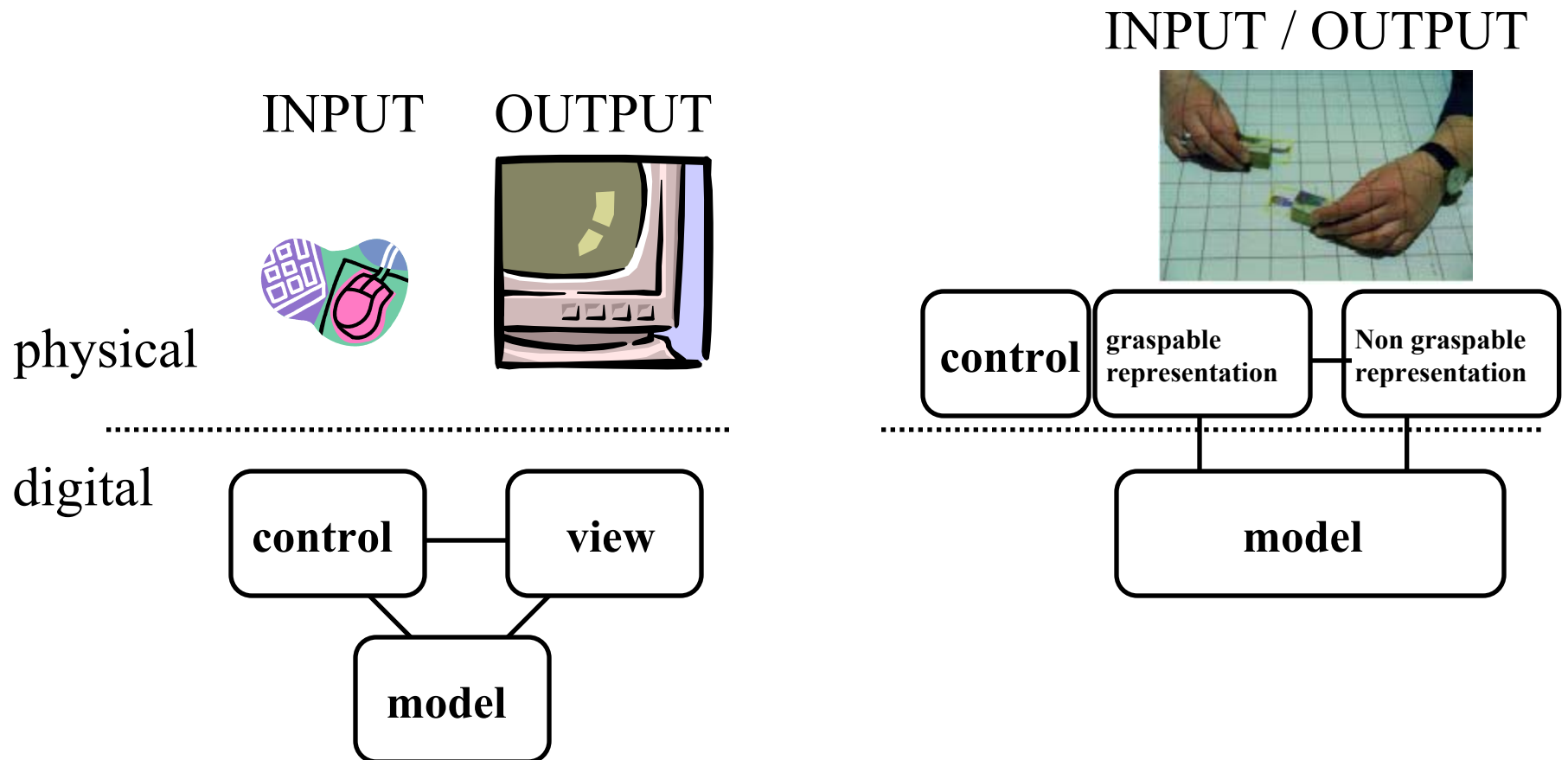
- Empirical validation
- Additional interaction techniques, e.g. speech input
- full 3D interaction possibilities
- video conferencing functionality for distributed cooperation



