



# An Interactive Tangram Game For Children With Autism

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# Introduction: Main Goal

How can a social robot may be integrated into therapeutic interventions with children with ASD as a support tool to engage children in turn taking activities?

# Introduction: Motivation

Children with ASD showed to have a **special interest** in robots and other technologies

Puzzles are used during therapy

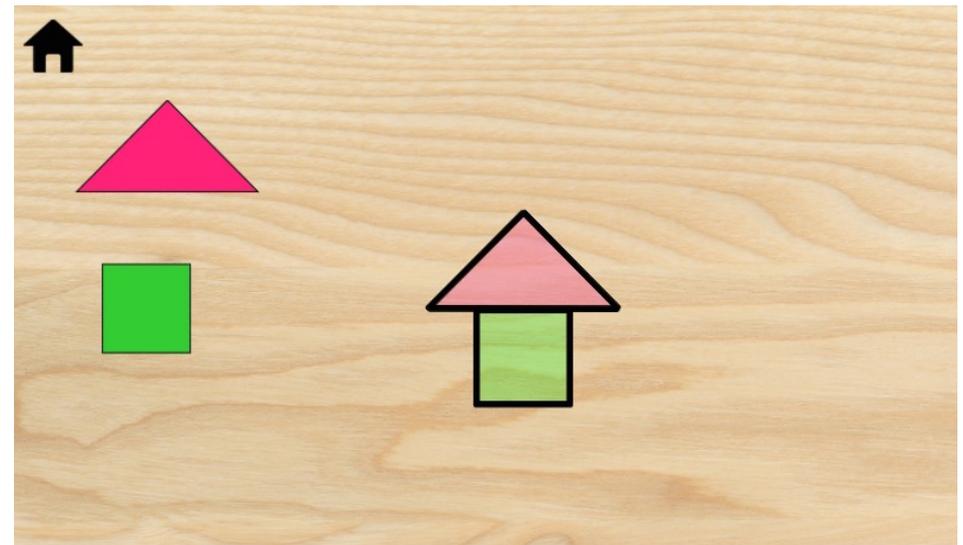
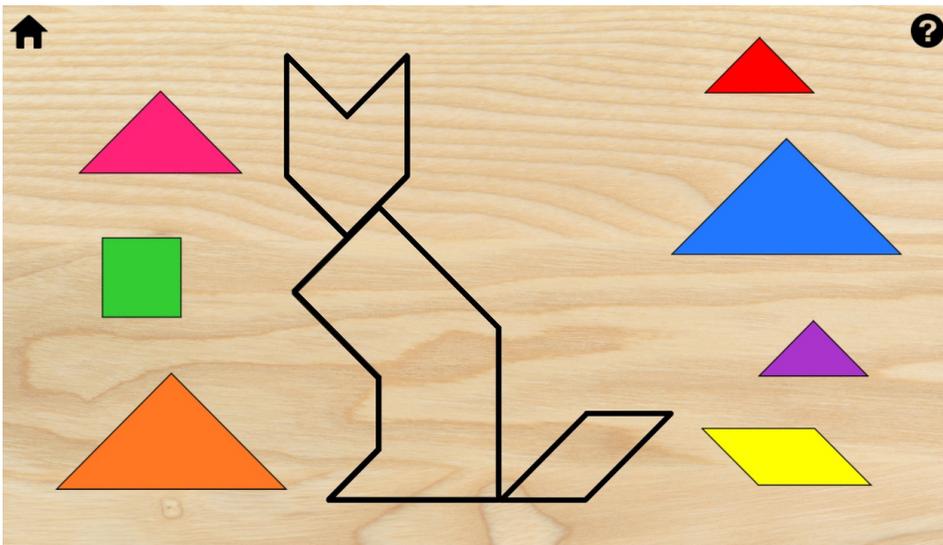
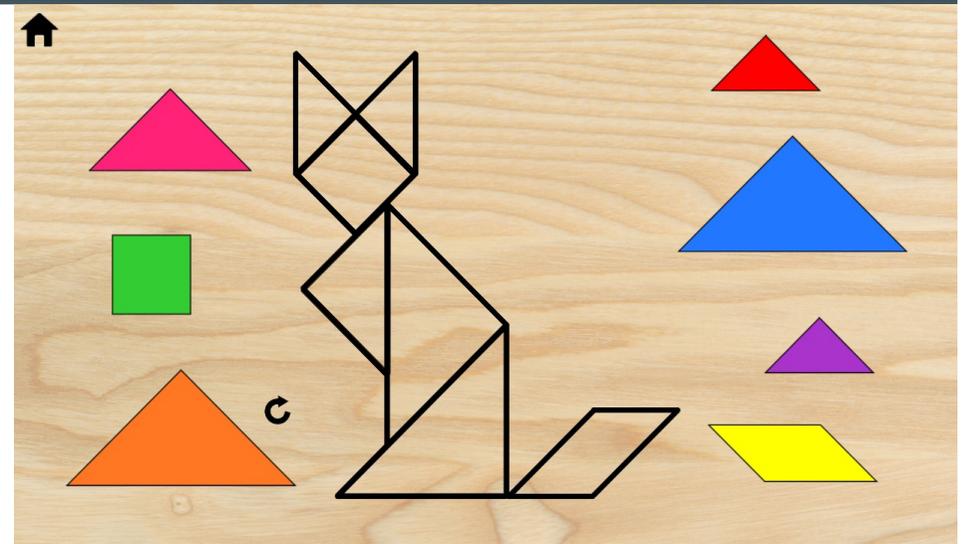
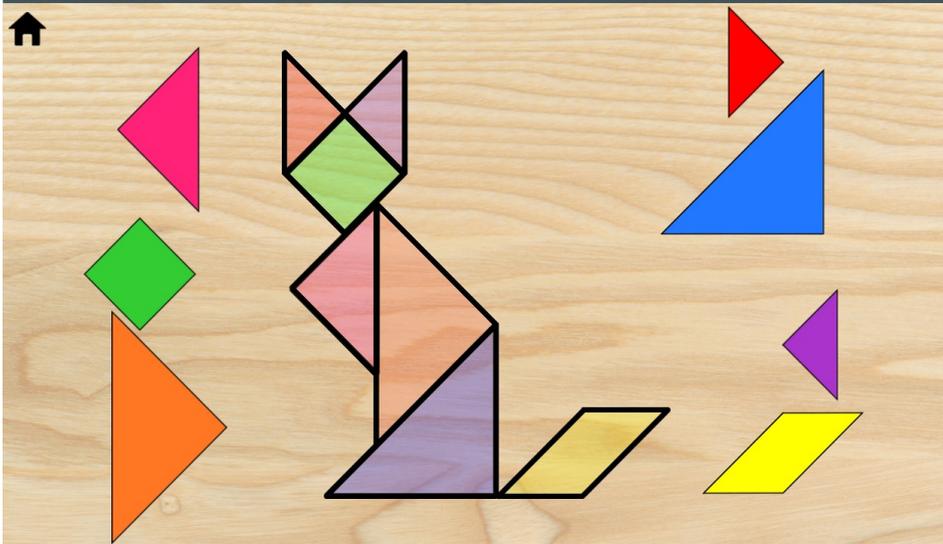
# Autism Spectrum Disorder

