Lost in Translation

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Picture by Elena Siu

Translation?

- **Linguist: between which languages**
  - Translating a word from one language to another

- **Psychologist: from research to application**
  - Translating a fundamental finding into practice

- **Engineer: between two locations**
  - Translating an object form A to B

A → B

Translation from HHI to HRI

- Both psychological and engineering concepts
  - Translate fundamental findings to improve the interaction between humans and robots
  - Find concepts that enable the robot to act upon its environment – especially with other people

- **Start learning each other's language – or find a common one!**

Spilling the beans

Helpful:

- Get rid of the sophisticated language of your discipline

- Try to explain it though your grandparents can understand (not your kids!)

- Question every term that you do not understand

- Consider the context

Most effective:

Find a <u>model of your data/findings</u> to enable you to talk "Math" or any other symbolic language

Spilling the bean – a class on action models

What is a model?
- Formal (mathematical) description of a system
- Characterizing its (changing) states or behavior

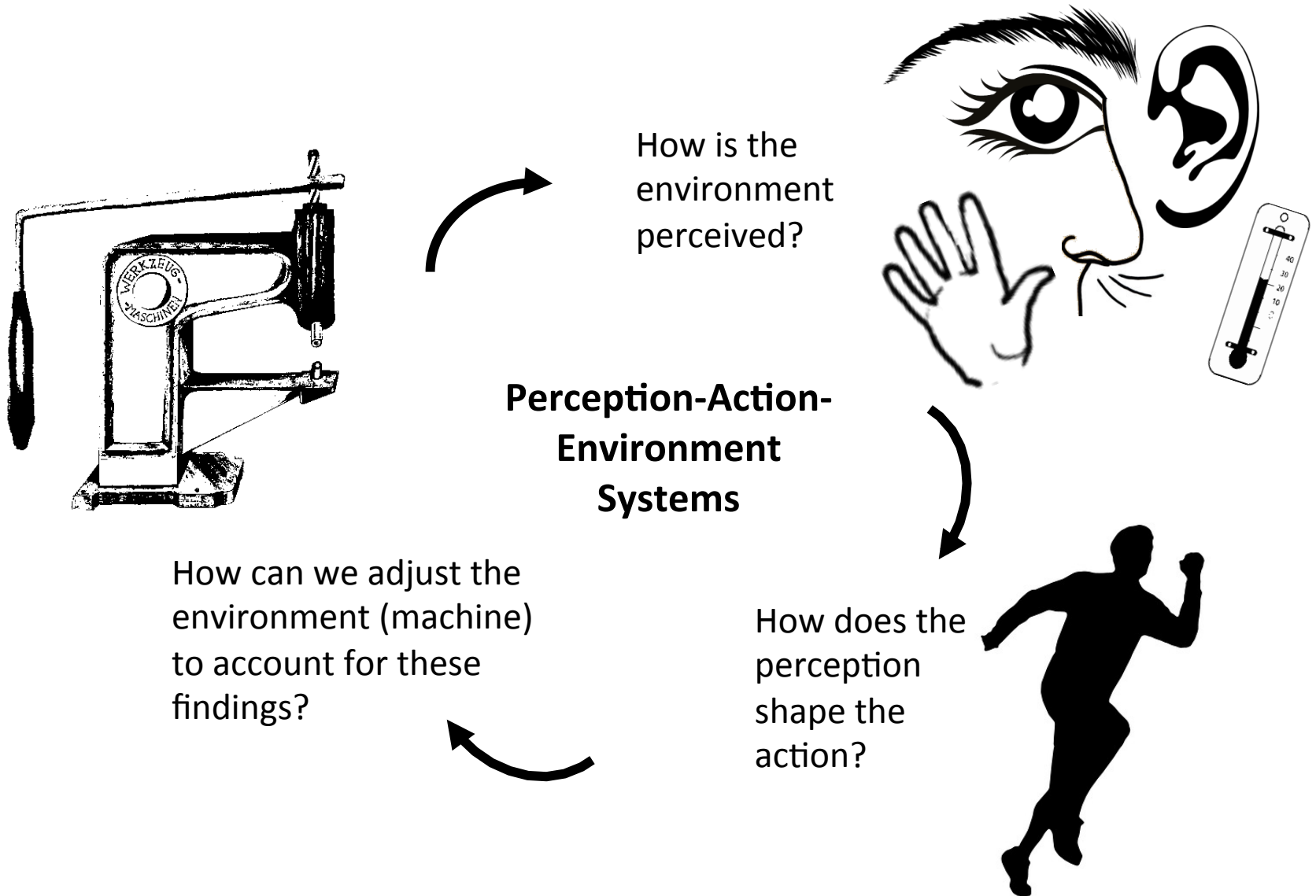# How to develop a good interaction model, Dr. Schaal?

