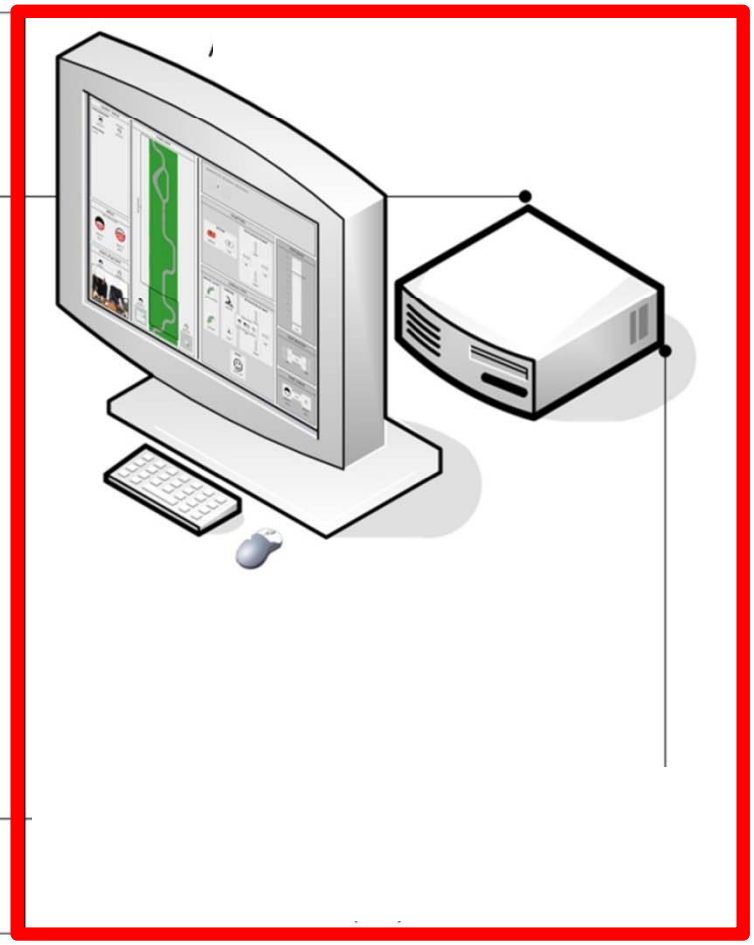
Artificial Agents
in Psychological Experiments
based on the
"Socially Augmented Microworld (SAM)"

Background ATEO and SAM

Complex **system** controlled by human **operator** via **interface**

e.g.
- Production system
- Traffic system
- Social system



Background ATEO and SAM

Complex **system** controlled by human **operator** via **interface**

Basic Hypothesis:

