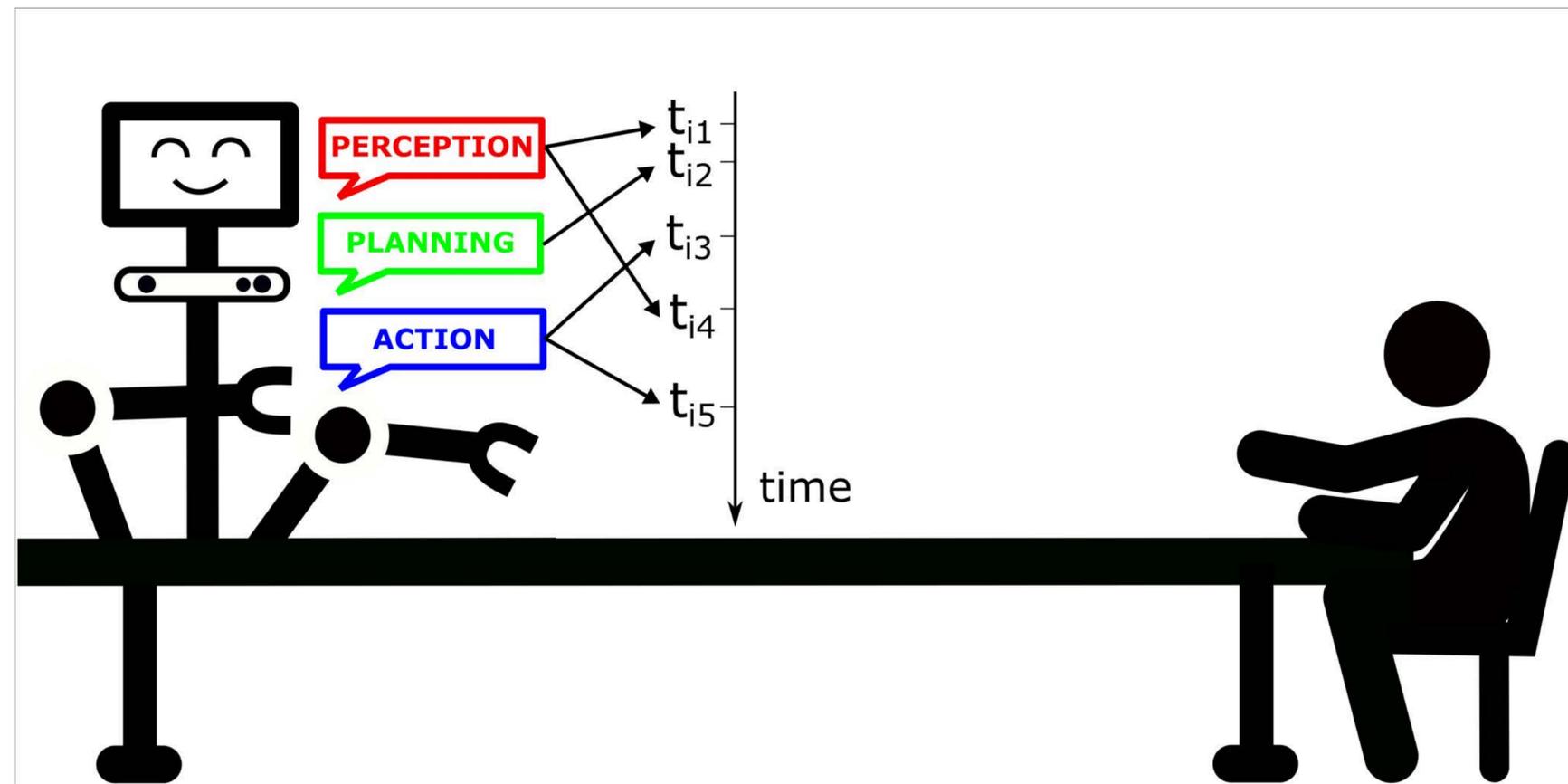