"…this is exactly the problem…but at least you are asking the right question!"
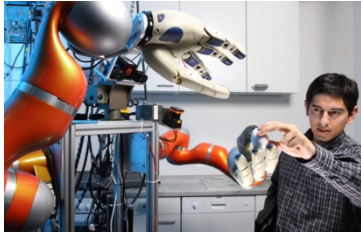
Stefan Schaal, USC, 2010

Several possibilities:
- Based on empirical findings
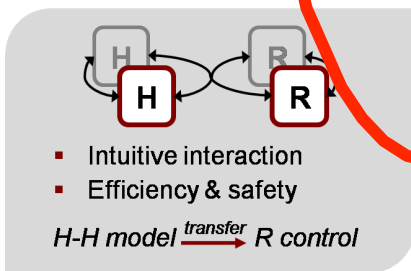- Based on theoretical considerations
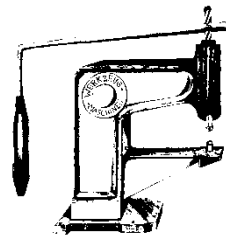- Optimally both

Human-Machine Interaction

How is the environment perceived?

Perception-Action-Environment Systems

How can we adjust the environment (machine) to account for these findings?

How does the perception shape the action?

Human- Robot Interaction (HRI)

How is the interaction with the robot perceived?

How is the environment perceived?

Perception-Action-Environment Systems

How can we adjust the environment (machine) to account for these findings?

How does the perception shape the action?

How can we implement this model for HRI?

- Intuitive interaction
- Efficiency & safety

H-H model →*transfer* *R control*

How does perception shape interaction?

How can we describe (model) this interaction ?

Translation from HHI to HRI

<u>Human-Like – golden standard</u>

- Copying human behavior
- Focus on interaction behavior itself

Advantage:

- High likelihood of creating intuitive behavior

Problems:

- Uncanny Valley
- No White Box Model for human behavior

Translation from HHI to HRI

<u>Ability-Inspired: the I-Phone Idea</u>

- Assumption: Human is very adaptive
- Find intuitive for the interaction with robots ("swiping")
- Maximize task performance instead of parameters

Advantage:
- Not uncanny
- Free choice of methods
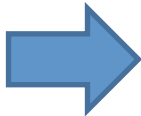- No need to create a perfect match between HRI and HRI

Problem:
- Finding the intuitive solution
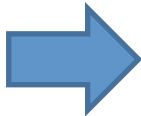
Still: Human-Machine Interaction

