

'Help me help you': A Human-Assisted Social Robot in Paediatric Rehabilitation

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Abstract

Socially assistive robots show great potential for boosting therapeutic outcomes in children undergoing intensive rehabilitation. However, the introduction of an additional interactive presence also imposes new demands on the therapist.

In this preliminary study we explore the time costs and issues associated with the inclusion of a semi-autonomous assistive robot in paediatric rehabilitation sessions.

The study

- Five normal patients' rehabilitation sessions
- Three different patients: 2 girls (9 and 11 years old) and 1 boy (6 years old)
- Each session varied with patients' needs. For instance, in session 3 only activities requiring *Helping to Keeping Pace* assistance were used.

Human-Supported Capabilities

Positioning the robot: During a typical rehabilitation session, NAO will perform activities in a range of locations. The robot starts each session placed on the floor, and must be positioned close to the patient on an adjacent bed or raised table in the line of sight of the patient. NAO requests this assistance by asking the attending adult to position it appropriately.

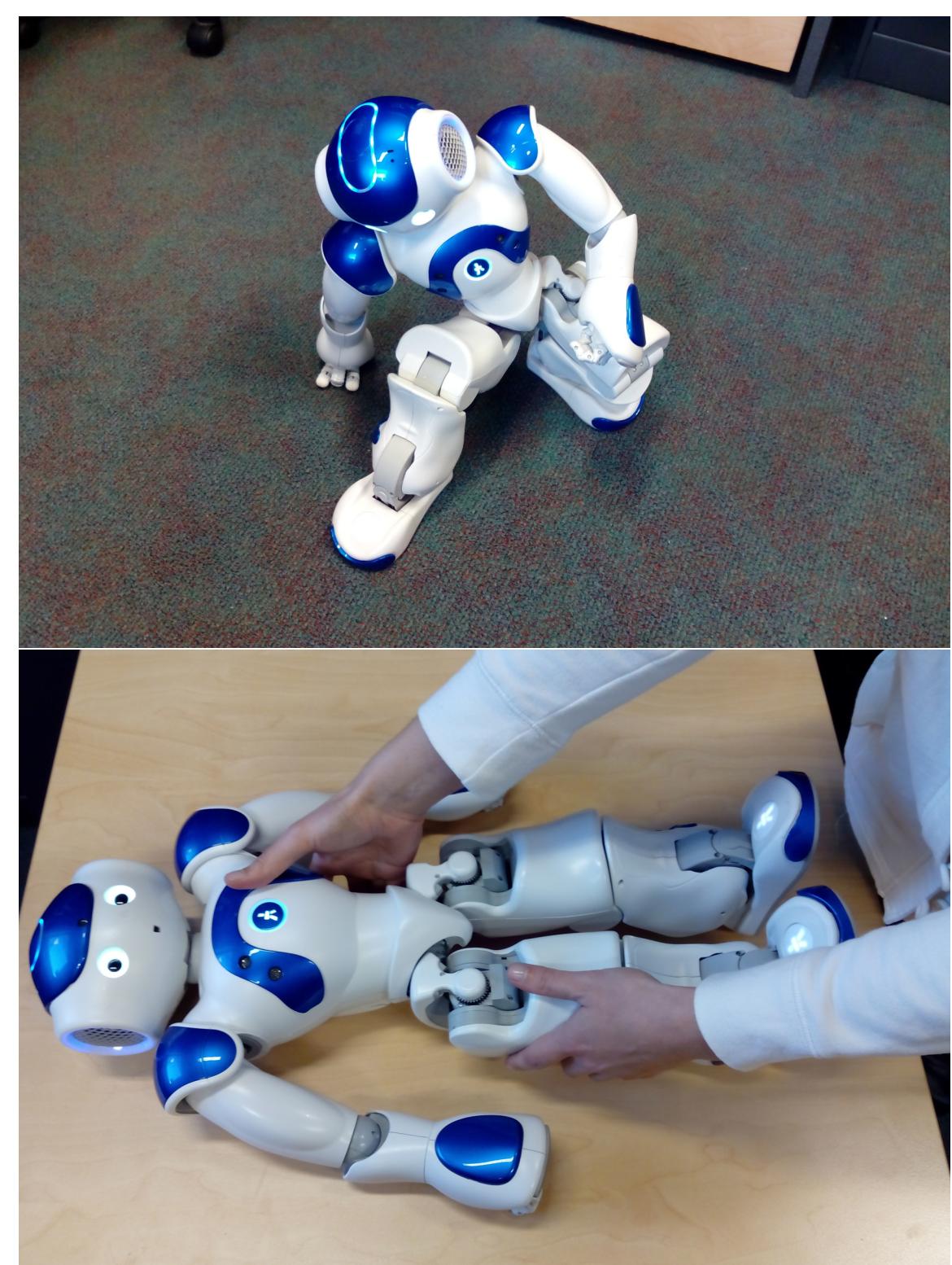
Posture: NAO cannot archive certain postures without human assistance. When needed, at the beginning of the exercise NAO changes posture and asks to be rolled onto its side.

