

# Modeling the Human Operator's Cognitive Process to Enable Assistant System Decisions

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## Manned-Unmanned Teaming (MUM-T)



## Assistant System Approaches for MUM-T

- Assistant System Requirements
- Recognizing the Operator's Current Activity
- Evaluating the Operator's Plan



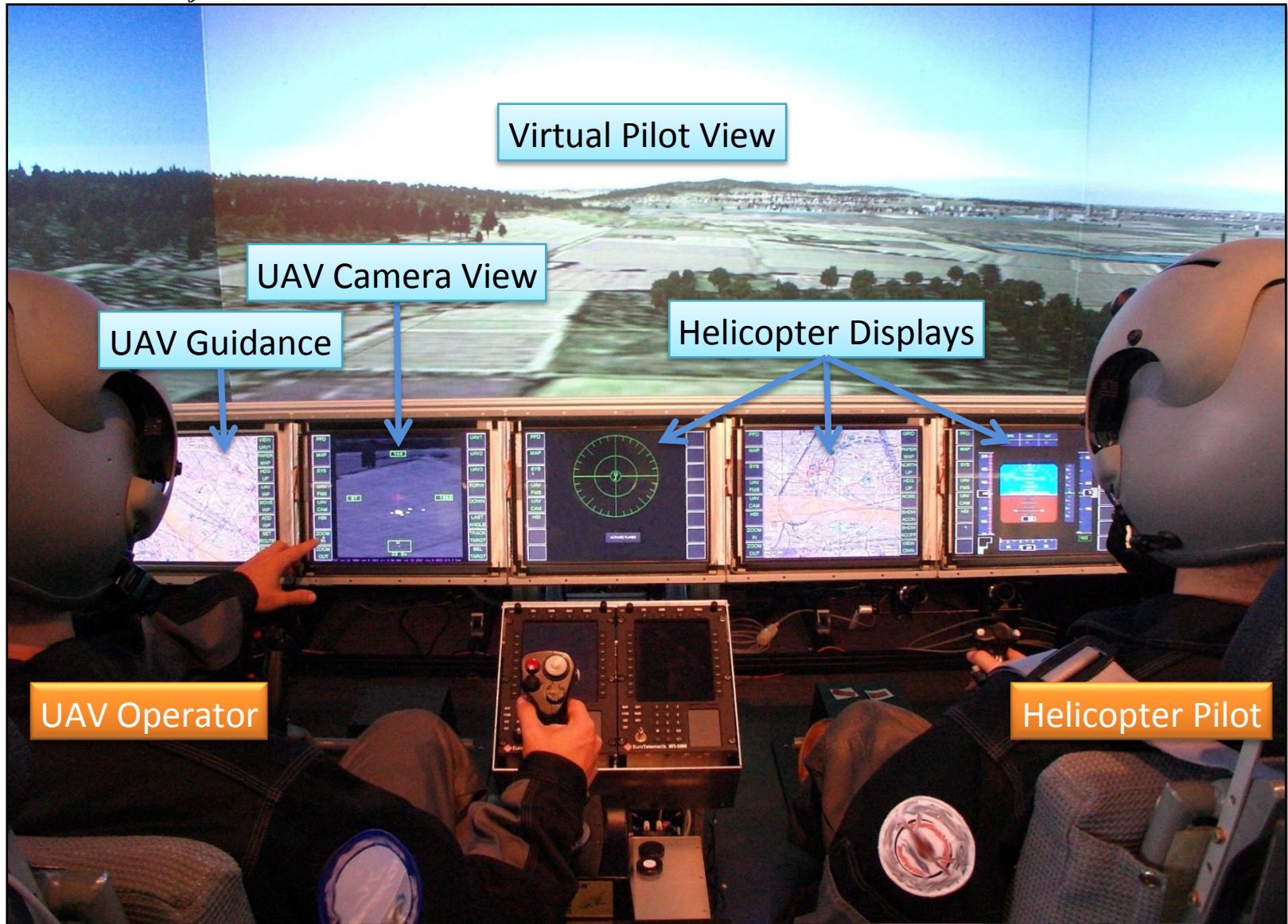
## Human Operator Model

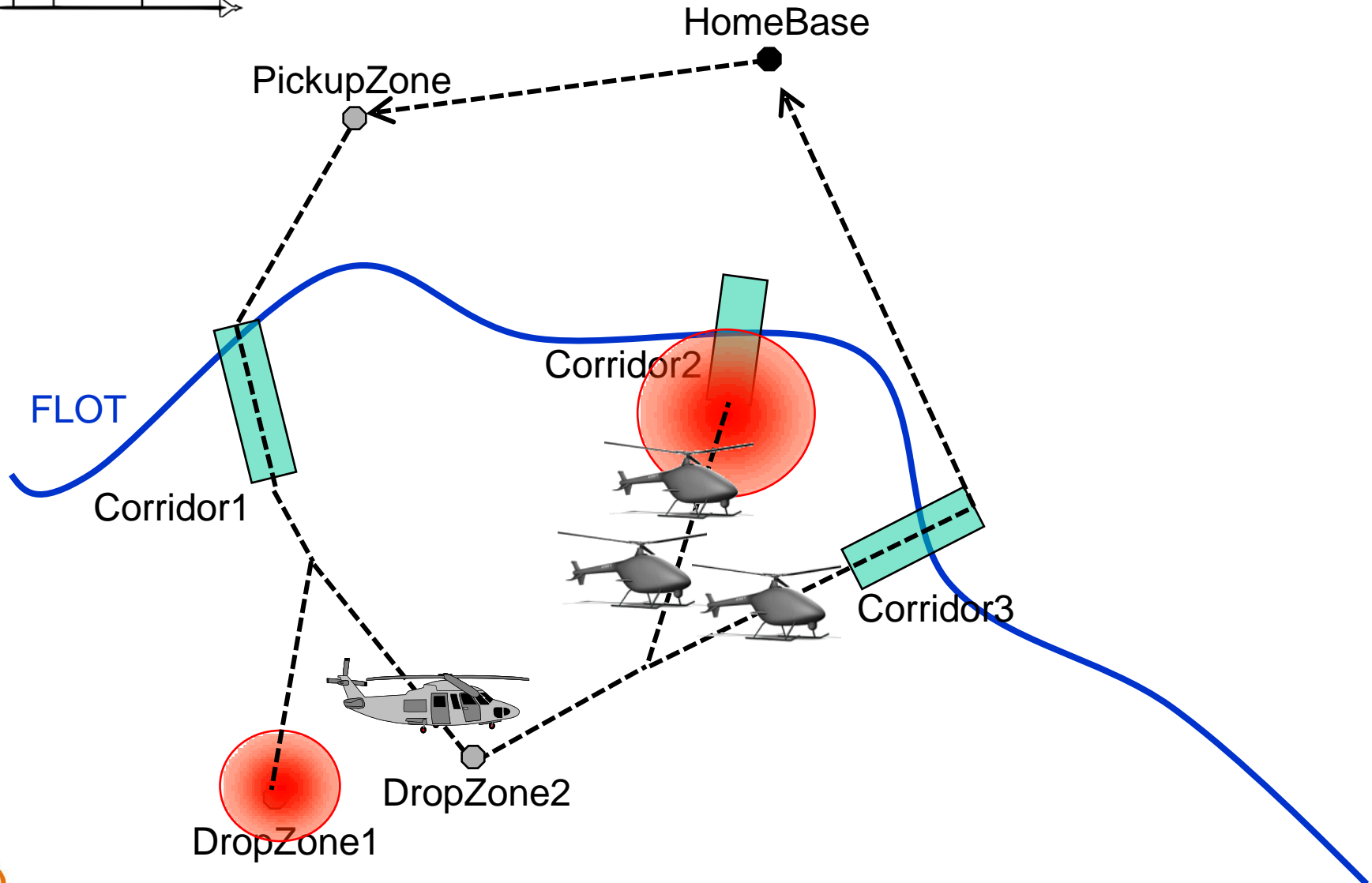


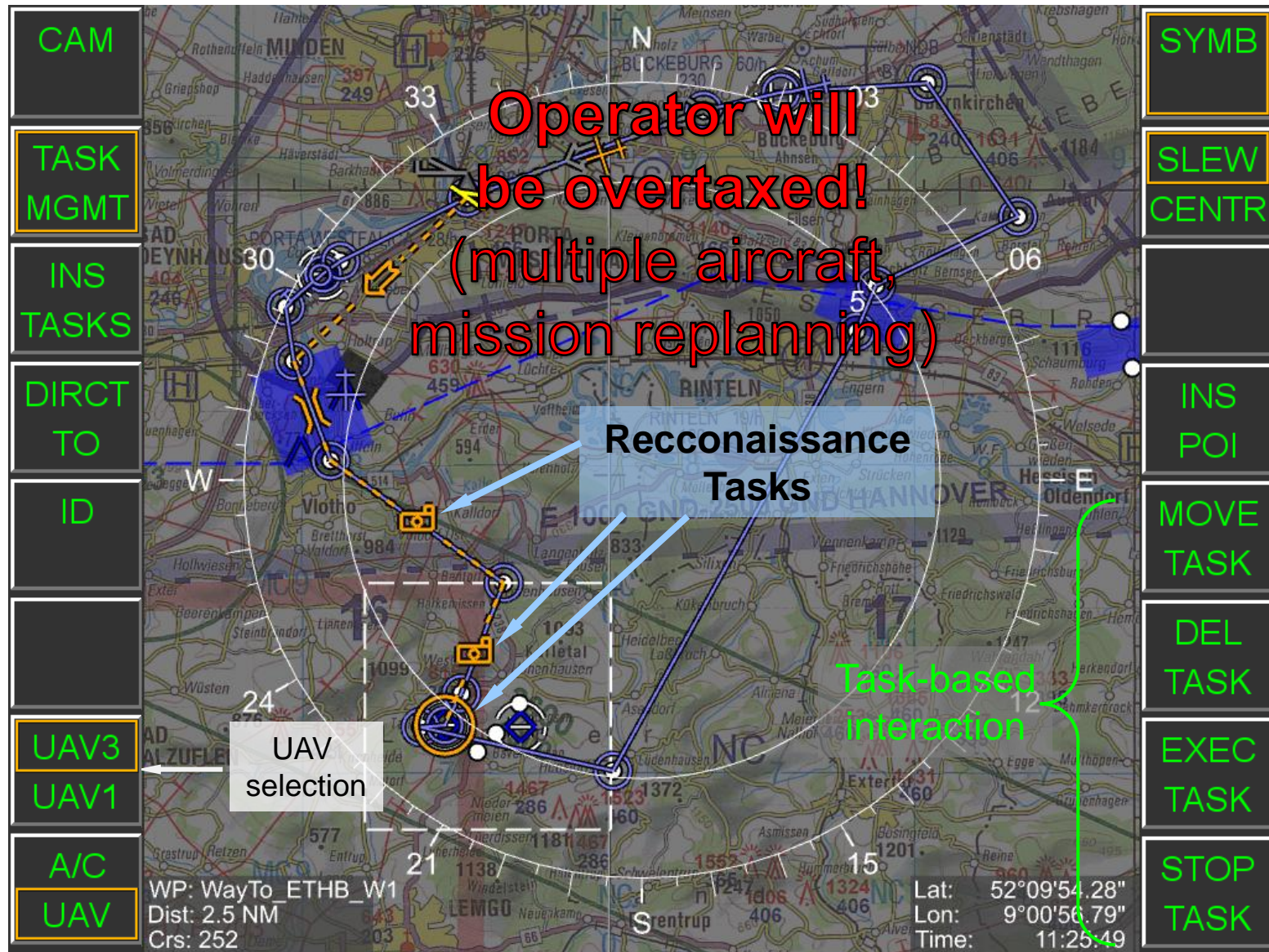