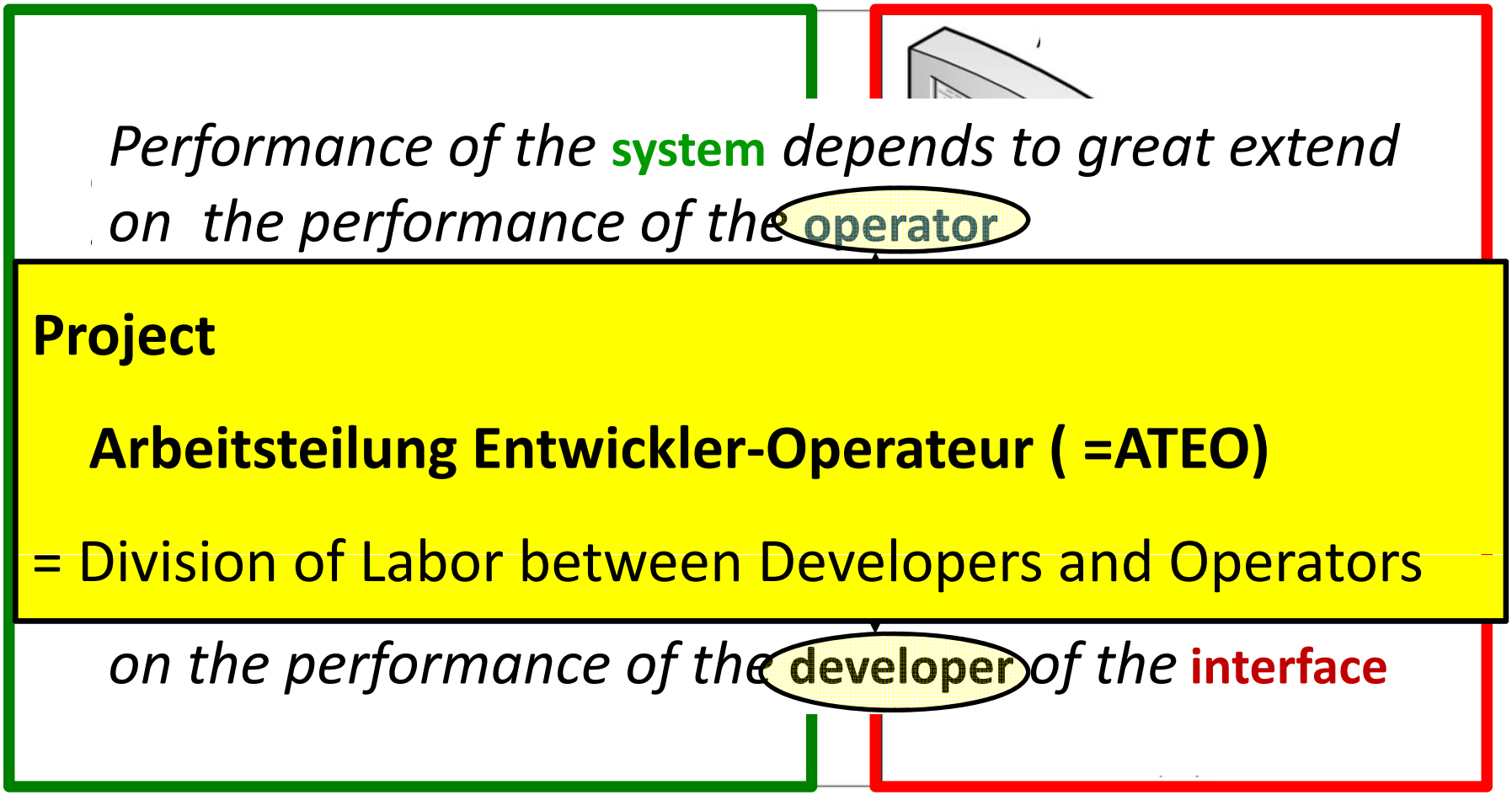
Performance of the **system** *depends to great extend on the performance of the* **operator**

Performance of the **operator** *depends to great extend on the performance of the* **interface**

Performance of the **interface** *depends to great extend on the performance of the* **developer** *of the* **interface**

Background ATEO and SAM

Complex **system** controlled by human **operator** via **interface**

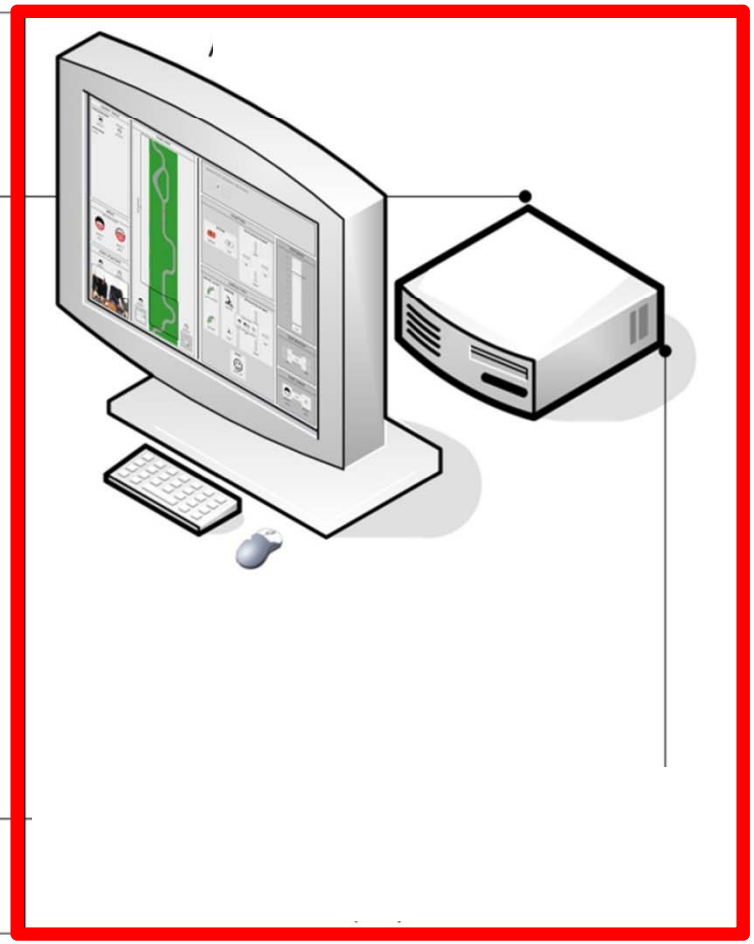


Background ATEO and SAM

Complex **system** controlled by human **operator** via **interface**

The
Socially Augmented Microworld (SAM)