Placing auxiliary aids:

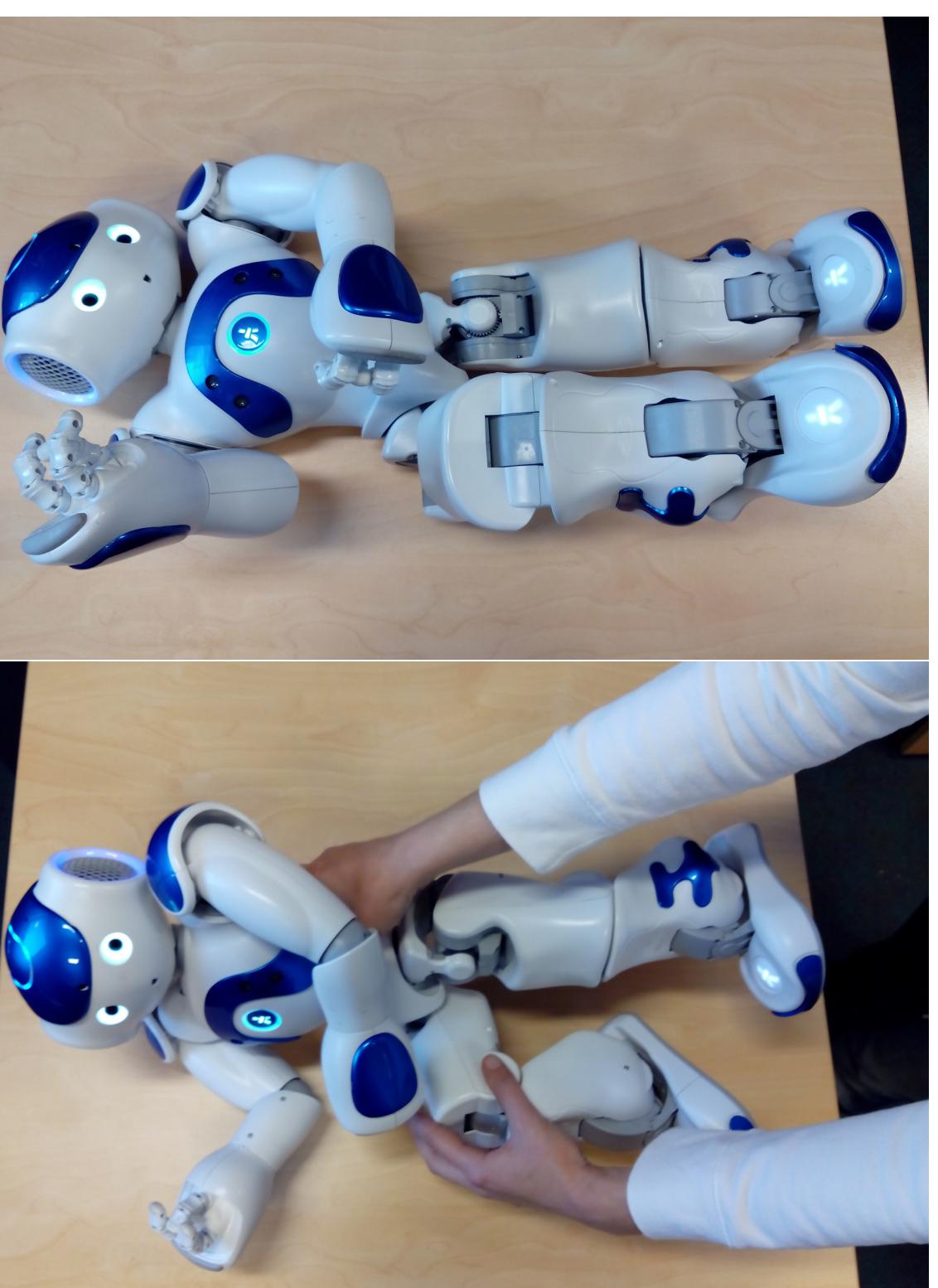
- **Rolled Towel:** *Quads over Roll* and *Static Quads* are examples of exercises which require a soft, cylindrically rolled towel to be placed under both the patient and robot's knees. Both require human assistance and so NAO requests this explicitly.
- **Seat:** Exercises such as *Sit to Stand* and *Quads Strengthening* are done from a sitting position. Therefore, the robot requires positioning of a seat behind its legs.