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## Manned-Unmanned Teaming (MUM-T) Crew Concept











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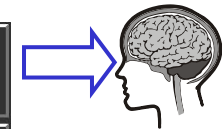
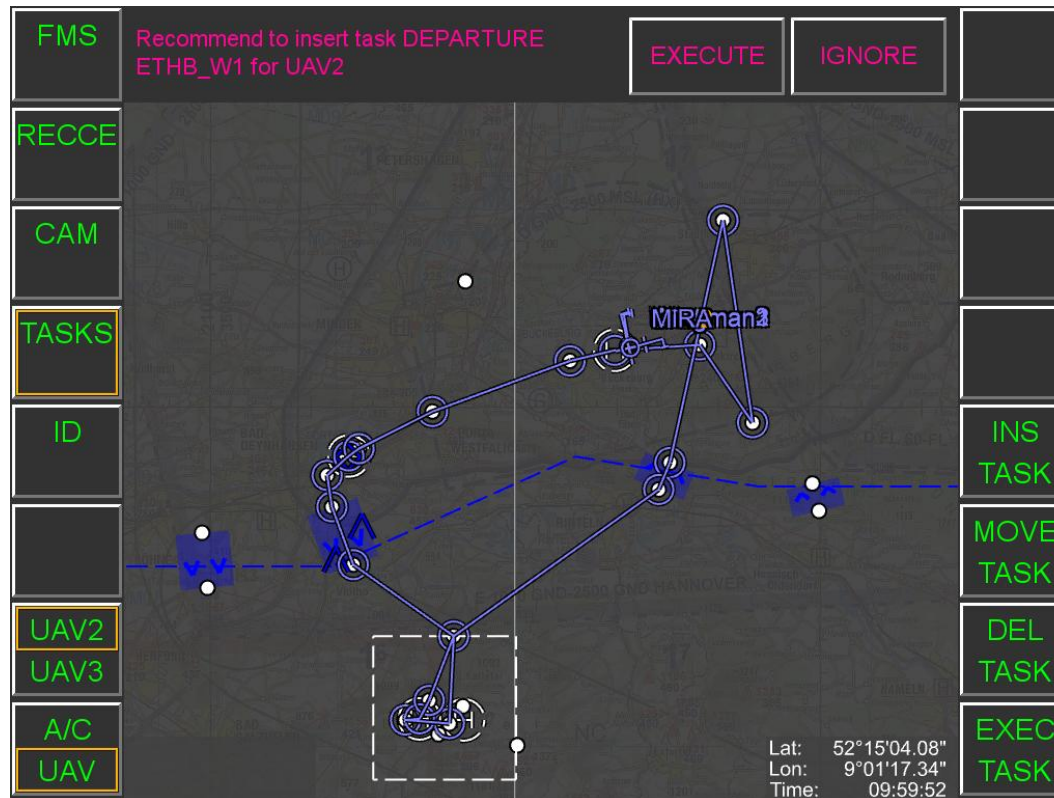
Human Operator Model



