Effectiveness and Adherence of a Robot-Enhanced Imitation Therapy in Autistic Children

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Contacts and more

Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized **by social and communication** deficits and restricted and repetitive behaviors [1]

ASD prevalence is 1 in 36 children in the U.S.A. [2]

Robot-Enhanced Imitation Therapy

Robot-Enhanced Therapy [3]

- Robots are **predictable**
- Robots can provide **replicable** stimuli
- Robots help **avoiding overstimulation**

Imitation Therapy [4]

- Gesture imitation is crucial in **empathy** development
- Imitation **facilitates engagement** in social and emotional contexts

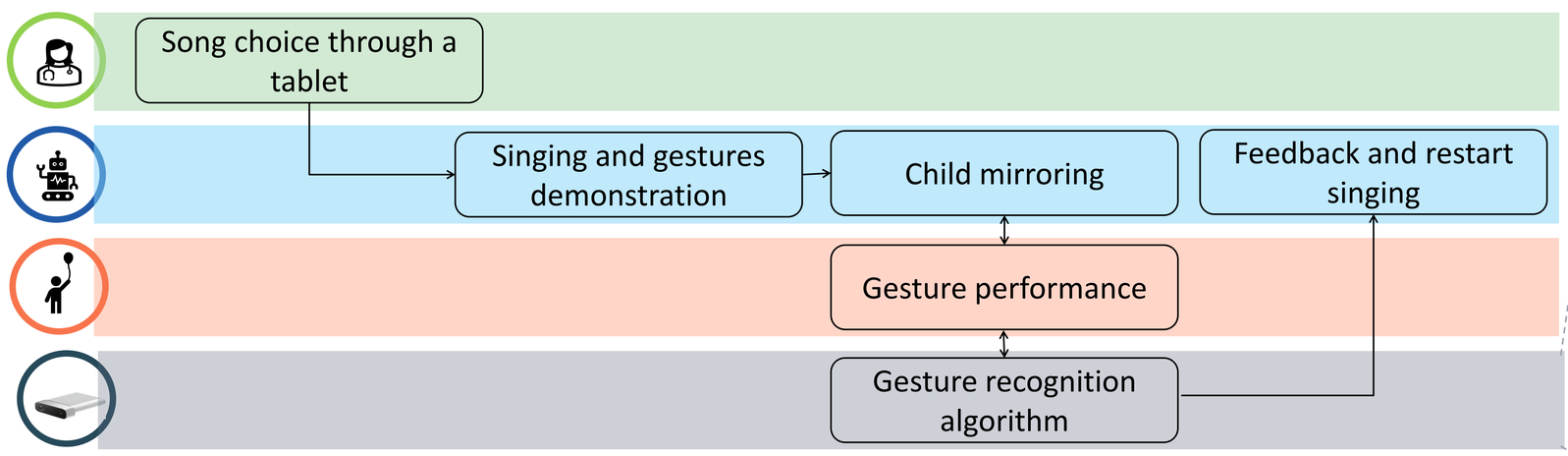
Song-Based Robot-Enhanced Imitation Therapy [5]

Song gestures [6]**:**

Music to promote **social communication**

Drama to help the acquisition of **social skills**

Therapy protocol



Aims

Evaluate the **effectiveness** of the proposed RET in terms of adaptive abilities

Evaluate the impact of **therapy adherence** on the therapy outcomes

Introduce an **automatic algorithm** to assess adherence

Study design

T0
Pre-Treatment assessment

12 weekly RET sessions

T1
Post-Treatment assessment

Patient ID	Sex	Months of age	GDQ (GDMS-III)	ADOS-2
DG01	F	52	56	9
DG02	M	42	<20	10
DG03	M	38	63	9
DG04	F	55	42	6
DG08	M	61	<20	7
DG10	F	63	<20	7
DG12	M	71	<20	6
DG13	M	35	73	9

Griffiths Mental Development Scale – III (GDMS-III)
Autism Diagnostic Observation Schedule – Second Edition (ADOS-2)