A developmental disability that is characterized by behavioral impairment in **Social interaction** and **Communication**, and demonstration of **Repetitive behaviors**

# Turn-taking

- Turn-taking is a basis for developing social skills
- Children with ASD have difficulties in taking turns

# Tangram: the game



# NAO Robot as a *Tutor*

Function:

- Helping and teaching
- For children that have difficulties playing puzzles



# Tutor Mode - Prompt System

The piece was **dragged to the wrong place** or **with the wrong angle**:

- P0 - no prompts
- P1 - the robot encourages the child to think about his/her decision
- P2 - the robot gives a clue about the right spot/angle
- P3 - the correct spot starts to shine.

The child **does not move any piece** within a few seconds:

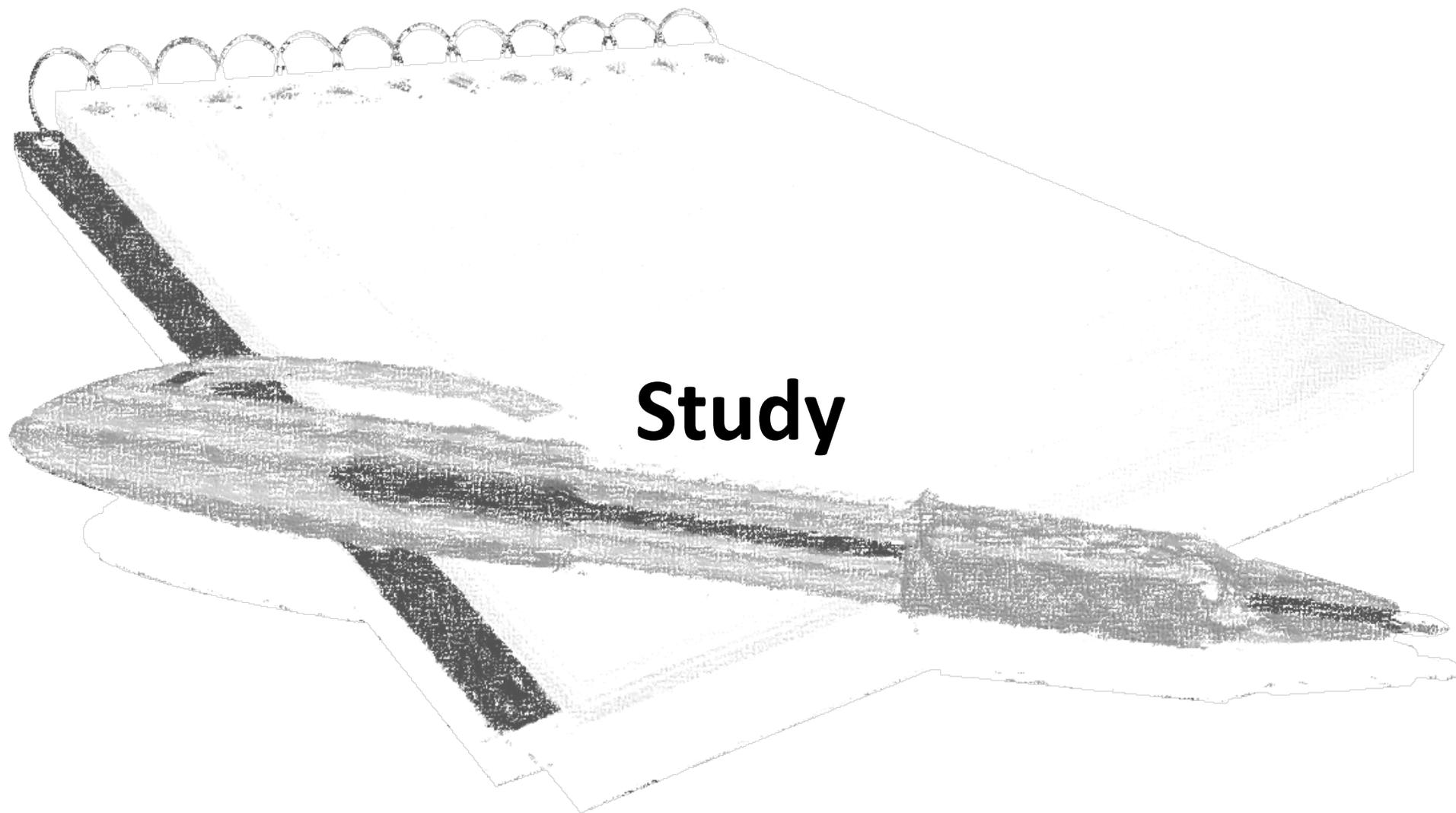
- P0 - no prompts
- P1 - a random piece shakes and the robot asks where should it go
- P2 - the robot gives a clue about the right spot
- P3 - the correct spot starts to shine.