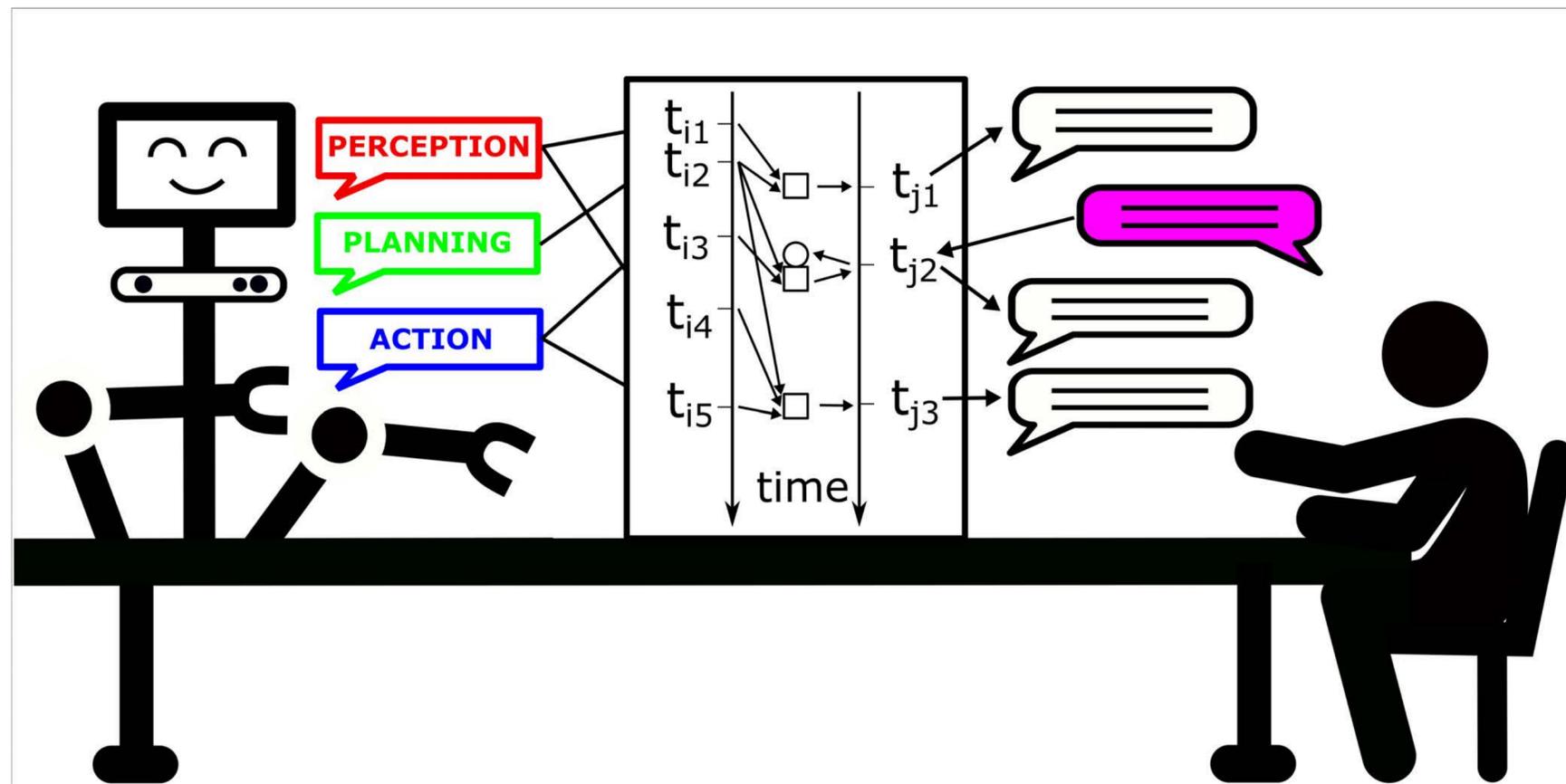