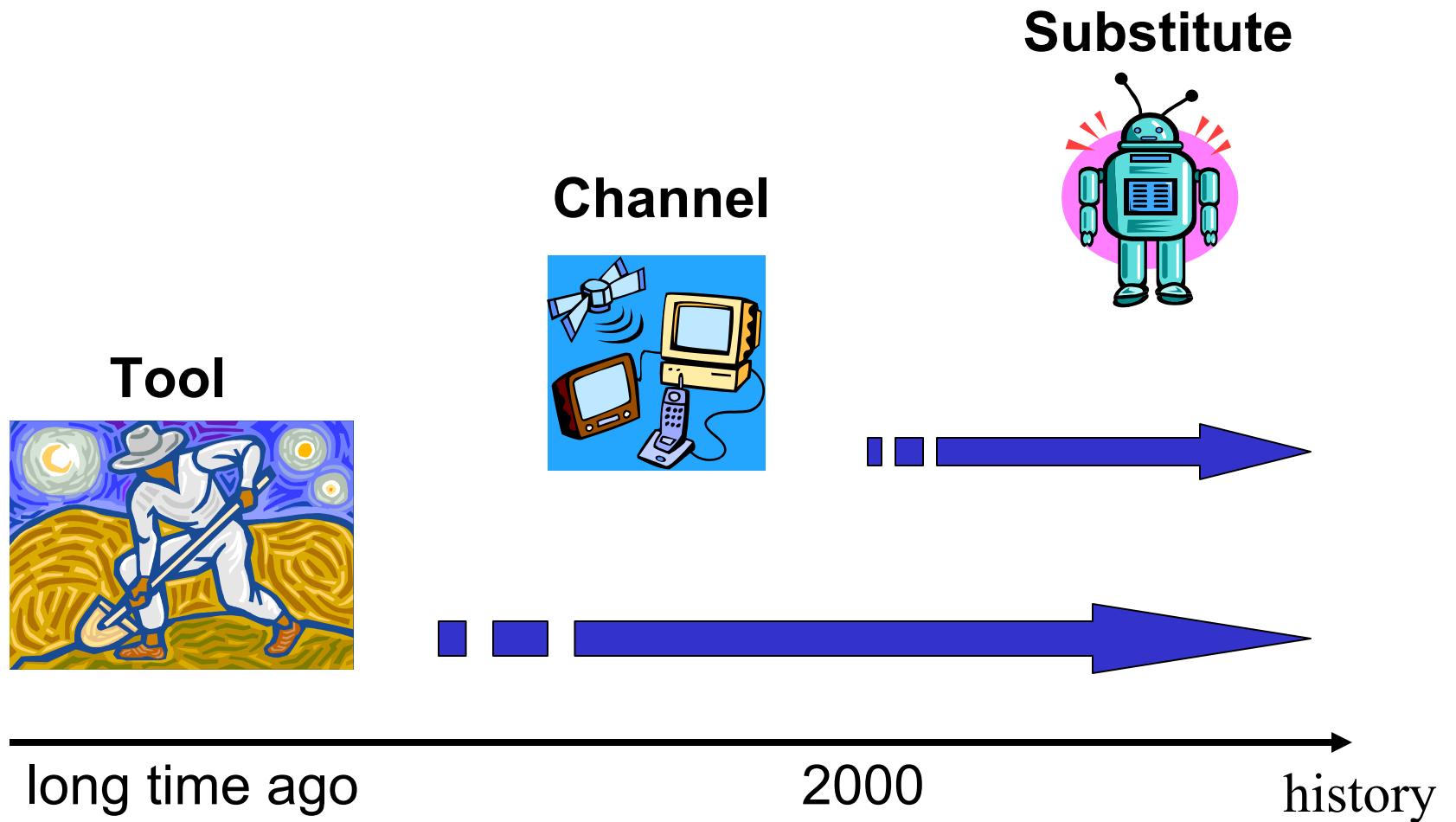


# GUI versus NUI interaction models

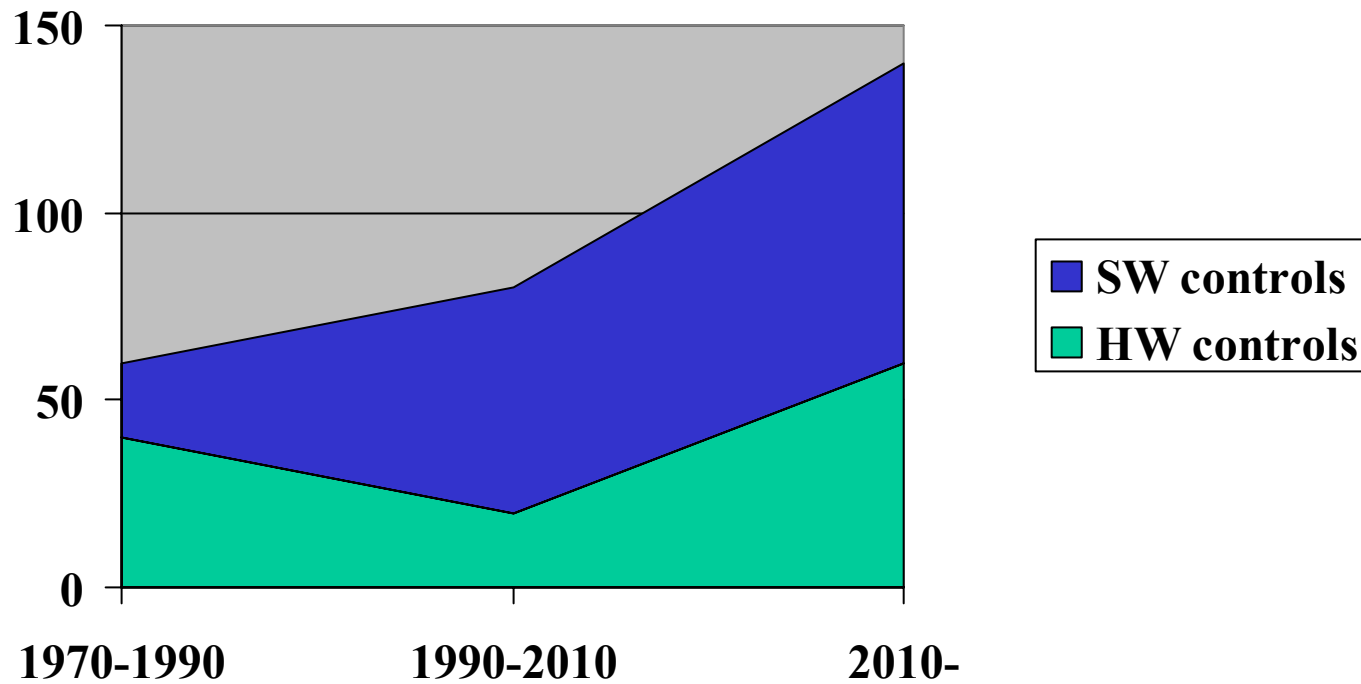
Ullmer & Ishii, 2000



# Design Metaphors



# Trend in Interface Design



mechanical style