# NAO as a *Peer*

- The robot plays a turn-taking cooperative Tangram game with the child
- NAO asks for help to:
  - place a certain piece
  - rotate a certain piece
- NAO gives help if the child needs

# Feedback

- Constant positive feedback
- Reduced negative feedback
- The robot and the game give a final reward



# The Setup

- Each participant performed 3 to 4 sessions once a week
- The sessions took approximately 15 to 25 minutes



Cam 1



NAO



Cam 2



Child



Therapist

# Single-Subject Research Design

- Usually for studies with one participant
- The participants serve as their own control
- The design strategy used was the A-B-A
- Consists in the session with the therapist (A) and intervention sessions (B)

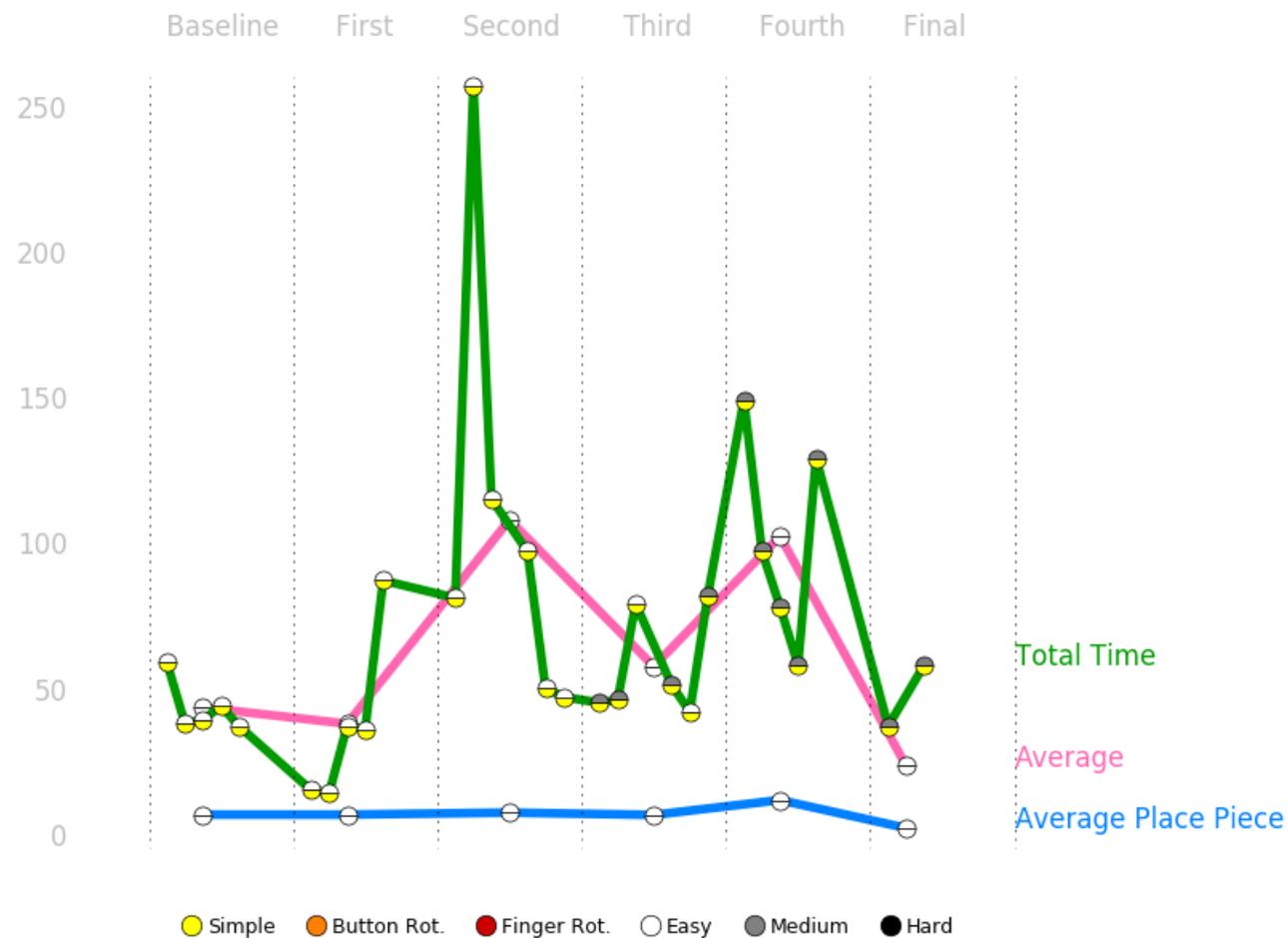


# [TC] Participant J.F.

- He has severe autism
- His linguistic, cognitive and motor development are strongly underdeveloped
- In the Baseline, he was not able to finish any puzzle without help
- Increase of autonomy over the games in the intervention sessions
- In the Final session, J.F. finished the original puzzle almost autonomously

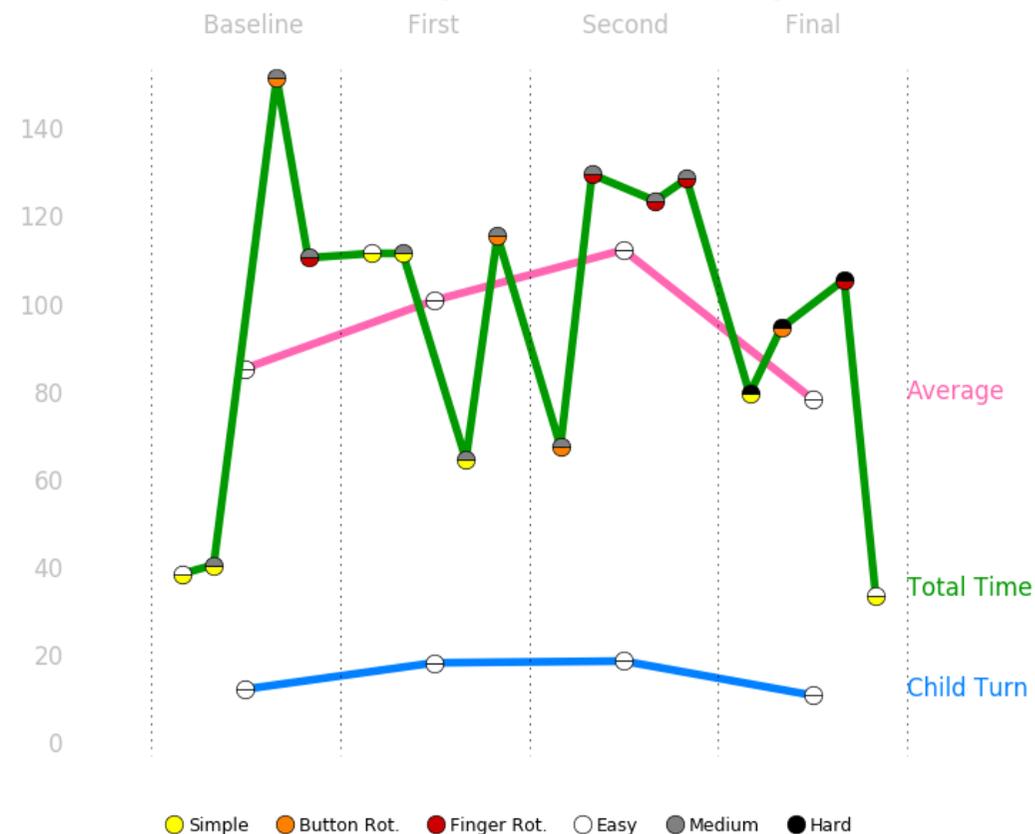
# [TC] Participant J.F. II

- His performance increased



# [PC] Participant M.A.

- He has moderate autism
- M.A. was able to complete the puzzles without difficulty