- Assistant system shall guide attention to most urgent task and intervene if necessary
- Assistant system communicates via *speech synthesis monolog* and *display dialog*
- Three initiative levels: *advice* → *proposal generation* → *task re-allocation*



**Assistant  
system for  
UAV operator**



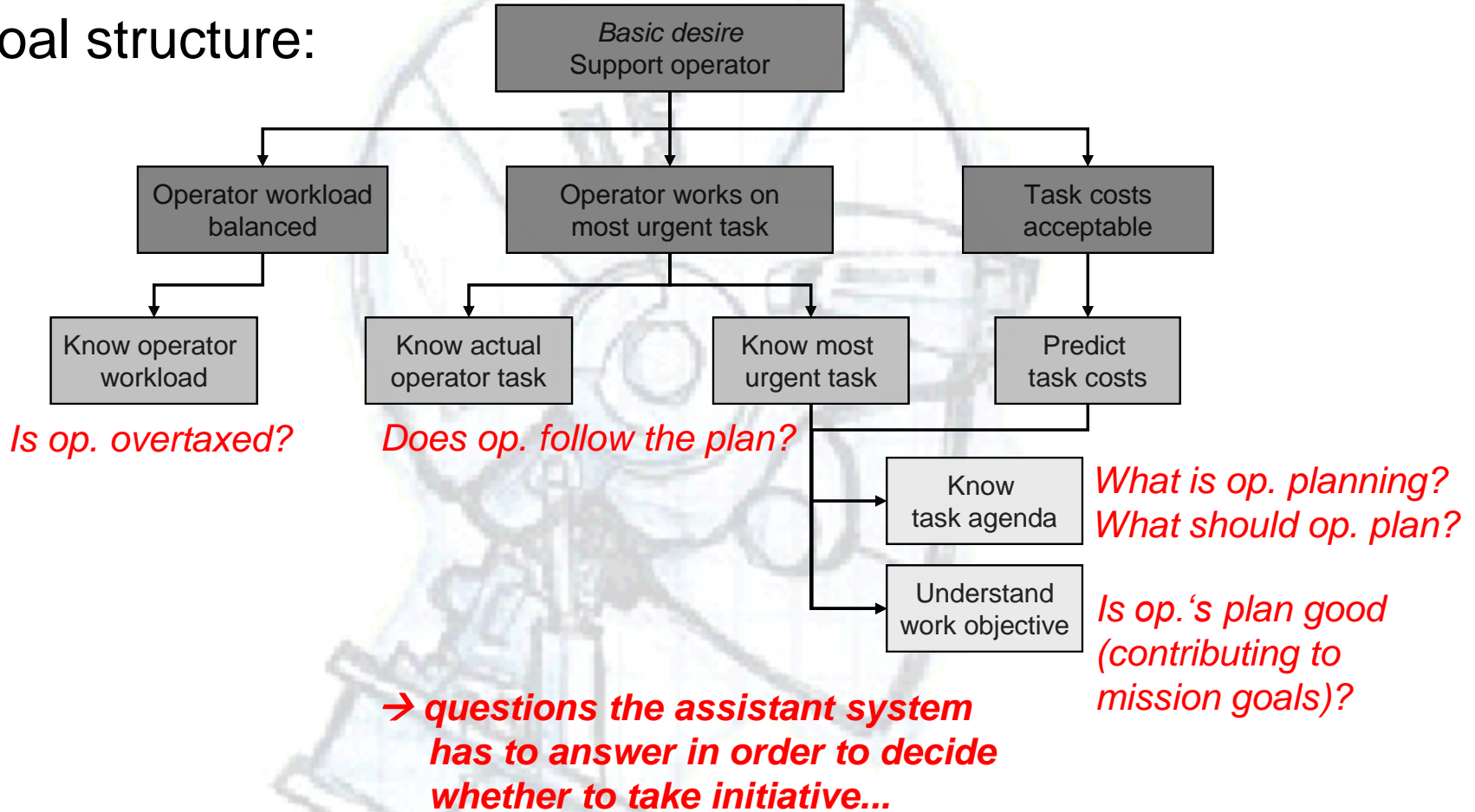
**UAV operator**



- Assistant System takes initiative: “UAV1 needs follow-up task”
- Operator presses **proposal**-button
- Assistant System proposes: “add task *transit A B* for UAV1”
- Operator presses **accept**-button
- Assistant System affirms: “added task *transit A B* for UAV1”
- etc.