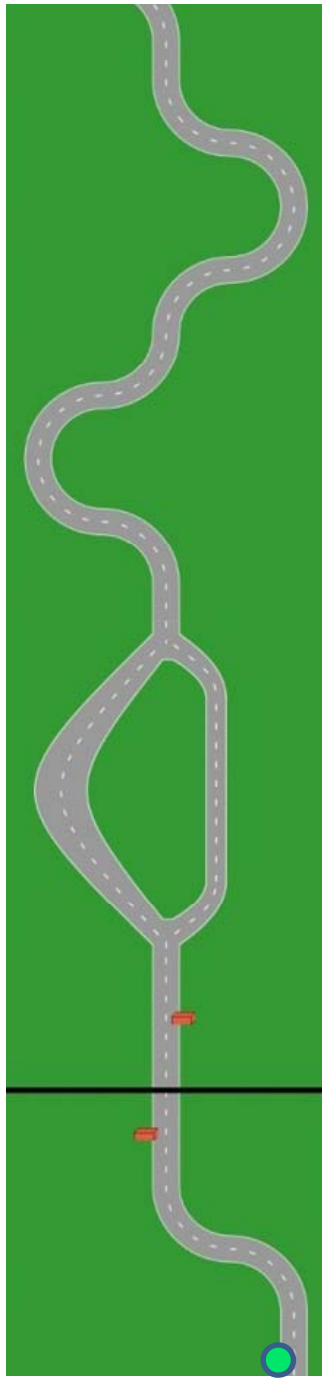
SAM was designed as a testbed for experiments concerning a comparison of performance of **developers** and **operators**



Tracking task

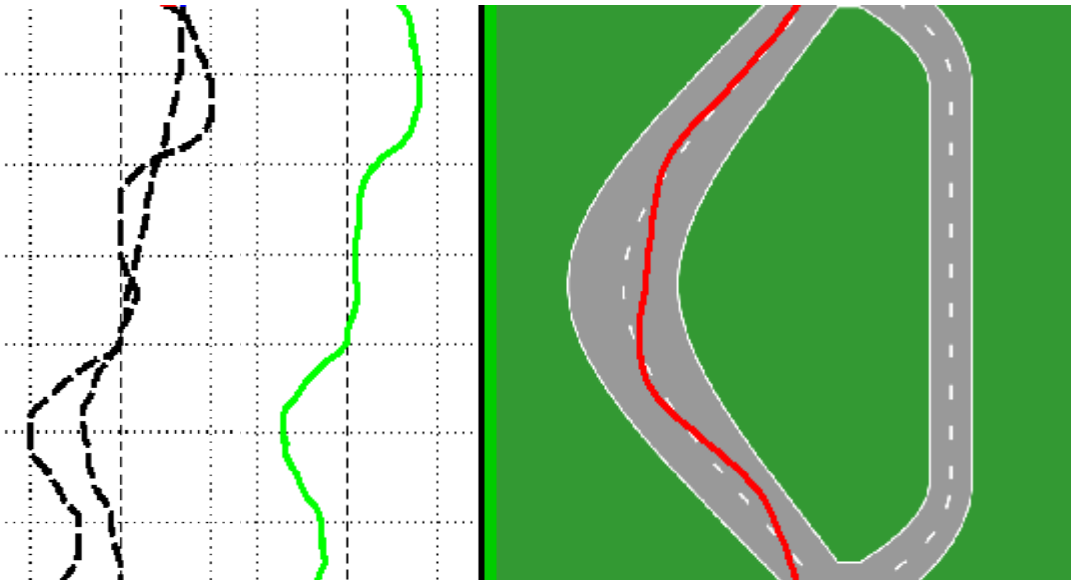
- Road with branches and obstacles
- Car ("**object**") controlled by **navigator** with joystick