Computer
Car
Coffee-Machine
…
 Passive

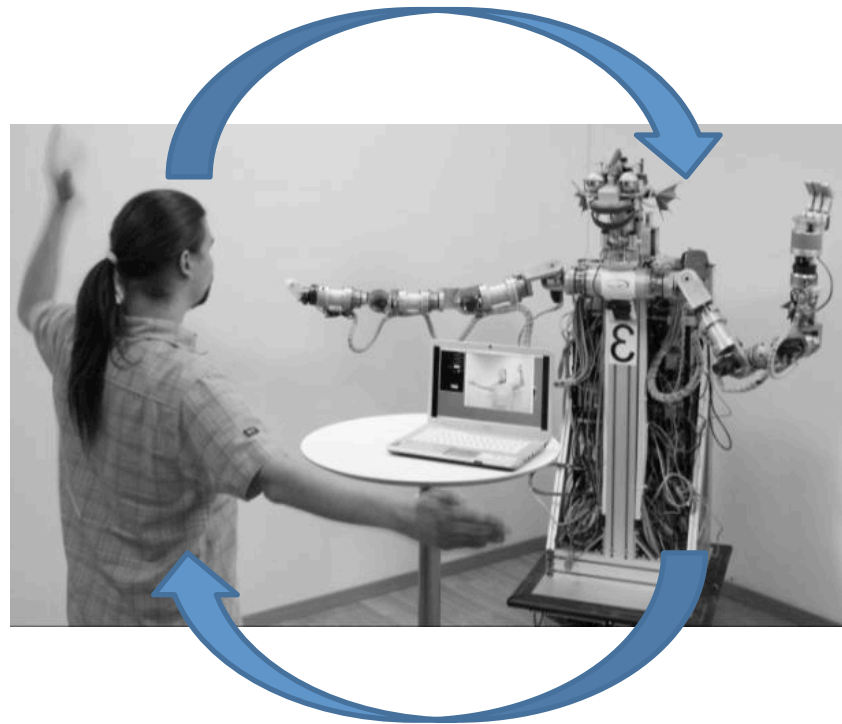**Robot** **Active**

Designing Interaction Dynamics

Understanding what is "**_human-like_**" or "**_interactable_**" interaction

Intuitive Interaction

Acceptance

Trust in Abilities

Safety

Trajectory
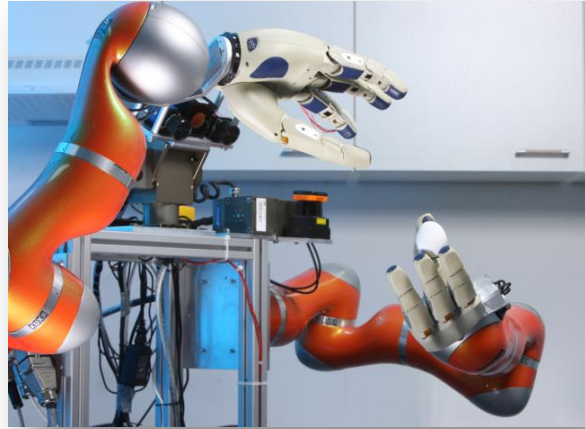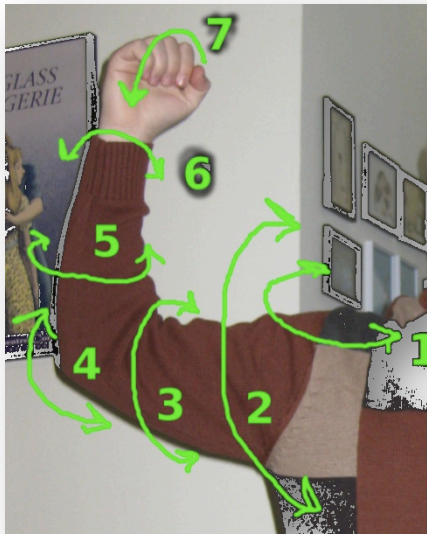
Timing

Velocity

Adaptation

Model for **autonomous** interaction
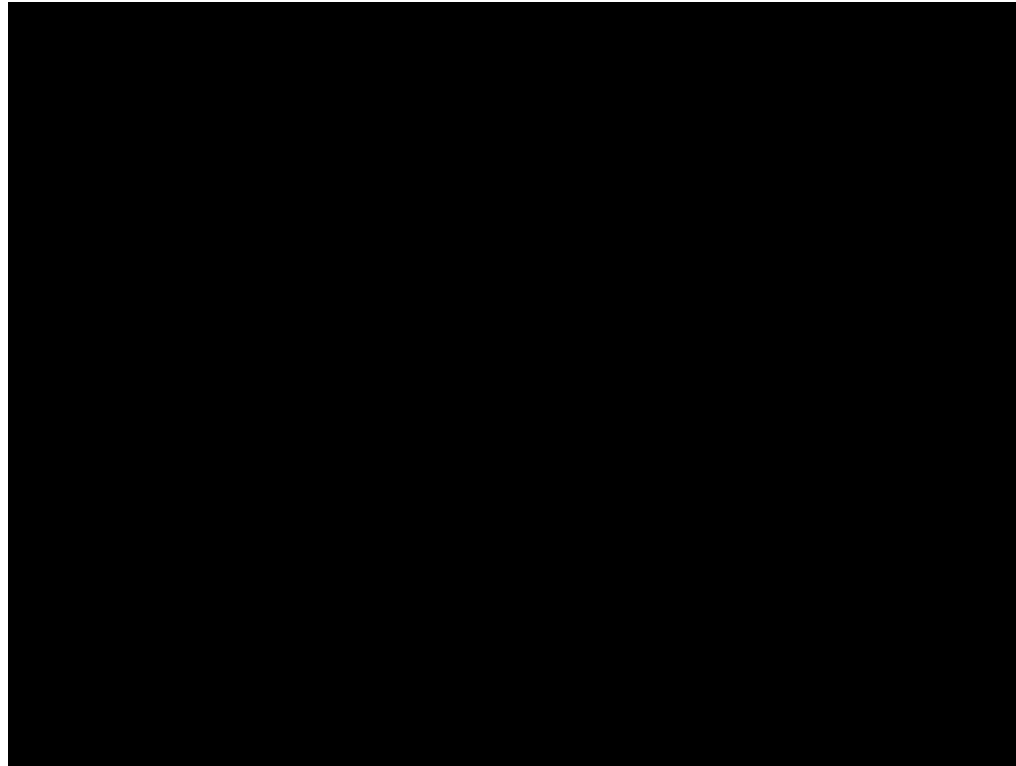
Designing Interaction Dynamics