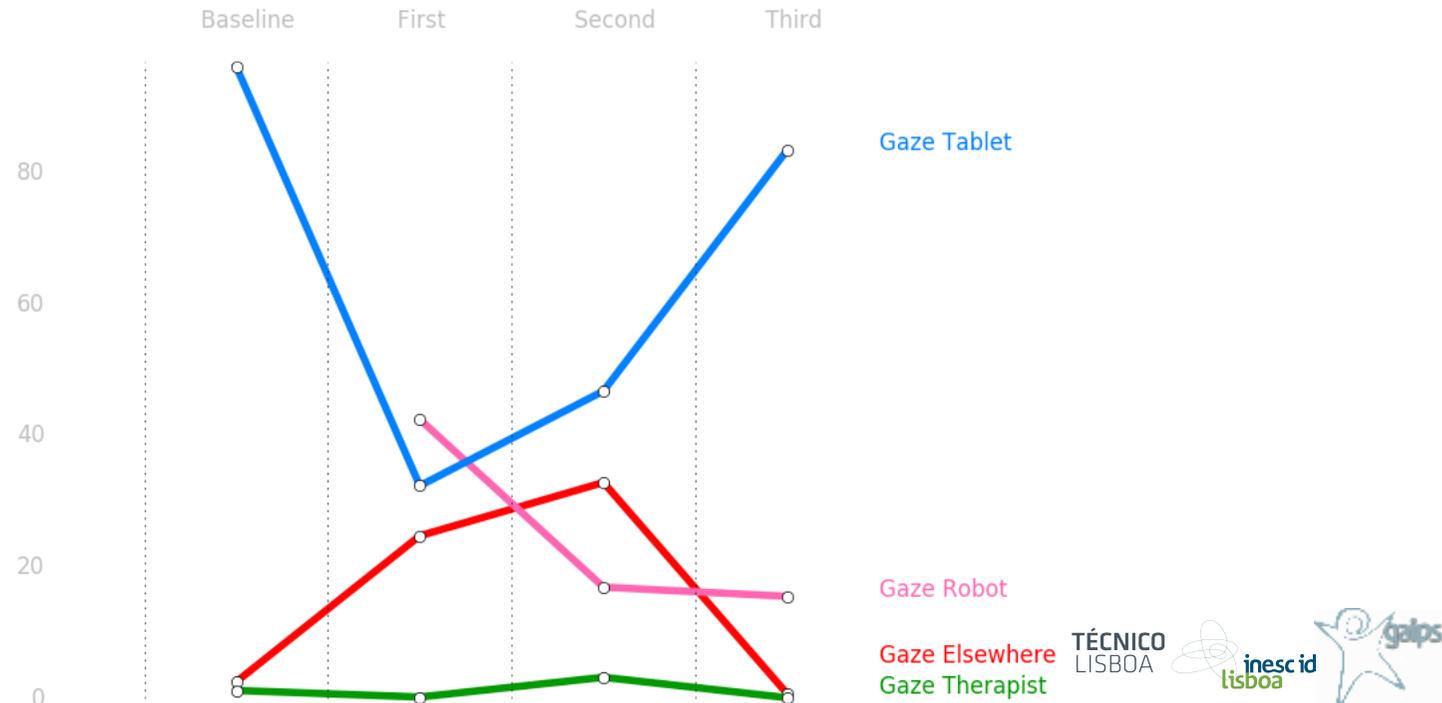
# [PC] Participant M.A. II

- He answered NAO's questions and mimicked the robot's request for help, even when he did not need help
- He understood the concept of turn-taking
- M.A. always respected NAO's instructions

	Baseline	First	Second	Final
Played in His Turn	100%	100%	100%	100%
Played Out of Turn	1	1	0	0
Helped the Robot	-	100%	100%	-

# [PC] Participant J.N.

- He has mild autism
- He did not react optimally when he met NAO
- J.N. was very distracted most of the sessions



# [PC] Participant J.N. II

- J.N. ignored most of NAO's instructions
- He tried to play out of his turn multiple times
- He did not want to play the final session with the therapist
- Although, his reactions improved over the sessions

	Baseline	First	Second	Third
Played in His Turn	100%	42%	47%	69%
Played Out of Turn	7	23	30	10
Helped the Robot	-	100%	60%	75%