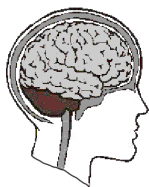
- Goal structure:



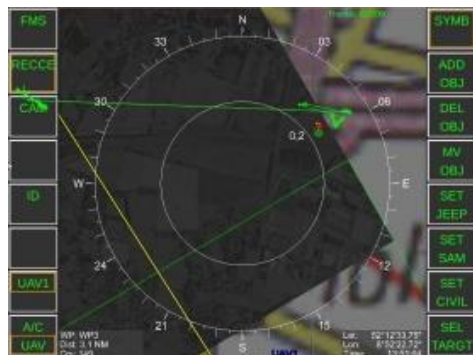
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## Estimating Operator's Current Workload and Task

Multi-UAV  
operator



Visual & manual  
touchscreen  
interactions



Most probable task and workload  
situation:

Target identification with 3UAVS,  
using self-adapting strategy SAS 2



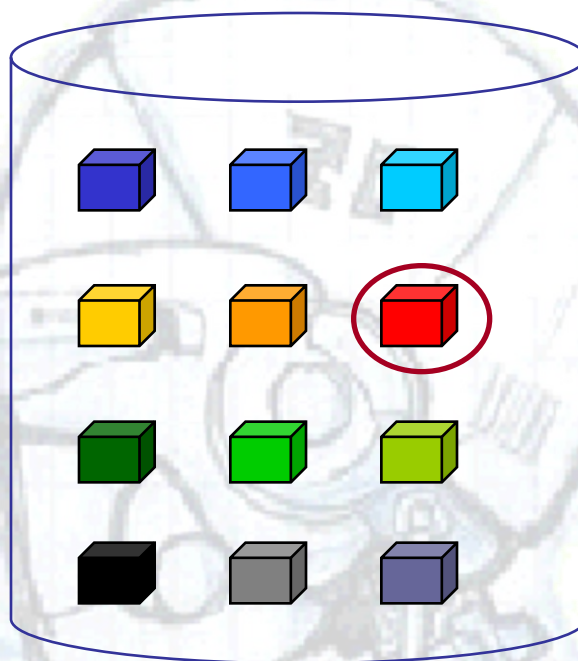
Tasks

Target identification (1UAV)

Target identification (3UAVs)

Threat replanning (1 UAV)

Threat replanning (3 UAVs)