7 Degrees of Freedom
+ Minimum-Jerk

Chose one arm (robot) to work with

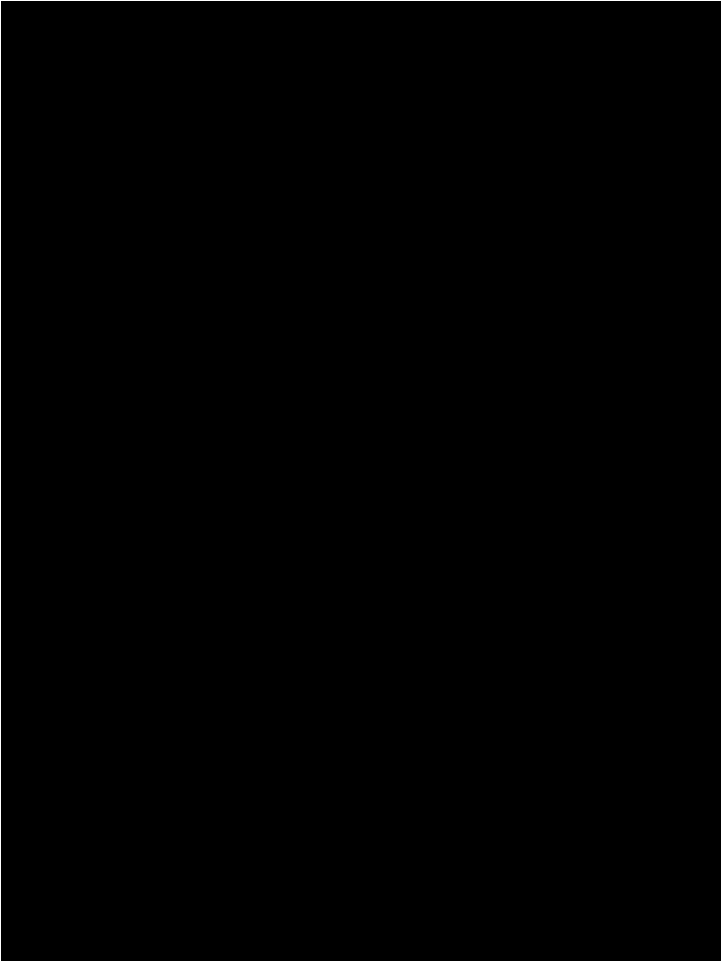**– or focus on platform independent solutions**

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Designing Interaction Dynamics

Create Predictable Interaction

Designing Interaction Dynamics

Autonomous grasping

At which point do you get the cup yourself?

Design dynamics in a way that the robot can immediately and timely react.

Technische Universität München – available from
https://www.youtube.com/watch?v=PurITnQKX_0

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Designing Interaction Dynamics

Here:
Interaction based on coupled oscillator dynamics

Open question:
How to scale adaptation?

Human-like or better Interactable?

Designing Interaction Dynamics - Summary

Do we want :

- human-like behavior?

- merely interactable behavior ?

Requirements in both cases:

- Predictable interaction ($\rightarrow$ safety)

- Immediate Interaction

- Platform-independent interaction

- Based on human abilities and developed based on human action-perception principles

Some (debatable) ideas

- Translating HHI to HRI
  - Start searching for quantifiable factors shaping human interaction
  - Address the *Cinderella of Psychology* (abandonment of motor control research) (Rosenbaum, 2005)

- Translating Robotics to HRI
  - Consider the user before "making it work"
  - Think platform independent

More translation needed?