Planning, Execution and Monitoring of Physical Rehabilitation Therapies with a Robotic Architecture

José Carlos González, José Carlos Pulido, Fernando Fernández y Cristina Suarez-Mejías

MIE 2015: Medical Informatics Europe

Overview

1. Introduction
2. Use Case Explanation
3. NAO Therapist Architecture
4. Evaluation
5. Conclusion and future work

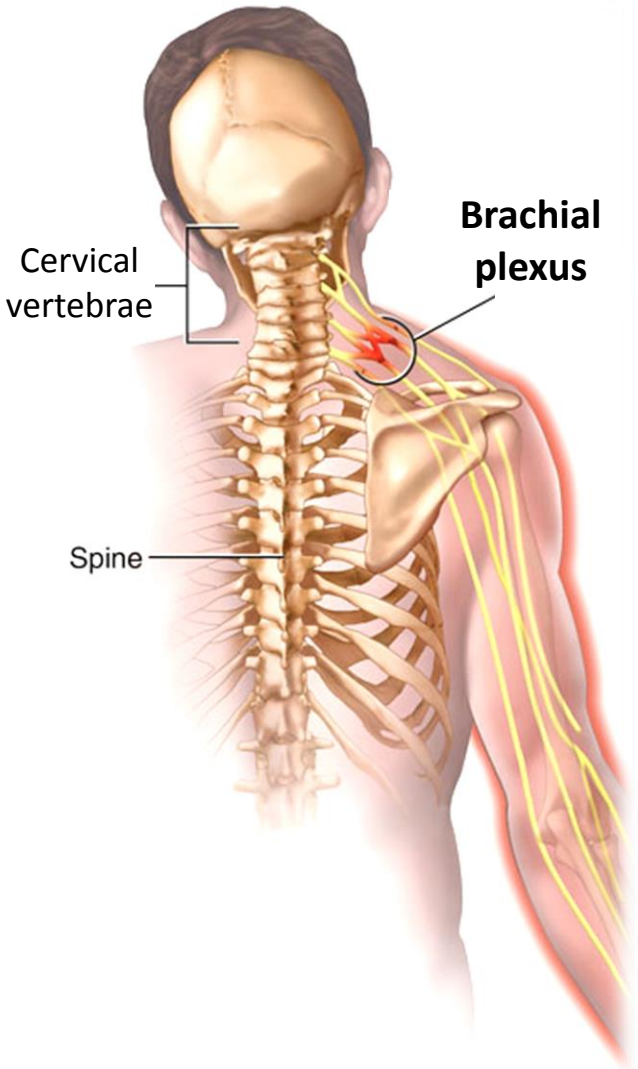
Introduction

Focused Patients

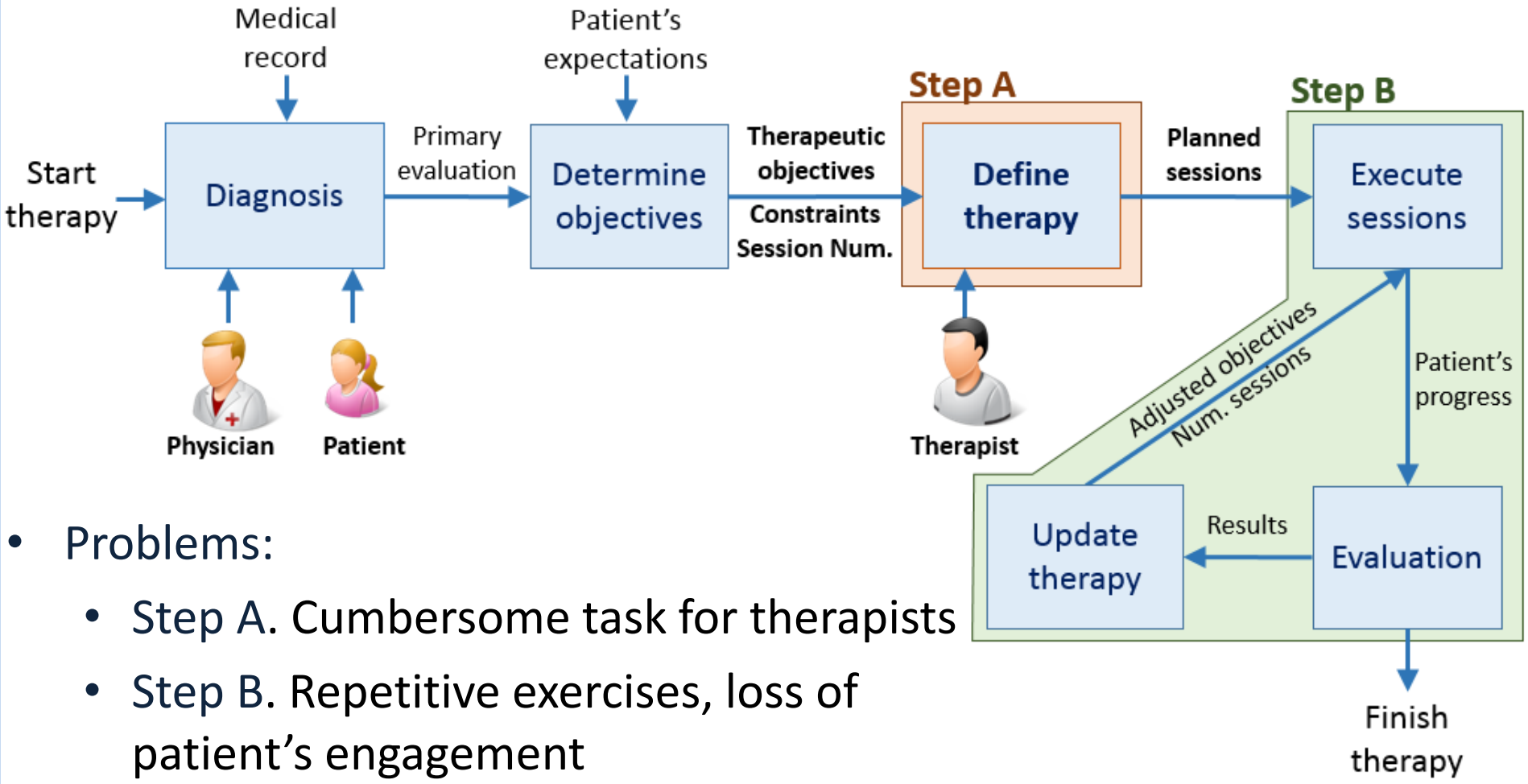
- Children from 4 to 14 years old
  - Obstetric Brachial Plexus Palsy
  - Cerebral Palsy

- Causing upper limb disorders

- Rehabilitation helps to:
  - ✓ Recover upper limb mobility
  - ✓ Drecrease muscle rigidity
  - ✓ Increase patient's autonomy
    - Dressing
    - Eating