COHERENT: COLLABORATIVE HIERARCHICAL ROBOTIC EXPLANATIONS

CSIC (Spain), KCL (UK) and UNINA (Italy)

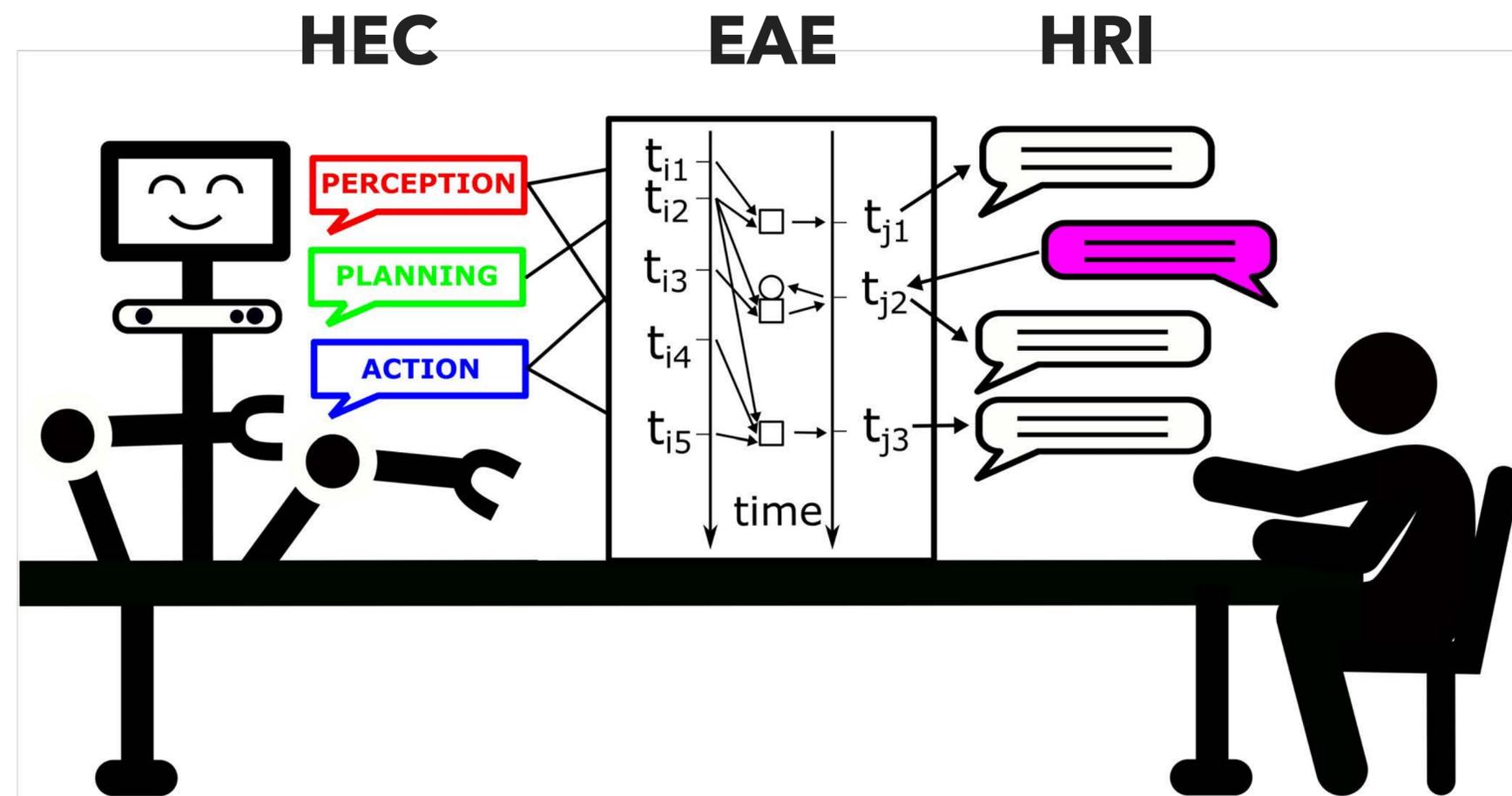
- ▶ Robotic systems consist of several processes interacting with each other to accomplish a task.
 - ▶ Relevant **explanations** may come from the such subsystems at **different layers**
 - ▶ Deep learning perception tools
 - ▶ Decision-making tools
 - ▶ Machine learning-based motions
- ➔ Combine into an **coherent** explanation



- ▶ **Hierarchical Explanation Framework:** to combine the information from the different levels
- ▶ Delivered **during execution** for true collaboration
- ▶ For user acceptance, explanations need to consider **user preferences** and **contextual information**.
- ▶ Definition of **measures** to evaluate the **effectiveness** of an explanation.