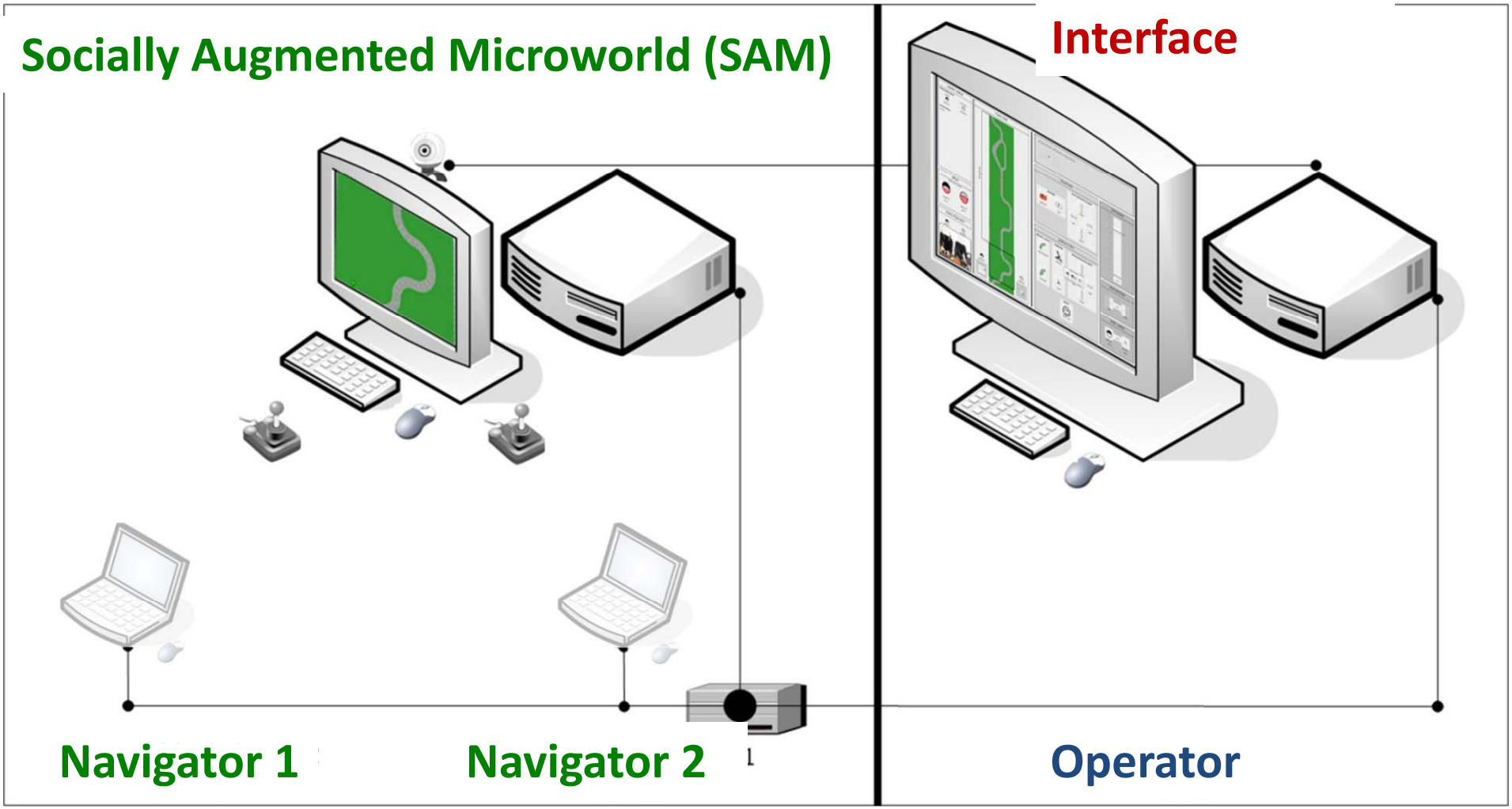
(Conflicting) Goals: *fast* and *accurate*



Microworld with 2 navigators

Extended tracking task:
2 independent **navigators**
with limited communication (e.g. gestures, observation)




