

Table Supplementary Material 1: Analysed papers and robotics categories

Year	Authors	Purpose	Robot	Human Robot Interaction			Measurements			Environment (clinical, house, school, research laboratory)
				Sensors	Feedback (vocal, action, reward)	Control/Autonomy	Autism Inclusion Criteria Diagnosis Evaluation	Analysed (quantitative and qualitative)	Manual / Automatic extraction of quantitative measures	
2020	David et al.	Therapy: Turn taking skills (social skills)	Humanoid: NAO robot	Camera	Vocal feedbacks	Wizard of Oz	- children diagnosed with ASD using DSM-V - their diagnosis is confirmed by the Autism Diagnostic Observation Scale, adapted into Romanian language	Quantitative and qualitative - Performance of waiting turn; Engagement; Eye contact; Verbal utterance; Stereotypical behaviours; Adaptive behaviours; Maladaptive behaviors; Positive and negative emotions;	Manual	CLINICAL SETUP Autism Transylvanian Association, an institution that provides clinical services for individuals with ASD from the city of Cluj-Napoca, Romania.
2020	Ramírez-Duque et al.	Diagnosis: wrap multiple stages of autism diagnostic process	Humanoid: Ono	Multi-camera array	Vocal feedback and gestures (pointing)	Semi-autonomous: adjust the behaviour of the robot in a supervised approach	- Diagnosed by an expert clinician based on DSM-V criteria - without severe auditory or visual impairments	Quantitative: joint attention score (considers head orientation, pointing gestures and time between elicited cue and child's response); adult seeking; eye contact (percentage of time looking to the robot/therapist); energy and displacement.	Manual and Automatic	CLINICAL SETTING Therapy room
2020	Zheng et al.	Therapy: investigate robot-mediated response to joint attention in young ASD children	Humanoid: NAO robot	4 cameras	verbal ("good job")+ reward video	Autonomous and Adaptive: a high level autonomous controller was used to direct the interaction of the components of the system by reporting results and responding to incoming commands.	ADOS2; Mullen Scale; Social Responsiveness Scale- Second Edition; Social Communication Questionnaire;	Qualitative: human-administration of STAT; Quantitative: within-system measurements of response to joint attention prompts administered by the robot at the end of the intervention period (average prompt level that a participant needs to hit a target in a trial and percentual of trials in which the participant hit the target)	Automatic	RESEARCH LABORATORY University Institutional Review Board
2020	Di Nuovo et al.	Therapy: Study about children with Autism Spectrum Disorder (ASD) interaction with robots during clinical interactions	Humanoid: NAO robot Non-humanoid: pet-like MiRo robot	NAO offered multimodal interaction via tactile sensors and four directional microphones, voice recognition and text-to-speech; 1 Camera	Vocal feedbacks Action feedbacks	N.D.	N.D.	Quantitative: number of instructions followed by the child Qualitative: Survey completed by the 5 children's parents	N.D.	CLINICAL SETUP
2020	Schadenberg et al.	Design: Spontaneous interactions	Humanoid: Zeno robot	Audio and Video recording	Gestures	Wizard of Oz	ADOS-2, CARS-2 VABS-2 familiarization: Social story that described the session, which included specific information about what to expect	Quantitative: video coding of the frequency of the different type of interactions (exploratory, relational, functional, social overture);	Manual	SCHOOL SETTING The children were recruited from three special education settings in the United Kingdom, which were also the locations of where the sessions took place.
2020	So et al.	Therapy: Joint attention and functional and symbolic play acts	Humanoid: two NAO robots	Video recordings	Snaks or access to toys after each session	Hybrid: The two NAO robots were programmed to speak and/or produce pretend acts in the dramas	Confirmed diagnostic: Autim Diagnostic Observation Schedule - Second Edition (ADOS -2) ; fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5)	Qualitative: Early Social Communication Scales; Structured Play Assessment; Social Responsivness Scale	N.D.	N.D.