Each cube  
represents  
one *HMM*

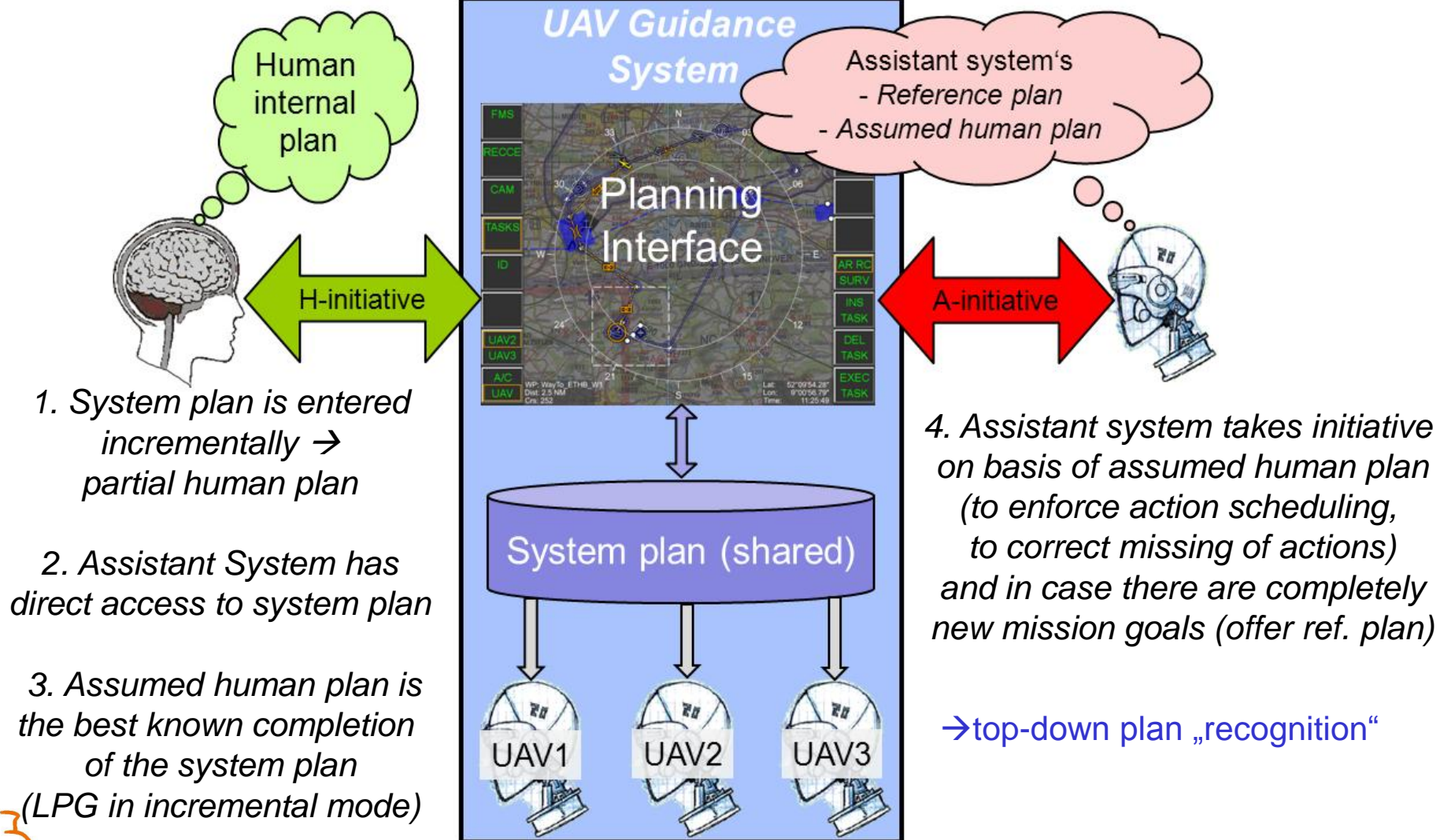
*...So far only  
offline...*

Workload



workload → Critical workload





→Srivastava et al. (2007) generating diverse plans via local search (LPG-d)

→Nguyen et al. (2009) working with partial user preference models

- Estimating operator's current mental resource utilization / capacity (online)
  - to adapt information channel used by assistant system
  - precondition: we have to know about operator's current