1900

electronic style



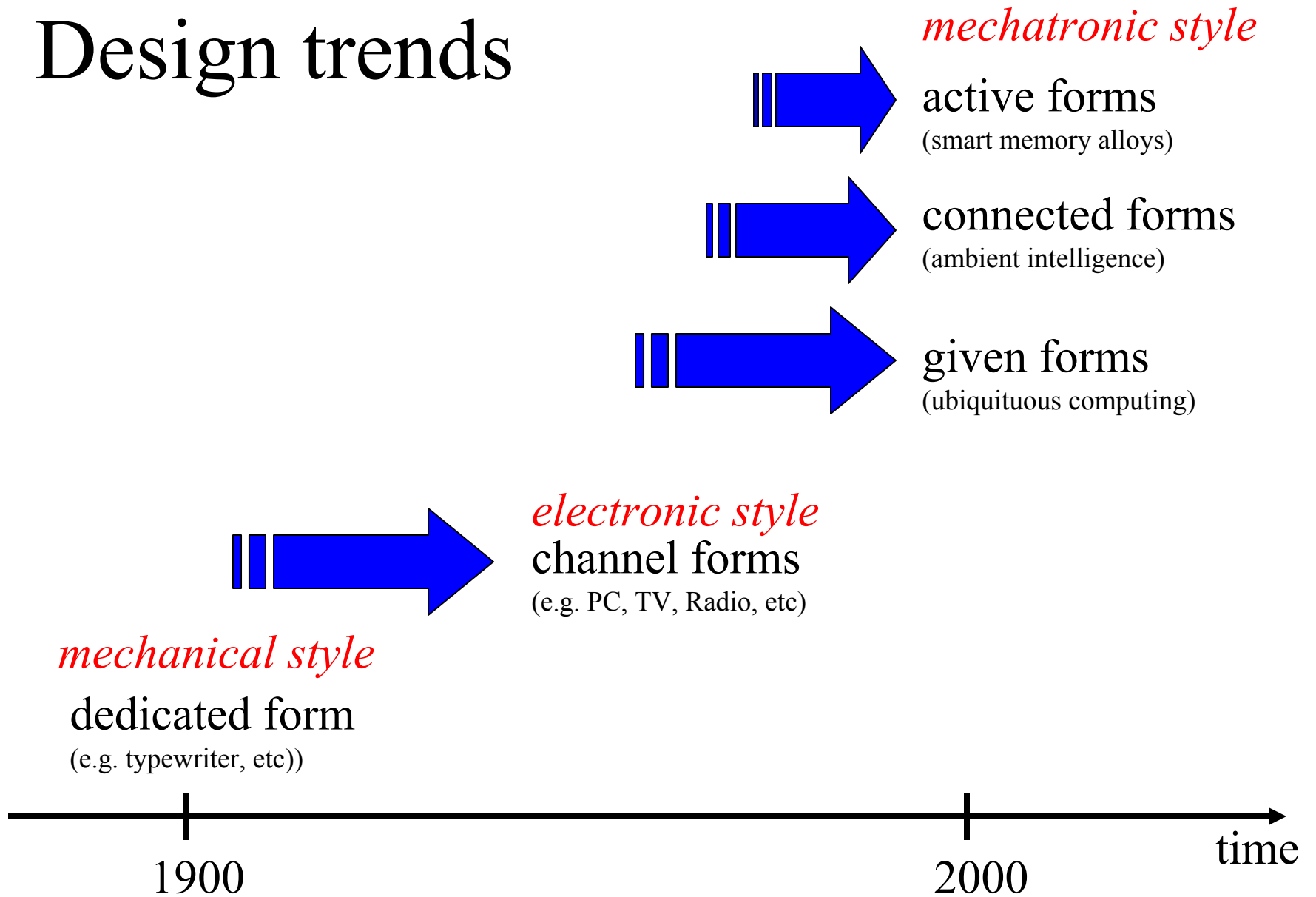
mechatronic style



2000

time

# Design trends



# Thank you for your attention

More at

<http://www.ipo.tue.nl/homepages/mrauterb/>