Rehabilitation Procedure



- Problems:
  - Step A. Cumbersome task for therapists
  - Step B. Repetitive exercises, loss of patient's engagement

Towards Novel Therapy Methods

Our Goals

- Cognitive architecture to support and develop physical rehabilitation sessions with a humanoid robot:
  - Based on child-robot social interaction
  - Full autonomy without human intervention
  - Session monitoring and exercise validation
  - Adaptation to each patient's difficulties
  - Automatic design of therapies
  - Generation of clinical reports

UNIVERSIDAD DE MÁLAGA

HOSPITALES UNIVERSITARIOS Virgen del Rocío

Use Case Explanation

NAOTherapist

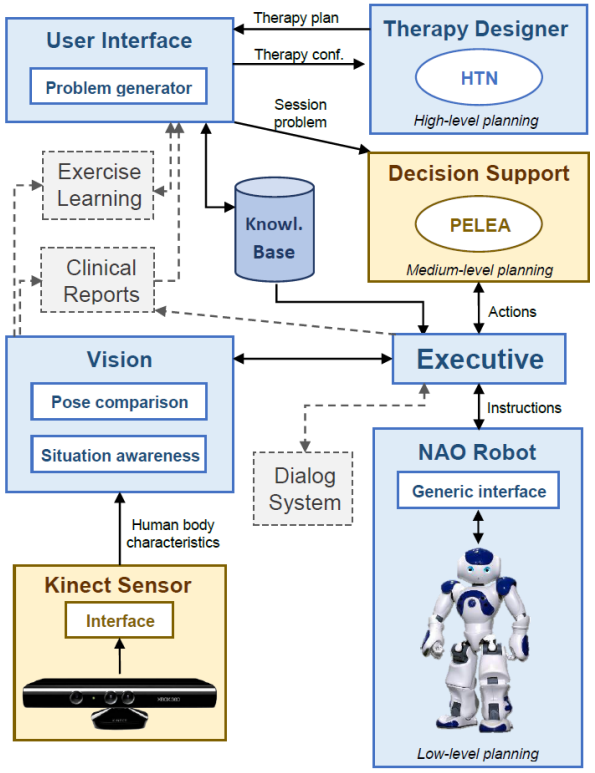
What is a rehabilitation session with NAO like?