2020	Barnes et al.	Therapy: Examination of the interactions between children and robots in the context of a musical game, Dance Freeze, where players dance while music plays and then freeze when the music stops unexpectedly	Humanoid: NAO robot	Video recordings	Feedback from parents based on thier perception of children's inteactions	N.D.	N.D.	Qualitative: metrics included mimicry of partner, quality of the dance, quality of gameplay, interaction level with the robot, and interaction level with the adult human. Quantitative: Also calculated the percentage of time the child's face was oriented toward the researcher/skeleton display of the Kinect device, the robot, or the mirror.	Manual	RESEARCH LABORATORY The experiment took place in a suite of three rooms designed for usability testing.

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2020	De Korte et al.	Therapy: Investigation of the effect of Pivotal Response Treatment versus robot-assisted Pivotal Response Treatment on self-initiations of children with autism spectrum disorder and to explore the relation between self-initiations and collateral gains in general social-communicative skills	Humanoid: NAO robot	Video recordings	N.D.	Hybrid	(1) Diagnostic and Statistical Manual of Mental Disorders (4th ed., text revision; DSM-IV-TR) algorithm (APA, 2004); (2) age of 3–8years; (3) a TIQ of 70 or higher; (4) ability to speak with one-word utterances at minimum; (5) at least one Dutch-speaking parent An exclusion criterion was having received PRT earlier. Comorbid psychiatric disorders of the child were allowed, but the primary diagnosis had to be ASD (and subsequently the primary intervention was focused on ASD).	Quantitative: number of self-initiations, in which only initiations considered as verbal, spontaneous (i.e. without prompting) and appropriate within the context were scored	Manual	Clinical: expert multi-site centre for child and adolescent psychiatry
2020	Chung	This study conducted an ABA time-series analysis to investigate the effects of using a social robot in a social skill training programme	Humanoid: NAO robot	Two cameras were placed in front of and adjacent to the child at a distance of 150 cm to capture the child's behaviour.	N.D.	Hybrid	Children with ASD were included if they (1) were diagnosed with ASD and the diagnosis was confirmed by a registered psychologist or medical practitioner, (2) had no hearing or vision deficits, (3) could follow simple commands, (4) were aged between 5 and 11 years, (5) had an IQ of 70 or above, and (6) had no self-injuries or aggressive behaviour	video coding procedure was performed to measure three target behaviours: frequency of eye contact, duration of eye contact, and frequency of verbal initiation with the human instructor	Manual	N.D.
2020	Billing et al.	Design: dataset of behavioural data to support data-driven studies towards improved therapy methods	Humanoid: NAO robot	3 high-resolution RGB cameras and 2 RGBD (Kinect) cameras that, in combination with state of the art sensor interpretation methods, provide information about the child's position, motion, eye-gaze, face expressions, and verbal utterances. In addition, the table captured the presence and location of objects used in the therapy	Positive feedback or indication to try again	Semi-autonomous	ADOS	Quantitative: Relative eye-gaze (Two-eye model-based gaze estimation based on RGBD) Head pose (Pose from Orthog-raphy and Scaling with Iterations (POSIT)) Gaze estimation (A 3D gaze vector is achieved by combining the relative eye-gaze with calculated head pose) Face detection (Boosted cascade face detector Facial features (Supervised descent method proposed) Face expressions (Frontalised Local Binary Patterns (LBP) classified using SVM) 3D skeleton (Microsoft Kinect SDK) Action recognition (3D joints Moving Trend method based on skeleton data) Object tracking (GM-PHD Tracker) Sound direction	Automatic	N.D.