Helping to keep pace: Fatigue, distraction and frustration can all affect the speed and timing of the rehabilitation session. It is crucial that NAO keeps pace and allows the patient to rest.

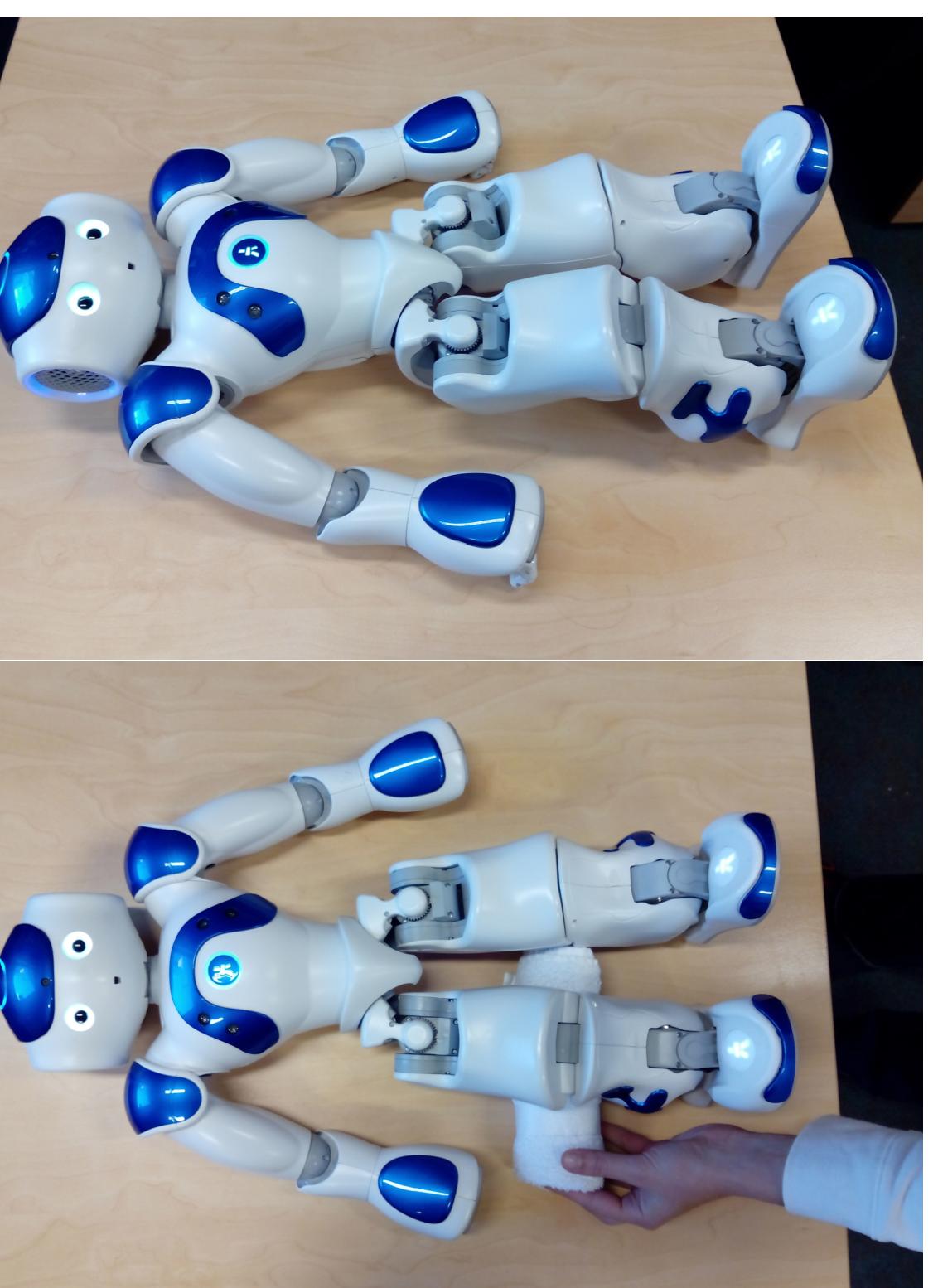
Assisting the robot



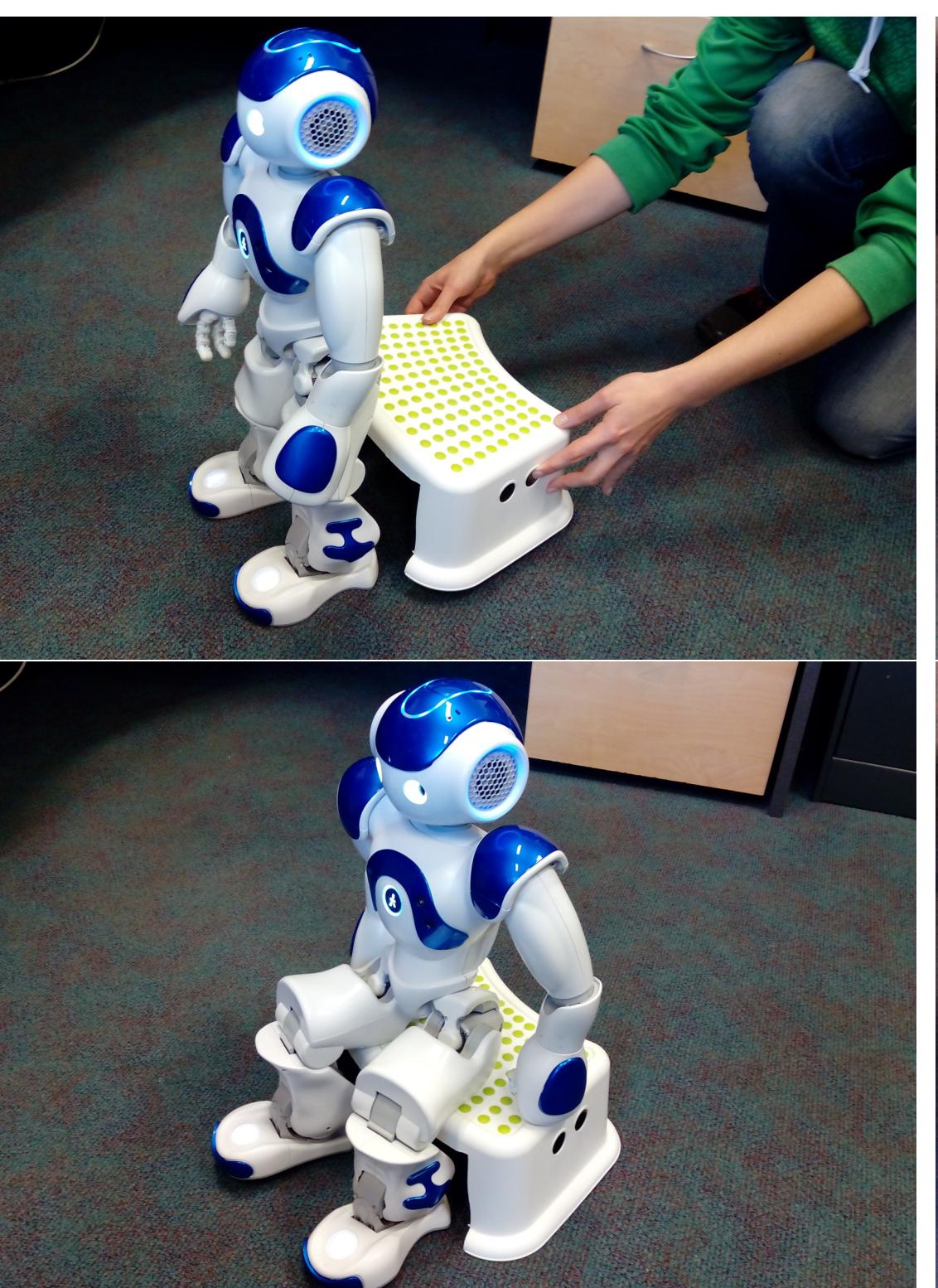
Positioning the robot: Robot laying down by itself on the floor (top). Robot being placed by the physiotherapist on a table (bottom).



Posture: Initial position of the robot when asking to be rolled (top). Physiotherapist rolling the robot onto its right side (bottom).



Placing a rolled towel: Initial position of the robot when asking for a towel (top). Physiotherapist putting a towel under robot's knee (bottom).