https://youtu.be/75xb39Q8QEg

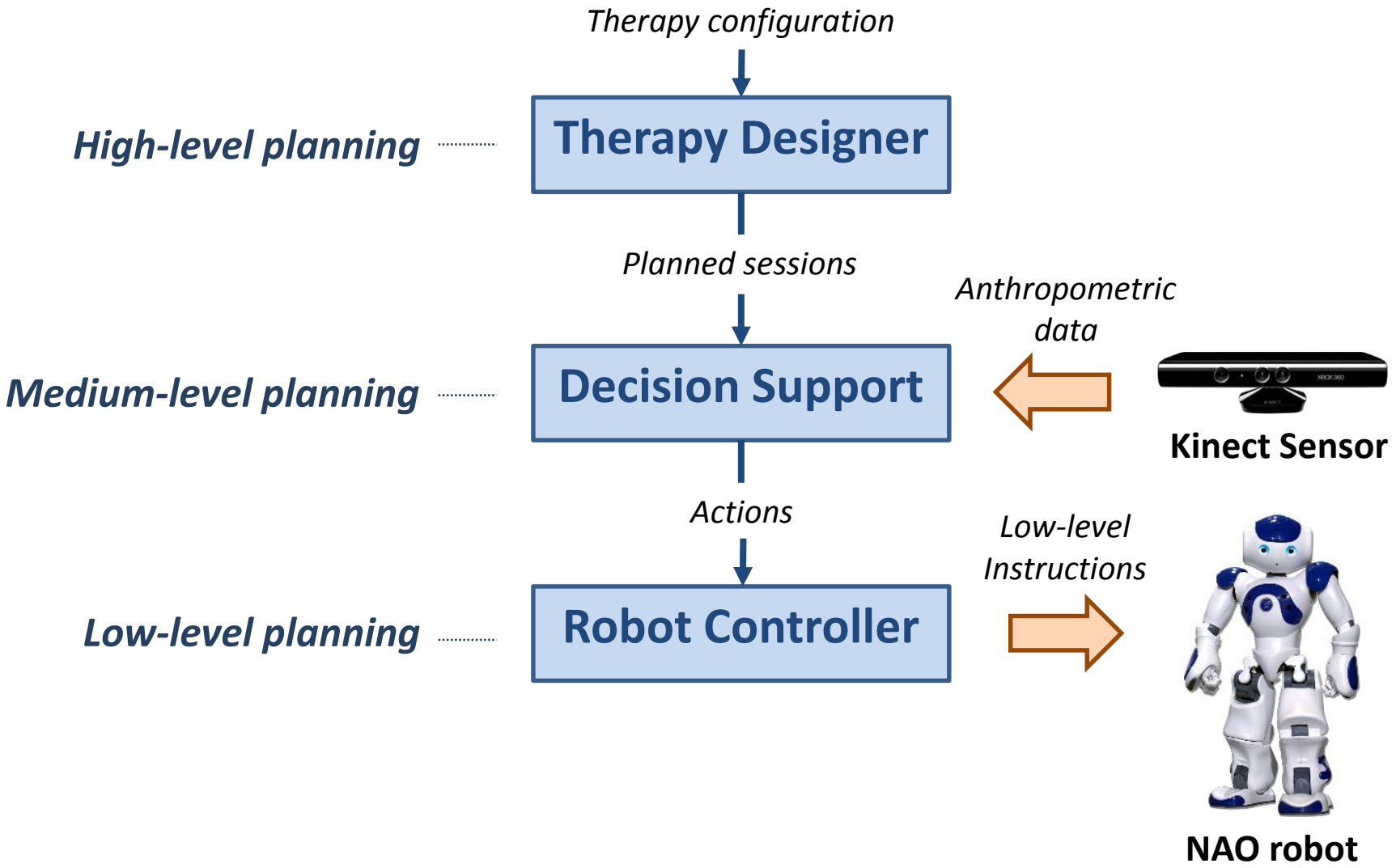
NAOTherapist Architecture

NAOTherapist Architecture

- Includes **Artificial Intelligence** techniques
- Comprises three levels of Automated Planning
- Based on individual components
- Easily extensible and configurable
- Independent of the robotic platform
- Provides complete autonomy to the robot