    - task situation (to match with a task-resource model)
    - activity (e.g. radio transmission, looking at display x)
- Improving gaze tracking data quality for online decision-making
  - data about operator's situation awareness (*beliefs*)
    - which map object looked at, which message read
  - precondition: know about operator's task situation
    - Kalman Filtering





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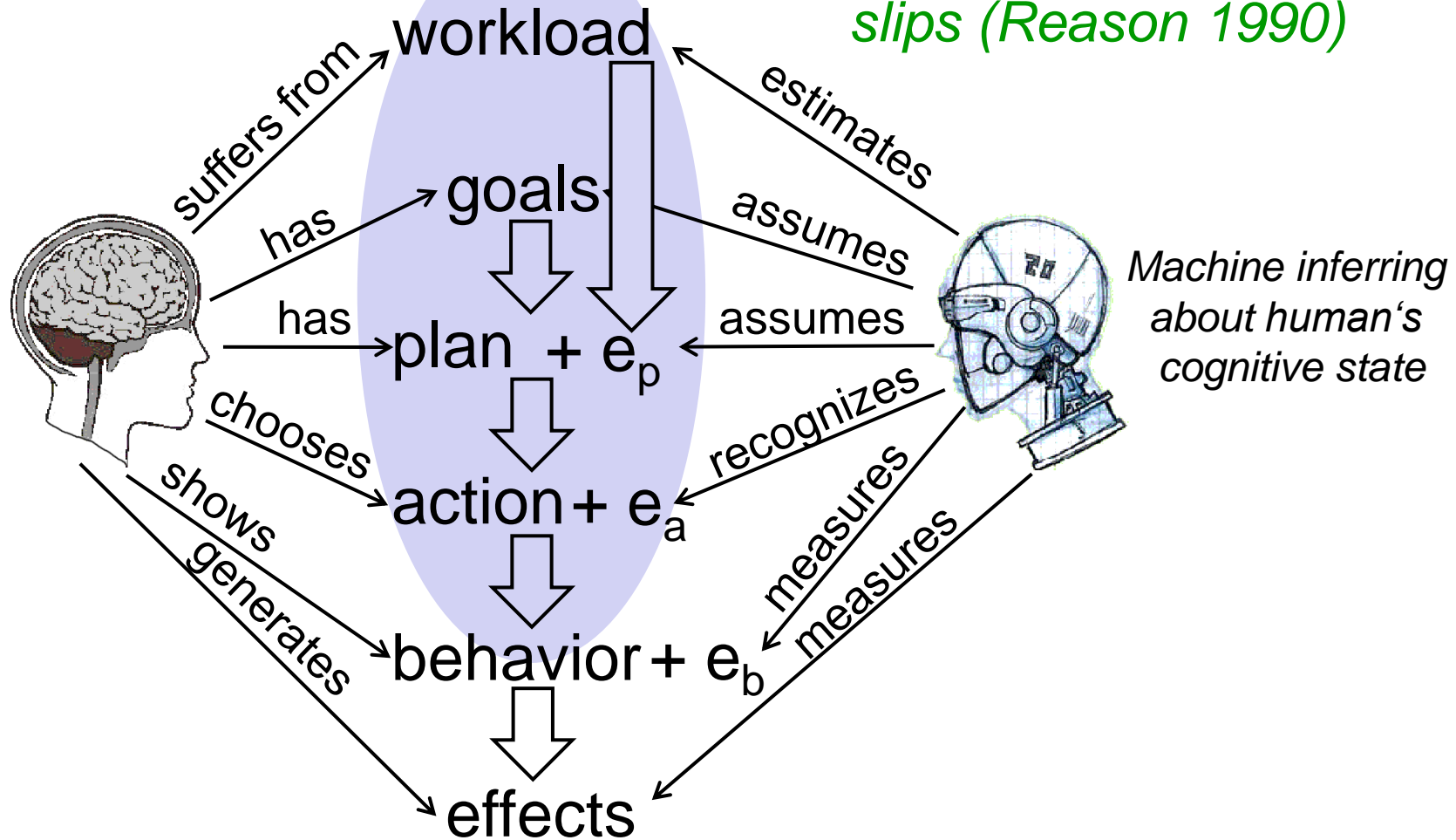