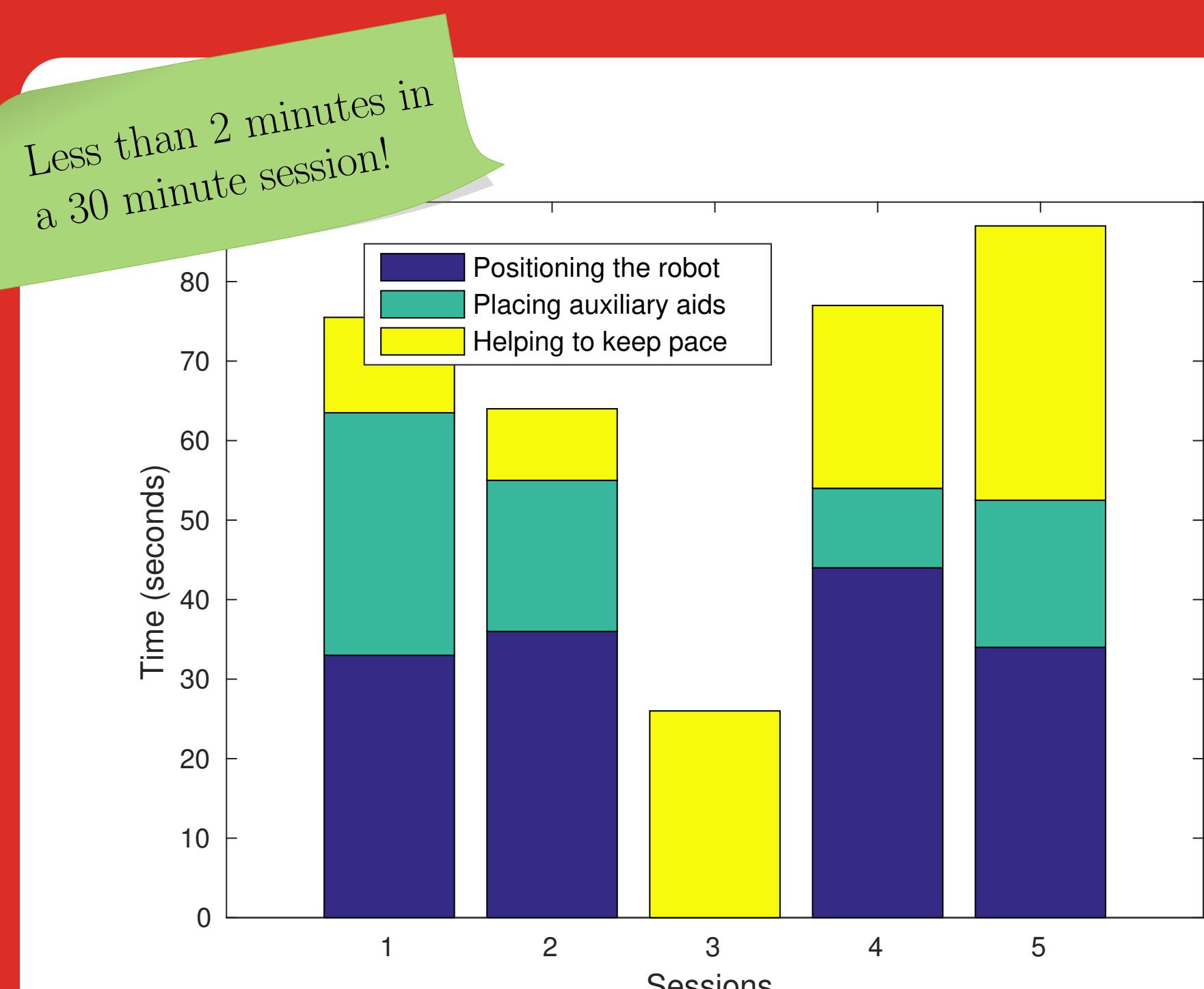


Placing a seat: Physiotherapist putting a seat behind the robot (top). Robot sitting, ready to start sitting exercises (bottom).



Helping to keep pace: Robot's brain LEDs blinking, waiting to be tapped (top). Patient tapping robot's head (bottom).