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2020	Qidwai et al.	Teaching: Quantify the improvement in a number of behavior and learning parameters when children performed the activities with NAO robot present with the teacher, as opposed to the same type of activities performed by the teacher alone.	Humanoid: NAO robot	Video recordings and Microphone	Once the song is completed, the robot used positive reinforcement statements such as "hurray" or "well-done" with high-five gestures to encourage the children to complete more activities. For an unsatisfactory child response, the robot encouraged them through such statements as "let's play again" or "try again" with spread-hand and welcoming gestures.	Wizard of Oz:	GSM-5 score	Qualitative: 1. Memory (MEM): how well the child remembers the game during the sessions. The teacher assigns the score out of 10 according to the subjective assessment. 2. Response Type (TPR): how well the child responds to the game. The higher the score out of 10 is, the higher the understanding of the activity is, and the more natural the response is. 3. Response Time (TMR): how quickly the child responds to the requirements of the game. 4. Number of Trials (NTR): the number of trials needed for a child to respond to the game in the same session.	Manual	SCHOOL
2020	Aryania et al.	Therapy: Comparison of the social engagement behaviors of the children with autism in interaction with a kid-size humanoid robot and a human partner in a motor imitation task	kid-size humanoid robot (ARC)	Video recordings	N.D.	N.D.	DSM criteria GARS-2 test ADI-R	Quantitative: Eye gaze (in terms of duration); Eye gaze shifting (among actors or objects); Completeness and correctness of the child's movements ("complete_correct," "complete_incorrect," or "incomplete_incorrect."); Initiation of the child's movement with/without prompt; Verbal instructions to the child; Time differences between the beginning/finishing the robot's arm movement and the beginning/finishing the child's arm movement (in terms of duration)	Manual	SCHOOL: In a room had one door and two windows overlooking the school's backyard.
2020	Sperati et al.	Therapy: supporting tool to help therapists to set up interactive play activities for early treatment with ASDs. Diagnosis: differential diagnosis between ASD and other neurodevelopment disorders like communication disorder.	Non-humanoid: cotton fabric and soft padding representing a panda	touch sensors on the robot; Camera	sounds or lights	Hybrid: controlled by an adult through a wireless tablet	Leiter R-scale; Griffiths Mental Development Scale II; ADOS-2; DSM-V	Quantitative: gaze direction(robot or caregiver); touching (robot or caregiver); holding robot; pointing; smiling or crying towards the robot.	Manual	CLINICAL SETTING
2020	Petric and Kovacic	Diagnosis:robot elicits the interaction and observes the child behaviour	Humanoid: NAO robot	Camera Microphones (on board on the robot and in the experimental room)	Vocal(call the children) and movements (gestures as pointing and the robot turning the head to attract child attention)	Semi-autonomous: the robot is aided by providing correct observations of social cues where the robot fails to detect them automatically, but it is not remotely controlled.	N.D.	Quantitative: eye-contact; joint attention; verbal activity; touch, imitation	Automatic	RESEARCH LABORATORY
2020	Amanatiadis et al.	Therapy: social skills training and neurocognitive games	Humanoid: NAO robot	N.D.	Gestures and sounds	NAO1 and NAO2 have been programmed offline to play a set of interactive games	N.D.	Qualitative: likert scale - engagement; satisfaction; understanding of the context and games through direct observation and short interviews with parents.		N.D.
2020	Baraka et al.	Design: optimal costs for the actions of robots that will train attention	Humanoid: NAO robot	N.D.	Gestures and sounds	Semi-autonomous: the robot control was automated during the tasks, just a perception wizard informs the robot of a success when it occurs (supervised autonomy)	N.D.	N.D.	N.D.	N.D.