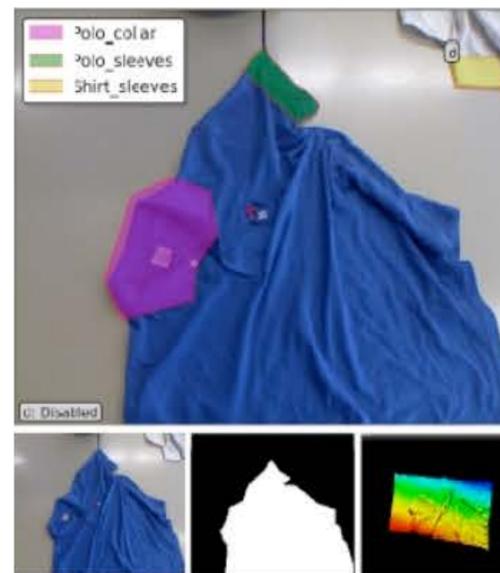
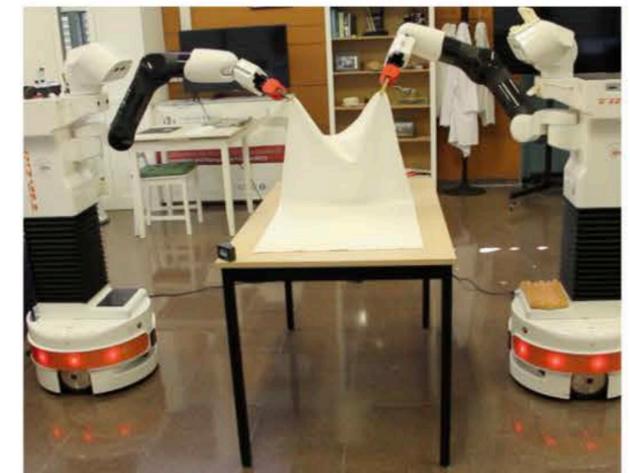


- ▶ Hierarchical Explanation Components (**HEC**): how to store and retrieve information.
- ▶ Explainability along the execution (**EAE**): what to explain and when.
- ▶ Benchmark for **HRI**: metrics for acceptance and effectiveness of explanations tailored for assistive robotic tasks



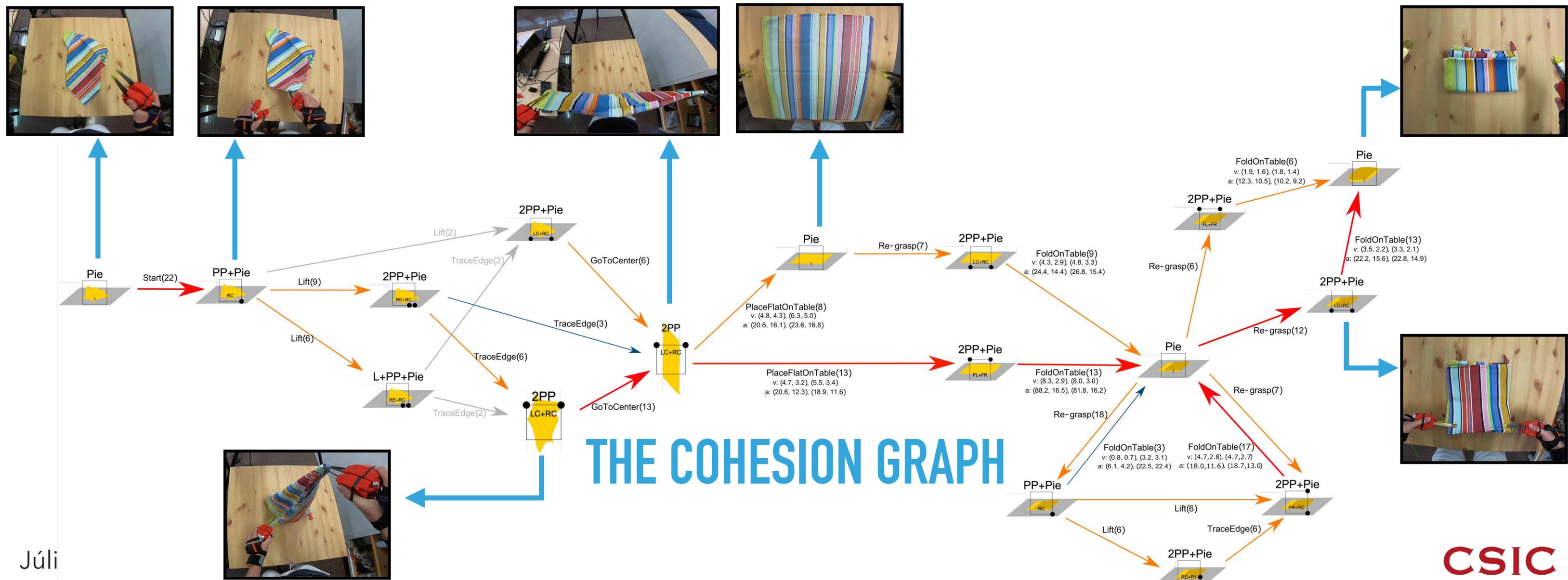
USE CASE: ASSISTIVE CLOTH MANIPULATION TASK

- ▶ Task with **impact in industry**
 - ▶ Clothing industry: inverse logistics and stores
 - ▶ Health care: logistics in hospitals and retirement homes.
 - ▶ Assistive robotics in general.
- ▶ Task with **enough complexity**
 - ▶ Bimanual grasps, environmental constraints, several steps
 - ▶ Requires to **reason** about manipulation **decisions**
- ▶ Utilize CSIC previous experience on cloth manipulation



HIERARCHICAL EXPLANATION FRAMEWORK

- ▶ Novel representation of a task as a graph of **transitions** between **scene states**.
- ▶ Common representation to drive each layer explanation, facilitating the **cohesion** and the **assembly of a coherent message**.