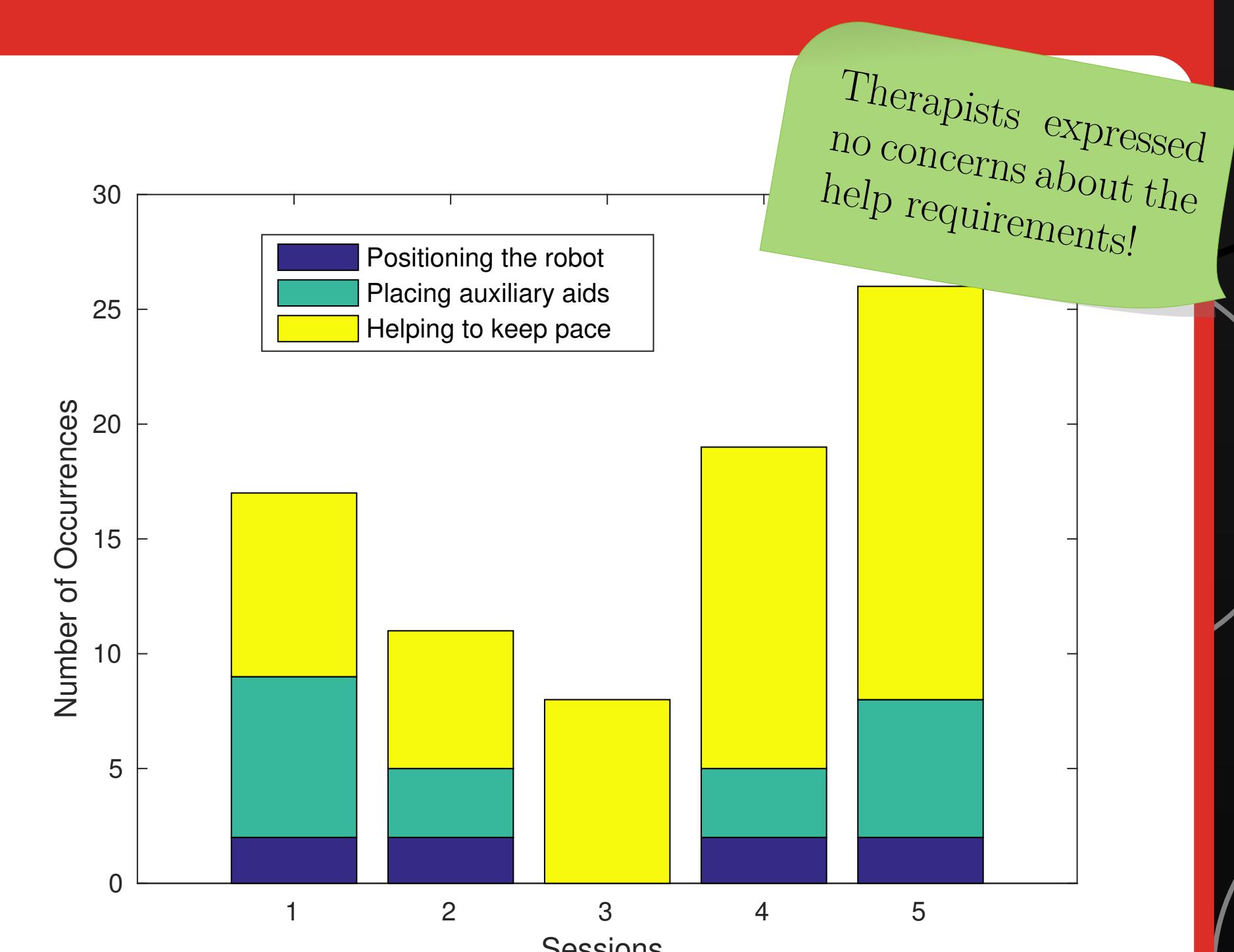
Time required to help the robot in a 30 minute session



Results

- **Positioning the robot took the longest time**, influenced by the proximity of the physiotherapist or the room layout.
- Assisting the robot to **keep pace** requires less time, but **occurs more often**. This kind of assistance scales roughly with the number of activities.
- Therapists **expressed no concern with this time cost** in the sessions, and the assistance requests are in an acceptable upper limit.
- **Keeping Pace actions** appeared to complement the general desire of patients to interact with the robot. Therapist feedback indicated that allowing patients to assist NAO **appeared to increase their activity and engagement** during the session.

Number of times help is needed in a 30 minute session



Conclusions

- Physiotherapists dealing with the robot were not over-burdened by the system's help requests. Indeed, it helped to engage patients.
- We are currently exploring the development of patient monitoring capabilities, a clinicians' interface and other refinements in preparation for a planned clinical trial in 2017.

Acknowledgements

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- Thanks to all the patients, parents and therapists who have engaged with NAO