Socially Augmented Microworld (SAM)
Interface
Navigator 1
Navigator 2
Operator

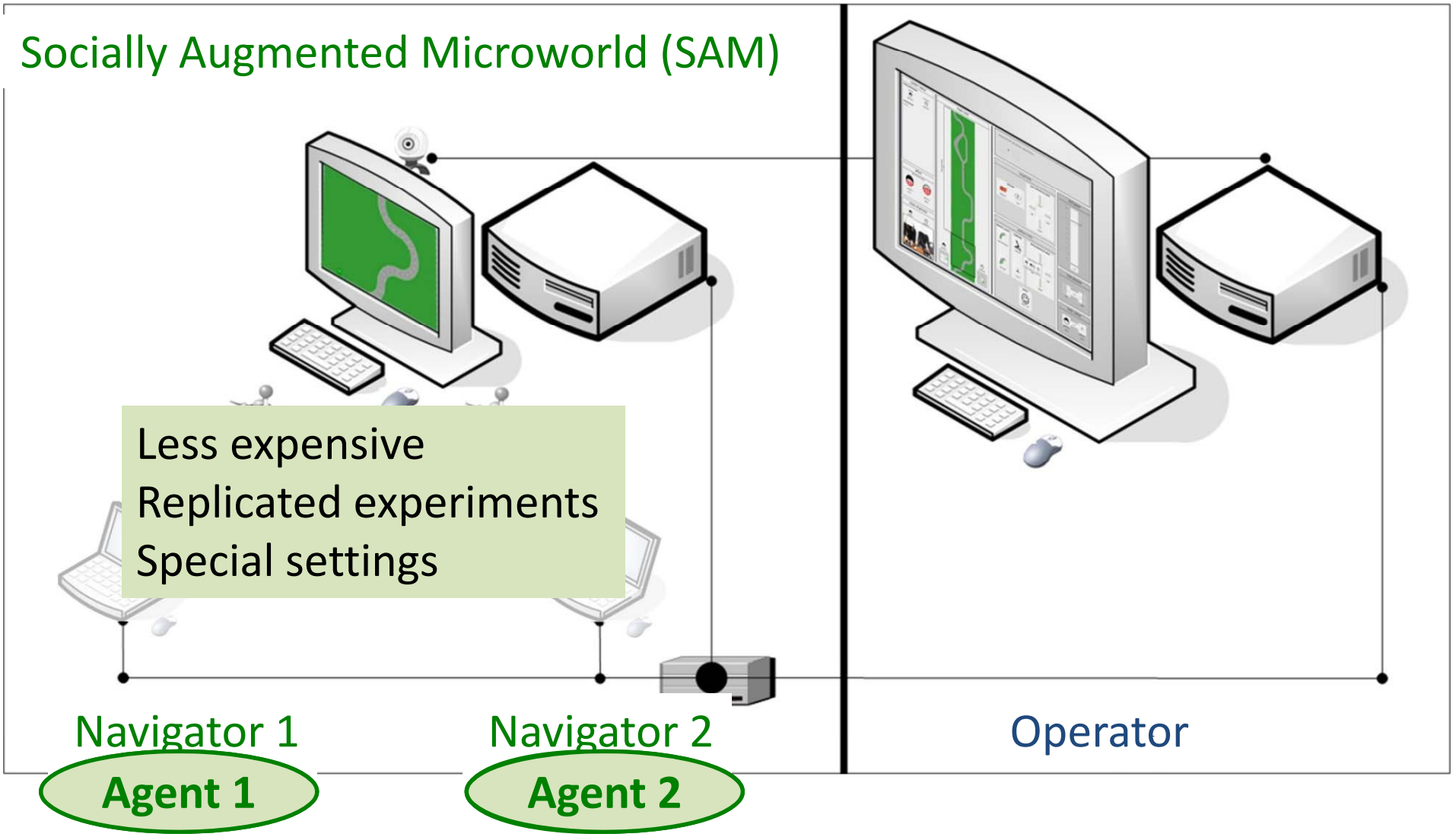
Control of microworld by operator

- Advices to the navigators, e.g.
  - driving style (fast, accurate, …)
  - road information (branch in front, obstacle, …)

- Change of the microworld, e.g.
  - vary the impact of navigators (standard 50% : 50%)
  - hide certain commands, e.g. no left driving

Experiments wit different interfaces.