Three Levels of Planning



Evaluation

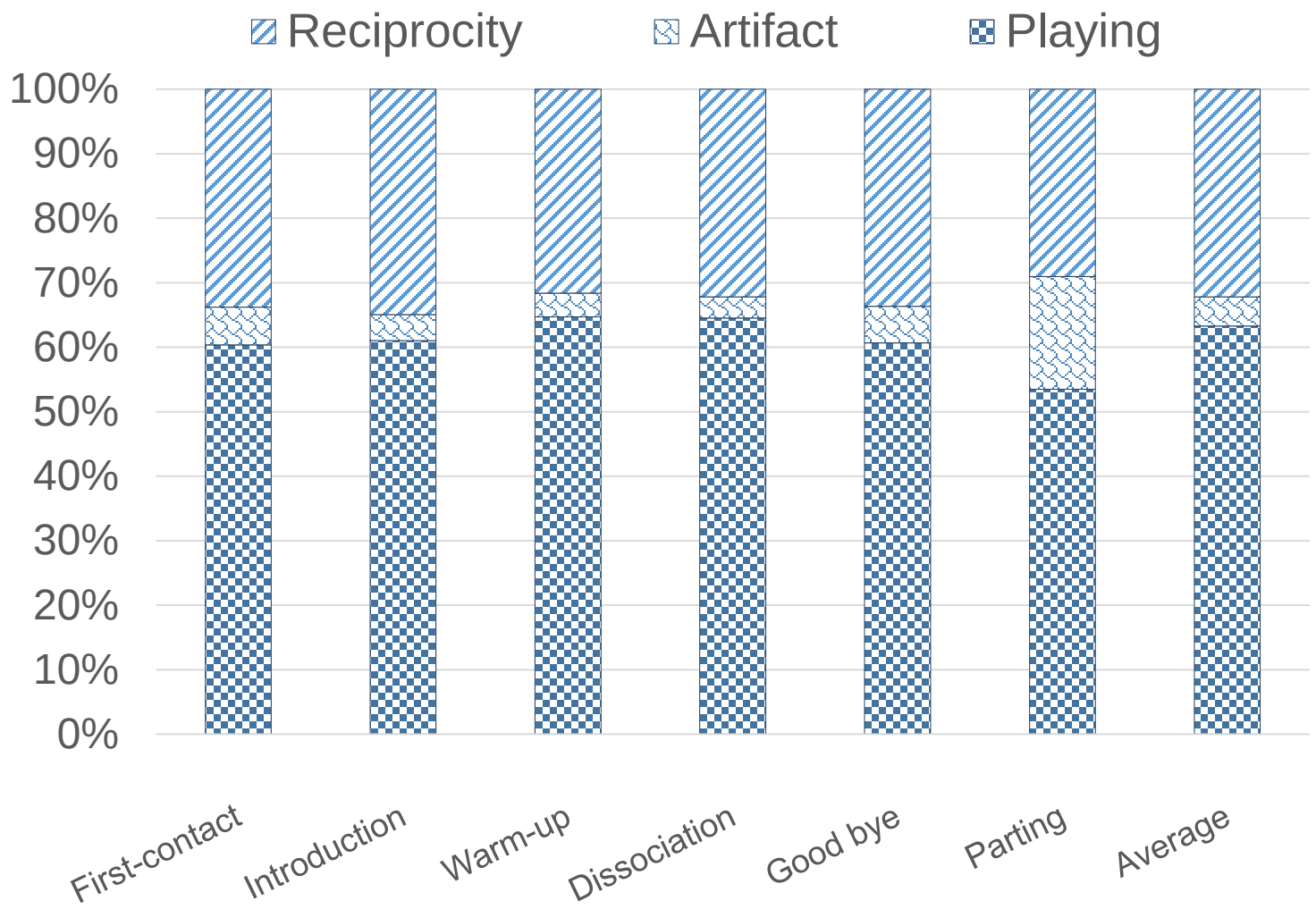
Evaluation

- First evaluation with **120 school children**
- Second evaluation with **3 pediatric patients** in the HUVR
- Evaluation points:
  - Social Interaction and presence of the robot
  - Children's attitude and behavior
  - Active engagement and commitment
  - Performance of the patients
  - Usefulness of the prototype