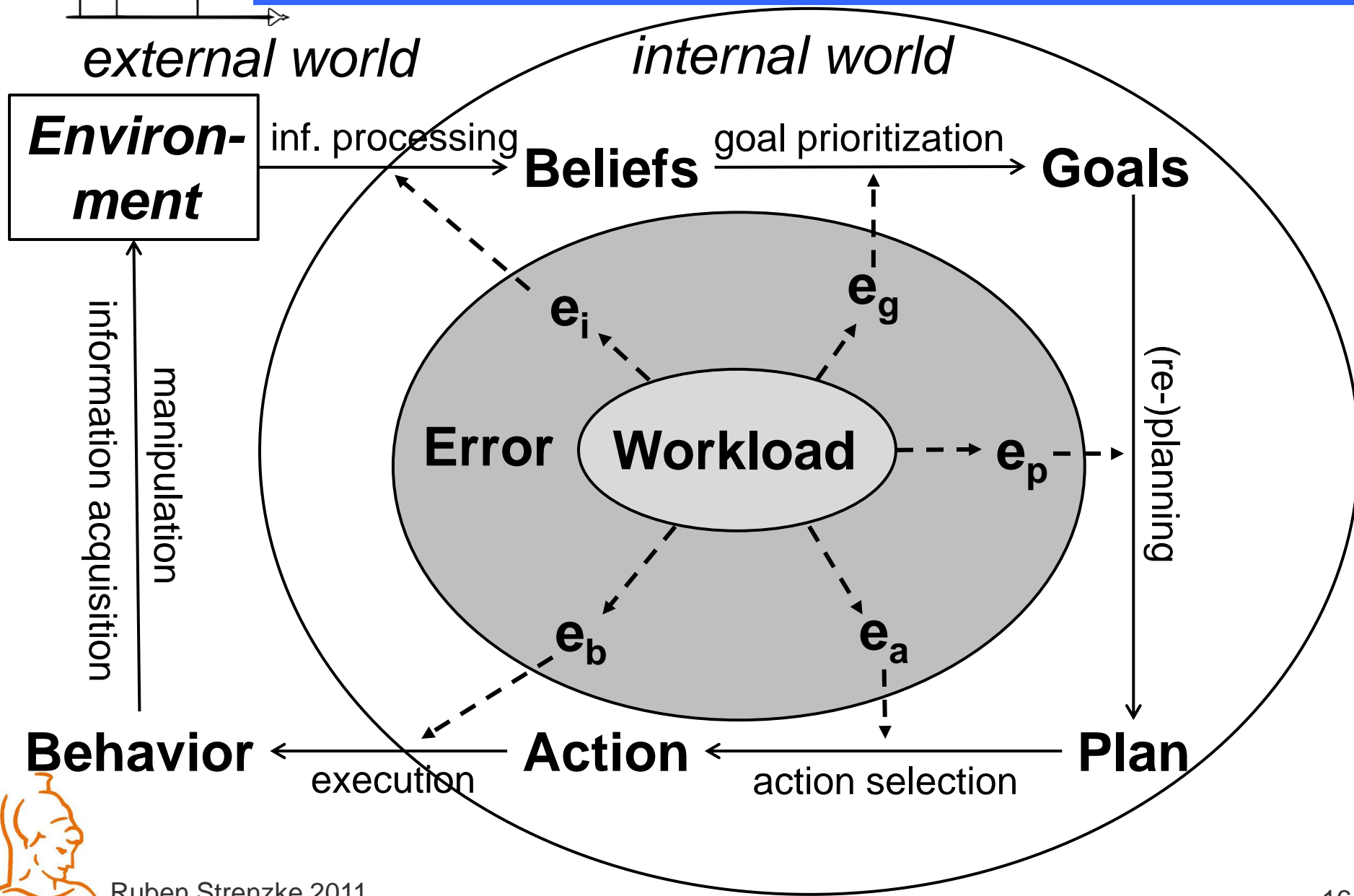
Human Operator Model

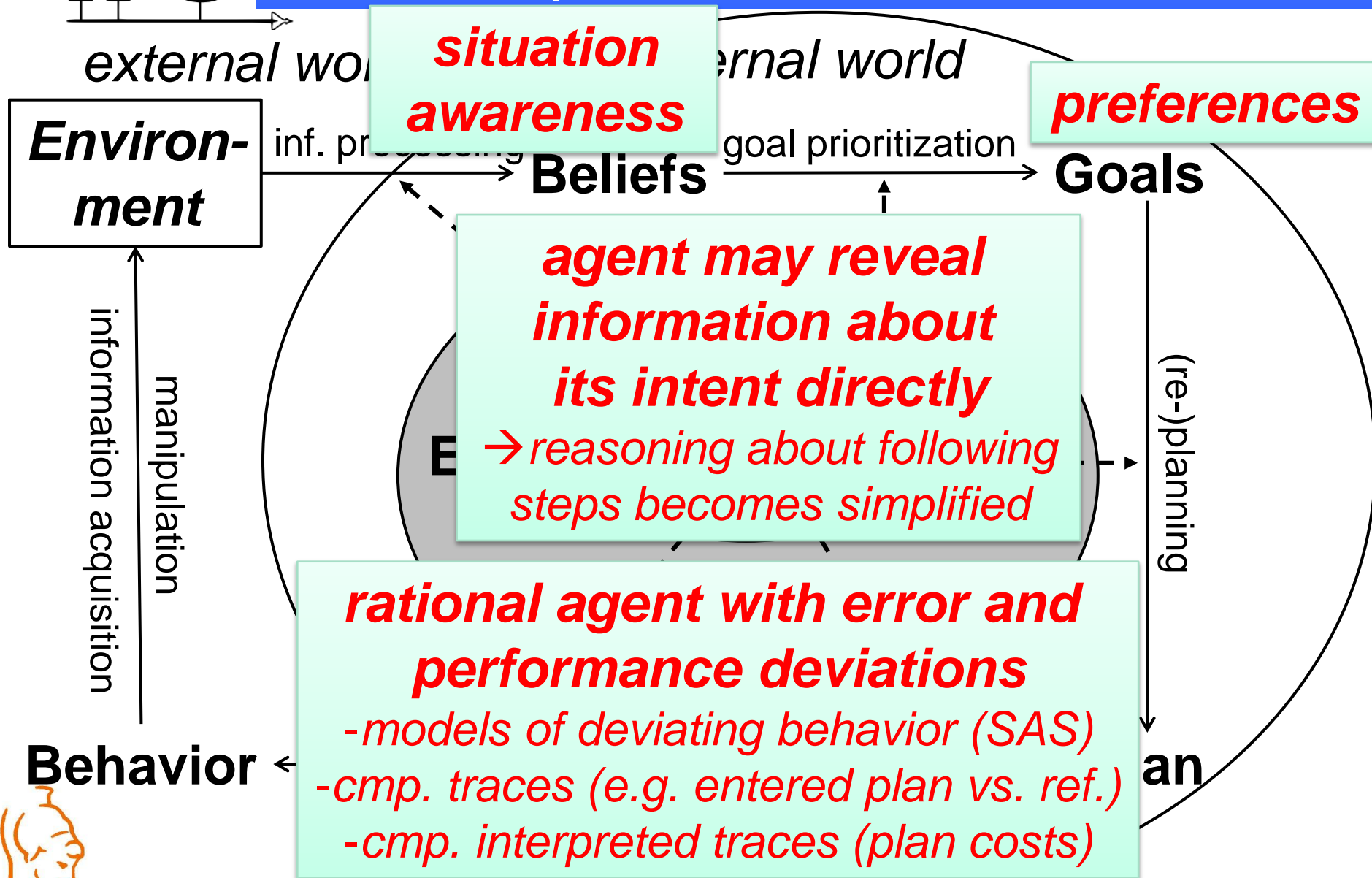


Human operator's  
cognitive state

*Human Error:  
Mistakes, lapses,  
slips (Reason 1990)*









*Thank you very much  
for your attention!*



*Comments and questions welcome...*



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