Substitute human navigators by agents



Reactive vs. deliberative behavior

Reactive:
No internal state:
Same action for
same sensory information

Deliberative:
Internal states like
• former information (world model)
• goals, plans
have impact on actions

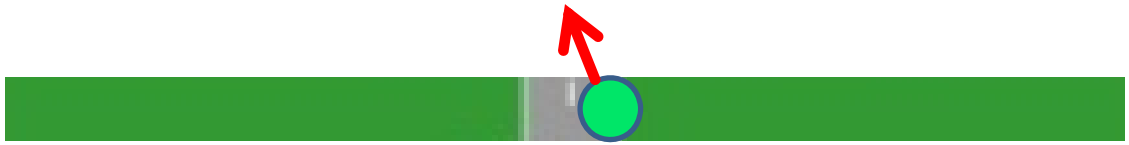
Learning the partner's navigation strategy needs internal states

"Braitenberg Vehicle"

Simple reactive behavior

Keep the car on the middle of the road.

If object left from middle line, then drive right.
If object right from middle line, then drive left.



Deviation from middle line $d \in -800,\ldots,+800$ (number of pixels)

Steering $s \in -100\%,\ldots,+100\%$

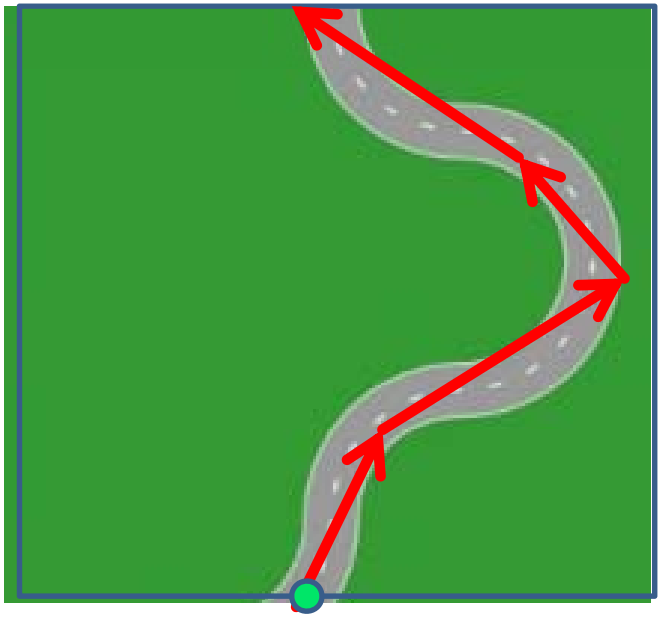
Acceleration $a \in -100\%,\ldots,+100\%$

Proportional to deviation: $s = p_s \cdot d \quad a = p_a \cdot d$ *(p-controller)*

with parameters p_s , p_a

With foresight

Drive according to some calculation.



Reactive:

New calculation at each cycle

Deliberative:

Keep calculated options (“plan”)

Further parameters: Amount of foresight, stability of plans, …

Adaptation

Adaptation to partner's behavior:

Bad results expected if both agents follow same adaptation style (by results from socionics experiments)

Further parameters for adaptation.

Operator can change the influence or give advices.

Experiments wit different interfaces.

Imitate human navigators

Identify *navigator types* according to

typical behaviors at different situations like

- Straight road
- Curves
- Branches
- Obstacles

by analyzing logfiles of experiments with human navigators.

Up to now analysis by hand, later by computer.