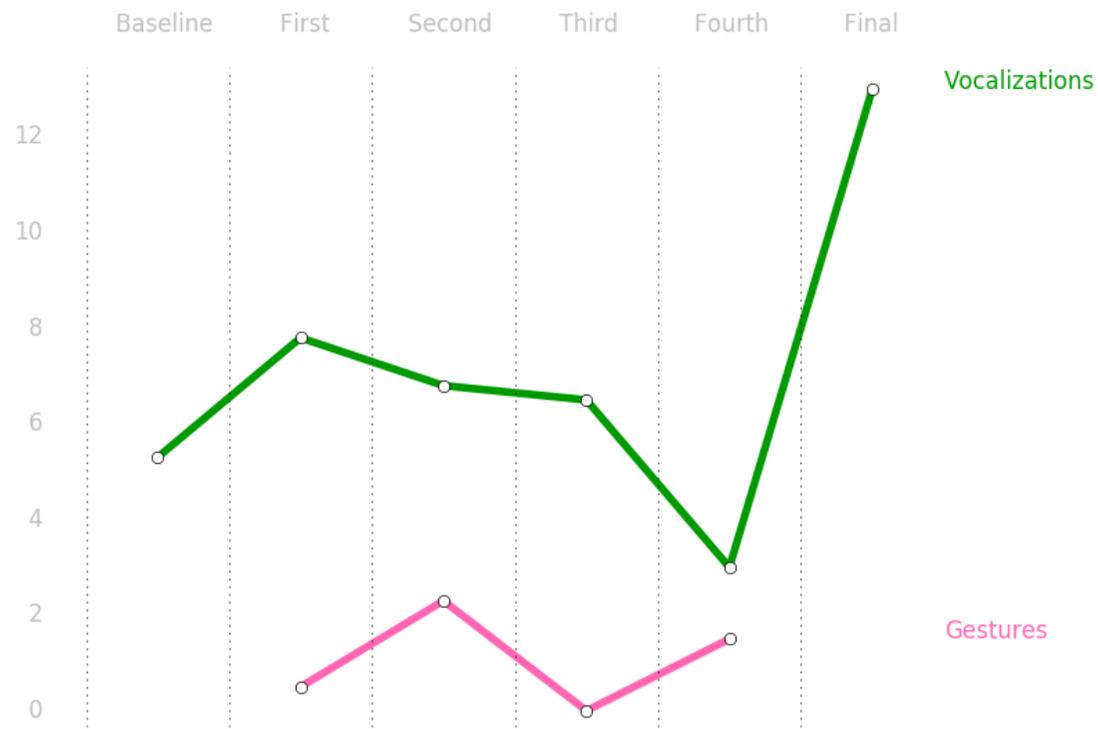
# [PC] Participant H.R.

- He has mild to moderate autism
- H.R. respected the turn-taking
- His performance improved over the sessions
- Always helped the robot

	Baseline	First	Second	Third	Fourth	Final
Played in His Turn	100%	100%	100%	100%	100%	100%
Played Out of Turn	1	2	0	0	0	0
Helped the Robot	-	100%	100%	100%	100%	-

# [PC] Participant H.R. II

- He was excited and answered the robot's questions
- Also, he asked NAO for help multiple times