Categories of Video Analysis

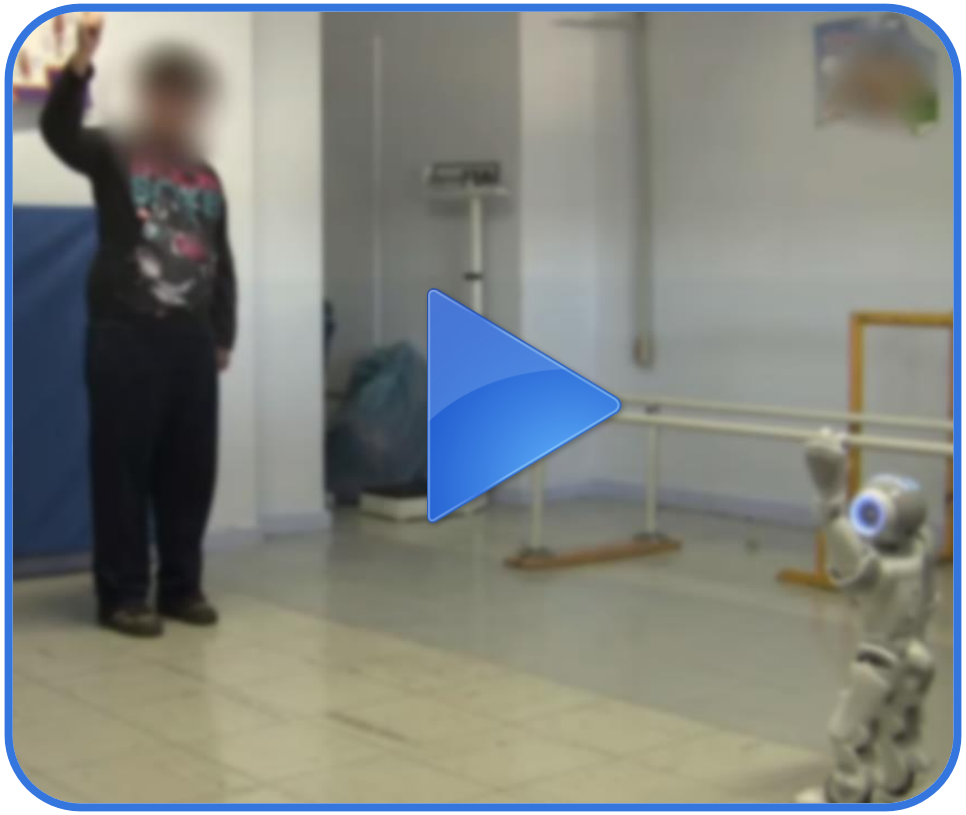
Group	Behavior	Category
Emotions	Enjoyment, happiness	Playing
	Engagement, focus	Playing
	Neutral	Playing
	Anxiety, frustration	Playing
	Boredom, laziness	Artifact
	Fear, displeasure	Artifact
Intentionality	Enthusiastic, energetic	Playing
	Proper	Playing
	Lazy	Artifact
	Does not train	Artifact
Gaze	Looks at the robot	Reciprocity
	Looks at himself	Reciprocity
	Looks at others	Artifact
	Not involved	Artifact
Communication	Speaks and gestures to the robot	Reciprocity
	Speaks or gestures to the robot	Reciprocity
	Hears the robot	Reciprocity
	Speaks to others	Artifact

Results of Video Analysis



50 videos of schoolchildren analyzed

Evaluation with Pediatric Patients



https://goo.gl/lBWKH4

Future works and initial conclusions

- The pilot with real patients will be performed in September in the VRUH. 20 patients will be training with THERAPIST during 3 months.

- The initial experiments indicate:
  - The combination of robotic platform with artificial intelligence will provide new ways for rehabilitation processes.
  - Time of professionals is optimized.
  - The interaction of users with NAO is fluent.
  - Children found pleasant the experience with NAO and involved during the rehabilitation session.

Planning, Execution and Monitoring of Physical Rehabilitation Therapies with a Robotic Architecture

José Carlos González, José Carlos Pulido, Fernando Fernández y Cristina Suarez-Mejías

MIE 2015: Medical Informatics Europe

Thank you for your attention!

Planning, Execution and Monitoring of Physical Rehabilitation Therapies with a Robotic Architecture

José Carlos González, José Carlos Pulido, Fernando Fernández y Cristina Suarez-Mejías

MIE 2015: Medical Informatics Europe

Cristina.Suarez.exts@juntadeandalucia.es