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2020	Javed et al.	Design: derive an automate measure of social engagement	Humanoid: Mini Robot Non-humanoid: IPod Robot - Romo	Camera	N.D	Hybrid: Controlled by the therapist	N.D.	Quantitative: eye gaze focus; vocalizations; smiling; self-initiated interactions; triadic interactions; imitations	Automatic	RESEARCH LABORATORY Controlled setup
2020	Kostrubiec and Kruck	Therapy: social skills training (turn-taking and request)	Non-humanoid: spherical ball	1 GoPro camera	Sensory reward	Wizard of Oz: another person controlled the robot	Social Communication Questionnaire	Quantitative: positive reactions to reward; prosocial behaviours (pointing, joint gazing, physical contact, smiles, vocalizations); orientations (head targeting human/robot); undesirable behaviours (stereotypes; undesirable vocalizations; lack of interest; attentional dropout)	Manual	Clinical setting
2020	Alnajjar et al.	Therapy: social skills training - attention	Humanoid: NAO robot	1 camera on board of the robot; 1 camera on a cellphone 1 microphone of the cellphone 1 camera recording the whole session	Vocal feedbacks & visual feedback (emotion displayed on the phone)	Hybrid: Wizard-of-Oz with an adaptive scenario and weighting technique	CARS2 of 30-36.5	Quantitative: attention scores (face detection towards the robot or not); joint attention score; sound response	Manual and Automatic	Clinical setting
2020	Huijnen et al.	Therapy: social skills training - making contact	Humanoid: Kaspar robot	Touch sensors	Vocal feedbacks	Hybrid: the main researcher tele-operated the robot and some sensors and actuators of the robots were functioning autonomously	Previous Diagnosis of autism	Quantitative: coding of the videos in terms of micro behaviours and frequency counting - physical proximity; touch; expression face/body; smile; non-verbal imitation; verbal utterance on initiative of the child; verbal utterance as reaction to robot/teacher; verbal imitation Qualitative: Opinion of the teachers with respect to the goal of making contact or not	Manual	School
2020	Giannopulu et al.	Design: investigate autonomic correlates and emotional feeling expression of ASD children in the context of interpersonal synchronization and emotional empathy with a human or a robot.	Non-humanoid: Pekkobba robot (plant)	robot has a sensor which reacts to speech; 1 watch monitor for the heart rate	Action - Nodding	Fully autonomous	DSM-V; CARS	Quantitative: heart rate; heart rate variability Qualitative: emotional feeling report	Physiological	School
2020	Jain et al.	Design: model user-engagemnet in the context of long-term, in-home SAR interventions for children with ASD	Non-humanoid: SPRITE with Kiwi Skin	2 Cameras	Verbal hints and body movements	Autonomous and Adaptive: personalizes the level of the game and the game based on the performance of the child	Previous diagnosis with DSM	Quantitative: engagement extracted features collected with OpenFace (face detection value, eye gaze direction, head positions and facial expression features), OpenPose (number of people in the environment), Praat (audio features- pitch, frequency, intensity and harmonicity) and game performance (challenge level, count of incorrect responses, elapsed time in a session, game and since the robot last talked).	Automatic	House setting
2020	Hudson and Lewis	Therapy: use of commercial robots as reinforcements in skills acquisition (Applied Behavior Analysis - ABA)	Non humanoid: Paro Seal Robot, Jibo Robot, Amazon Echo Dot inserted in a stuffed animal, Joy-for-All Cat Robot, Joy-for-All Puppy Robot	N.D.	N.D.	Fully autonomous	N.D.	Quantitative: number of speaking and/or physical interactions with the robot	Manual	CLINICAL SETTING

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2020	Arpaia et al.	Therapy: rehabilitation robot to treat symptoms of inattention, hyperactivity and impulsiveness	Humanoid: SanBot Elf	EEG	Audio feedback	Adaptive and autonomous: the robot moves according to the stimulus given by the user. The user wears AR glasses and decides where the robot should move. The BCI interface then transmits this stimulus to the robot.	ADOS-2 CGI (Clinical Global Impression)	Qualitative: reluctance to the system and completion of the task	N.D.	N.D.
2020	Rakhymbayeva et al.	Therapy: social skills training	Humanoid: NAO robot	1 Camera	Vocal feedback & clapping hands	N.D.	ADOS	Quantitative: Engagement time - Duration in minutes of eye gaze/eye contact with the robot, positive facial expressions (smiles, laughs, etc.), compliance to robot's requests, verbal responses to the questions, repetition of actions (dancing, demonstration of transports, animals), or task execution. Qualitative: Questionnaire to the parents asking their opinion about the evolution of the child and his/her background in terms of social and overall suggestions for the protocol	Manual	CLINICAL SETTING
2020	Arshad et al.	Teaching: learning the concept of place value in Maths	Non-humanoid: LEGO Mindstorms EV3	N.D.	N.D.	Hybrid: the child clicks on the starting button and then the robot detects the numbers and says them	Verbal Autism	Qualitative: questionnaire/interview to the teachers Quantitative: assessment module on the topics learnt done by the child	Manual	SCHOOL
2020	Casas-Bocanegra et al.	Design: test a new open source robot CASTOR	Humanoid: CASTOR robot	touch sensors	Vocal feedback	N.D.	N.D.	Quantitative: N° of times there were physical interactions between the robot and the child	Manual	CLINICAL SETTING
2019	Ali et al.	Therapy: Joint attention and imitation therapy	Humanoid: two NAO robots	Kinect EEG NAO camera	Imitation module - vocal feedbacks if correctly done; Joint attention module - light; sounds+light; sounds+light+movement to catch the child attention	Autonomous and adaptive	Childhood Autism Rating Scale Schedule used for confirming the diagnosis	Quantitative (number of eye contacts; correctly done imitation; attentiveness (EEG)); CARS scale is also used (qualitative);	Manual and Automatic	RESEARCH LABORATORY Autism Resource Center (ARC)
2019	Cao et al.	Therapy: Joint attention therapy	Humanoid: NAO robot (in video)	TOBII X3-120 eye tracker	N.D	Fully Autonomous	Diagnosis done previously using DSM-IV	Quantitative: Fixation time; gaze transitions; longest common subsequence (to calculate the gaze transitions)	Automatic	RESEARCH LABORATORY The study protocol was approved by the Ethics Committee of the authors' affiliated University.