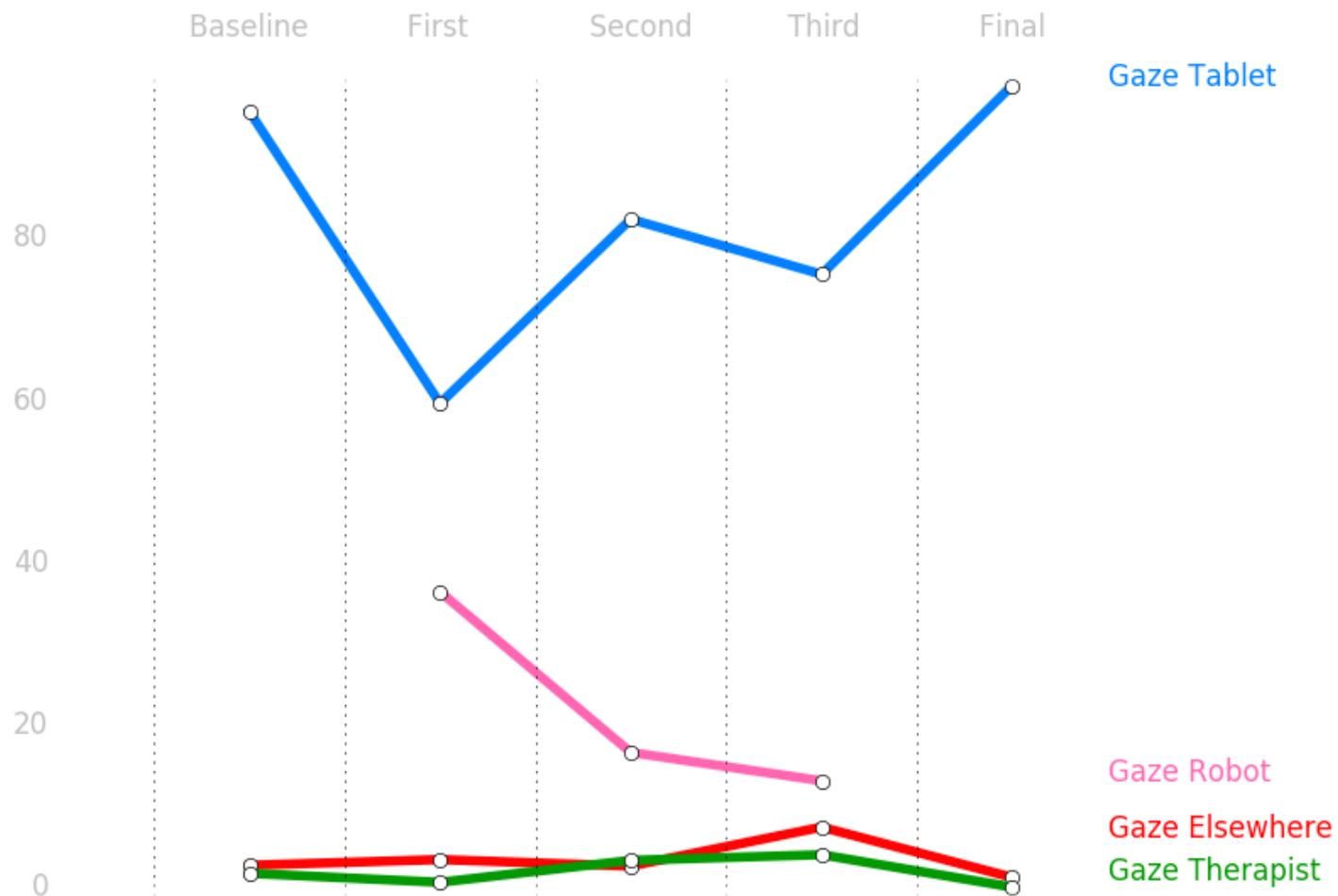


# [PC] Participant D.B.

- He has difficulty in concentrating and taking turns
- With the advance of the game he was losing focus on the robot
- He tried to play more out of turn and sometimes he did not help NAO
- With the therapist, he was more focused

	Baseline	First	Second	Third	Final
Played in His Turn	100%	100%	79%	77%	93%
Played Out of Turn	6	8	35	21	2
Helped the Robot	-	100%	100%	100%	-

# [PC] Participant D.B. II



# Discussion of Results

- For most participants the robot was able to stipulate the turns
- All participants improved their performance
- The interest for the robot decreased
- All children respond to NAO's questions
- Some spontaneously imitated NAO
- A gradual growing disinterest by some of the participants

# Conclusion

- Each child with ASD is different so interventions like this one must take these differences into account in the analysis
- The development of a Tangram game that both **Tutor** and **Peer** could engage all children with ASD was really a challenge
- Children engaged in turn taking and even the therapist was surprised.

**Thank you. Questions?**

# References

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