Types of human navigators

Results of human analysis

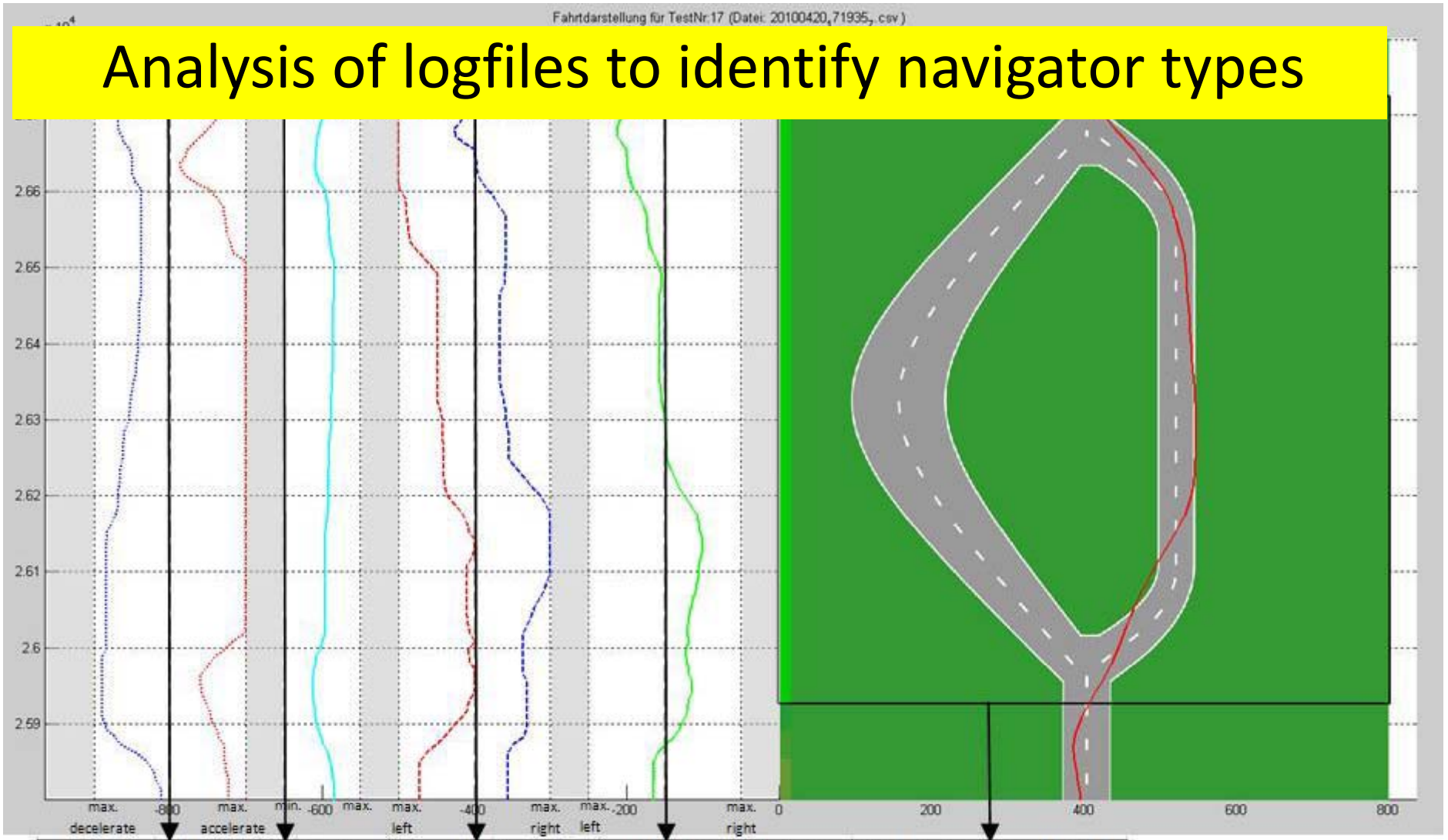
Concerning speed:

- very fast
- fast
- normal
- slow
- very slow

Concerning steering:

- extreme
- adjusted
- direction oriented
- no-steering
- undecided
- not classified

Analysis of logfiles to identify navigator types



acceleration		speed	steering		resultant conjoint steering	relativized route on the track
direction	intensity		direction	intensity		
accelerate	0 =none		right	0 =none		
decelerate	1 =low		left	1 =low		
none	2 =middle		none	2 =middle		
	3 =high			3 =high		

Similarity of navigators

Similarity expresses quality of imitation

measured e.g. by

- similarity of trajectories
- similarity of controls
- similarity of qualitative features (e.g. speed at branches)