- ▶ Standard **framework** to
 - ▶ **Combine** explanations of **different natures**.
 - ▶ Provide explanations **along execution**.
- ▶ A set of **measures** to evaluate the **effectiveness** of explanations, together with a **benchmark of tasks**.
- ▶ **Dataset:**
 - ▶ Labeled video data (used to learn the Cohesion Graph).
 - ▶ Collected data during the pilot study.
- ▶ The **Cohesion Graph**: A data structure to encode a manipulation task.
To close the gap between
 - ▶ High level planning, semantics and explainability.
 - ▶ Low-level trajectories and execution controllers.

PROJECT PLAN AND ORGANIZATION



CSIC - Spain

PI & Coord.: Júlia Borràs



KCL - UK

PI: Andrew Coles



UNINA - Italy

PI: Silvia Rossi

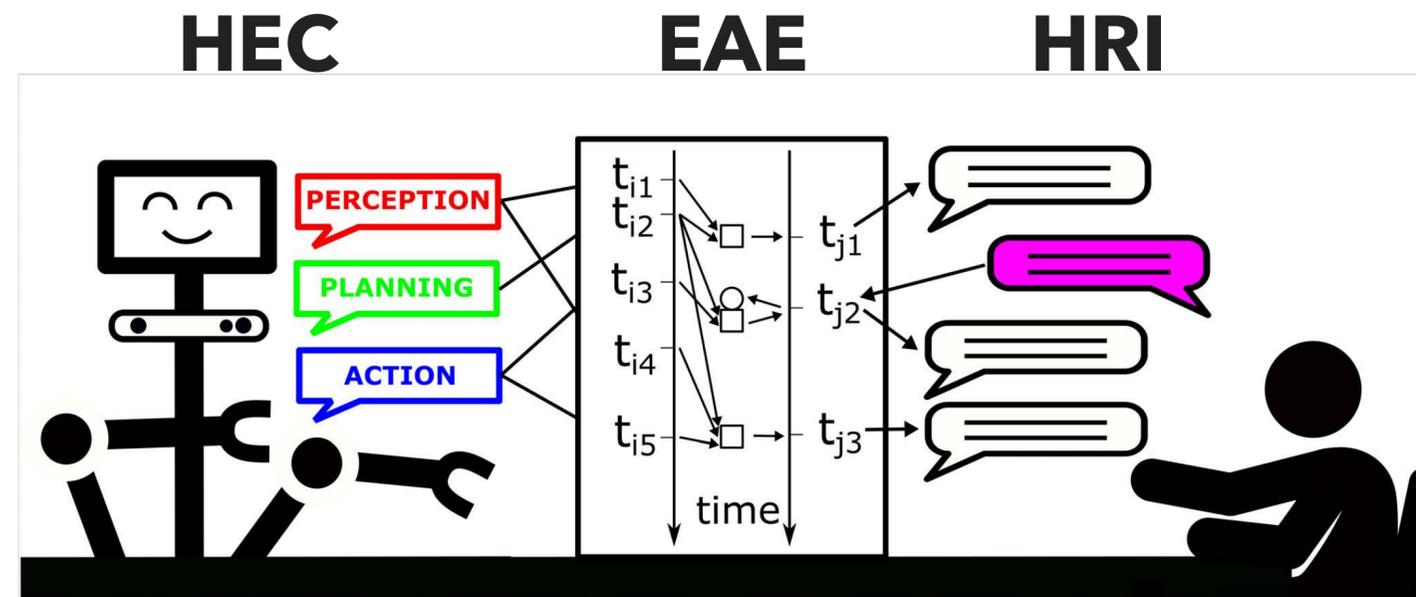


- ▶ Started April 1st, 2021 – 3 year project

Cohesion graph

Timing, synthesis, communication, metrics...

Pilot study



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COHERENT: COLLABORATIVE HIERARCHICAL ROBOTIC EXPLANATIONS