Fondazione don Gnocchi **Ethical Committee Approval** ID: 07/2023

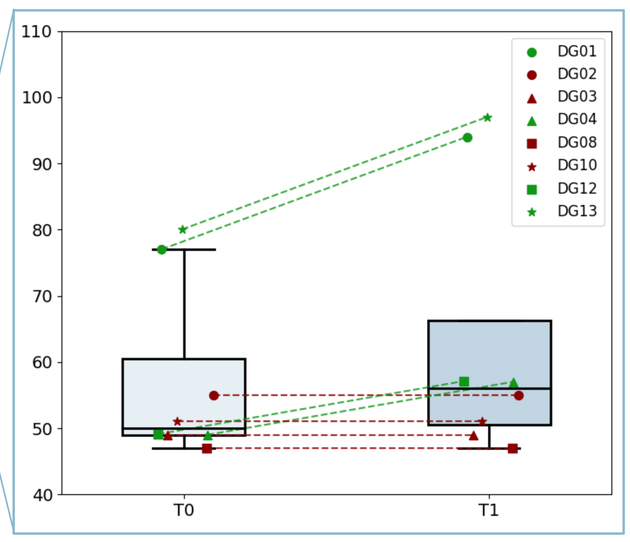
Results

Clinical results

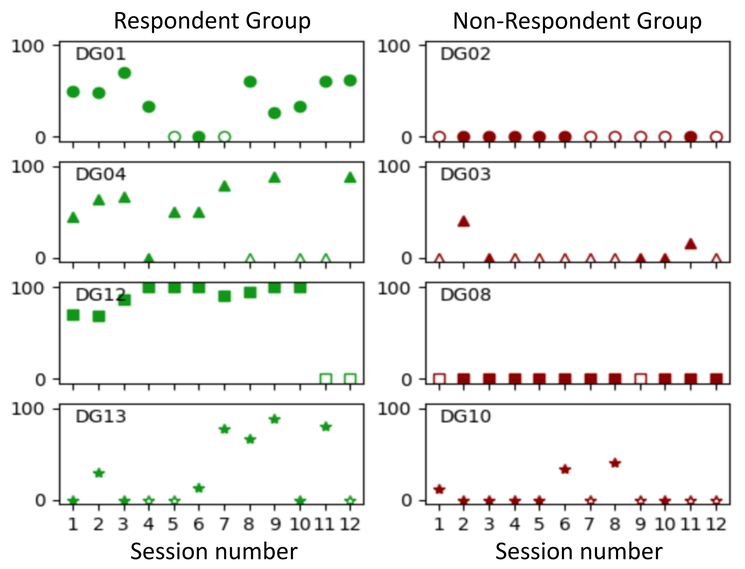
Scale	Domain	T0 median [IQR]	T1 median [IQR]	p-value (Wilcoxon test)
ABAS-II GAC	**Global**	**41 [37-51]**	**49 [39-68]**	**0.04**
ABAS-II CAD	Conceptual	45.5 [41-60]	56 [41-78]	0.3
ABAS-II SAD	Social	49 [49-61]	56 [49-66]	0.3
ABAS-II PAD	**Practical**	**46 [44-61]**	**57.5 [49-68]**	**0.04**
MacArthur-Bates PVB	Communication	38.5 [34-45]	42.5 [37-54]	0.1

Adaptive Behavior Assessment Scale – Second Edition (ABAS-II)
MacArthur-Bates Communicative Developmental Inventories, Primo Vocabolario del Bambino (PVB)

ABAS-II Social Adaptive Domain



Adherence measured as percentage of imitated gestures



Automatic gesture recognition algorithm

F1 score: 57%

Conclusions

- The proposed RET proved effective in enhancing global adaptive abilities
- Improvements in the social domain were observed only in children who actively engaged in the imitation task
- The automatic gesture recognition algorithm underperforms, likely due to challenges in gesture segmentation

Future works

- Include more participants and a control group.
- Explore additional metrics beyond the percentage of imitated gestures to assess adherence.
- Enhance the automatic gesture recognition algorithm, particularly for more robust gesture segmentation.

[1] American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorder (5th edn) (DSM-5),* APA, 2013.
[2] Maenner et al, *Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years*, Surveillance Summaries, 2020.
[3] Santos et al, *Applications of Robotics for Autism Spectrum Disorder: a Scoping Review,* Review Journal of Autism and Developmental Disorders, 2023
[5] Fassina et al, Song Gesture Recognition for a Robot-Enhanced Imitation Therapy, International Conference on Robot and Human Interactive Communication, 2024
[6] Beer et al, Robot Assisted Music Therapy: a Case Study with Children Diagnosed with Autism, International Conference on Human-Robot Interaction, 2016