Similarity used for clustering: Identify types of navigators

Artificial Agents as Navigators

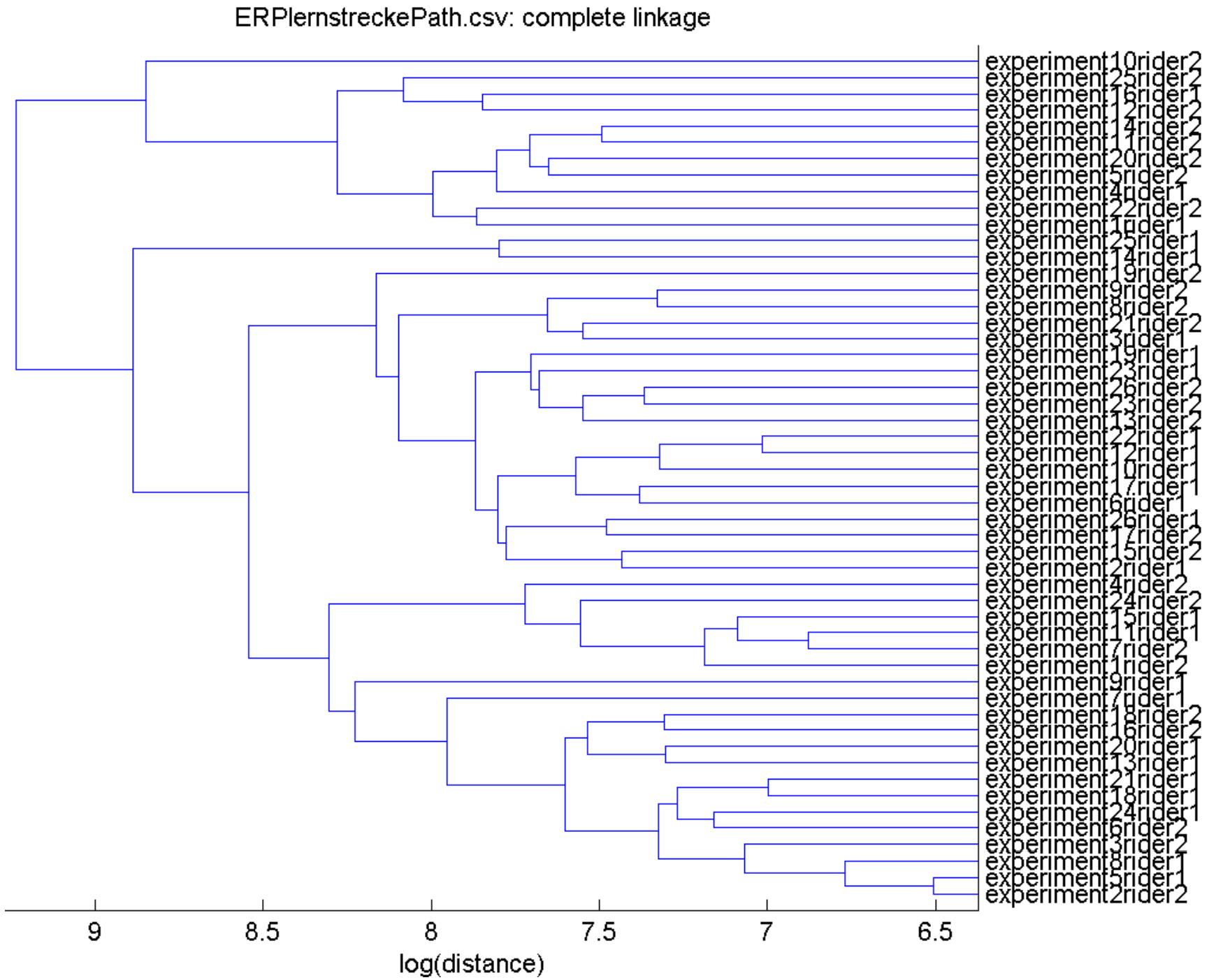
- Substitute humans by agents in experiments

- How complex is human behavior
  (which kind of agent is needed)

Analysis of time series

using

- FAP (Framework for Analysis and Prediction) developed at the Department of Mathematics and Informatics, University of Novi Sad providing usage of
  - All widely accepted similarity measures, including Lp, DTW, CDTW, LCS, CLCS , ERP, EDR, Swale
  - Clustering according to similarity
  - data points, lists of data points, series,
  - some additional mathematical concepts,
  - some representations


ERPlernstreckePath.csv: complete linkage
experiment10rider2
experiment25rider2
experiment16rider1
experiment12rider2
experiment14rider2
experiment11rider2
experiment20rider2
experiment5rider2
experiment4rider1
experiment22rider2
experiment1rider1
experiment25rider1
experiment14rider1
experiment19rider2
experiment9rider2
experiment8rider2
experiment21rider2
experiment3rider1
experiment19rider1
experiment23rider1
experiment26rider2
experiment23rider2
experiment13rider2
experiment22rider1
experiment12rider1
experiment10rider1
experiment17rider1
experiment6rider1
experiment26rider1
experiment17rider2
experiment15rider2
experiment2rider1
experiment4rider2
experiment24rider2
experiment15rider1
experiment11rider1
experiment7rider2
experiment1rider2
experiment9rider1
experiment7rider1
experiment18rider2
experiment16rider2
experiment20rider1
experiment13rider1
experiment21rider1
experiment18rider1
experiment24rider1
experiment6rider2
experiment3rider2
experiment8rider1
experiment5rider1
experiment2rider2
9
8.5
8
7.5
7
6.5
log(distance)