2019	So et al.	Therapy: Narrative skills training and gestural skills training	Humanoid: two NAO robots	Cameras	Snaks or access to toys after each session	Fully Autonomous	Diagnosis confirmed by ADOS-2 and DSM-V	Quantitative: Narrative length; proportion of complex clauses; proportion of goal-based stories; proportion of stories with cognitive inferences; number of gestures done	Manual	N.D.
2019	Javed et al.	Therapy: Sensory processing	Humanoid: Mini Robot Non-humanoid: IPod Robot - Romo	Camera	N.D.	Hybrid	N.D.	Qualitative: parents questionnaires; Quantitative - Engagement level (gaze focus; vocalizations, smile, triadic interaction, self initiated interactions, imitation)	Manual and Automatic	RESEARCH LABORATORY Controlled setup
2019	Clabaugh et al.	Teaching: Learning abstract concepts (mathematical skills)	Non-humanoid: SPRITE with Kiwi Skin	Camera	Verbal hints and body movements	Autonomous and adaptive: personalizes the level of the game and the game based on the performance of the child	- Age between 3 and 8 years old - Stable physical, sensory (hearing, vision), and medical health - English as a primary language spoken in the family - Clinical diagnosis of ASD in mild to moderate ranges as described in the Diagnostic and Statistical Manual of Mental Disorders-Version 5	Quantitative: video, audio, performance - video was used to see if the child was engage or not Qualitative: families interviews twice a week about usefulness and relationship	Manual	HOUSE SETTING

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2019	Hirokawa et al.	Design: Test system flexibility	Humanoid: NAO robot	EMG	N.D.	Wizard of Oz: robot tele-operation method using a doll-type interface and possible to click on predefined movements as standing up	N.D.	Quantitative: percentage of smiles	Manual	CLINICAL SETTING : the procedure took place during therapy sessions
2019	Zhang et al.	Therapy: Social skills (distrust/deception)	Humanoid: NAO robot	N.D	gaining tokens	Hybrid: Pre-programmed and adjusted by the experimenter	- some children previously diagnosed by experienced hospital pediatricians based on the DSM-IV-TR diagnostic criteria - others confirmed by the Autism Diagnostic Observation Schedule and Autism Diagnostic Interview-Revised - others were assessed using the Social Responsive Scale (parents report)	Quantitative: performance in executing the task Qualitative: questions about the robot antropomorphy	Manual	RESEARCH LABORATORY (They recruited all the children from local schools)
2019	Kumazaki et al.	Teaching: To develop a job interview training program using an android robot in order to facilitate job interview skill training in young adults with ASD.	Humanoid: a female android robot Actroid F	Camera	N.D.	Wizard of Oz: tele-operating an android robot and conversing with others Fully autonomous: All scripts were prepared before the mock job interview. When a button is pushed by a teacher who is familiar with this system, the android robot begins to speak according to previously prepared scripts.	- Age between 18-27 years old - QI > 70 - Unemployed workers who were seeking for a job and have undergone consecutive mock job interviews before - Diagnosed with childhood autism/atypical autism/Asperger's syndrome using the criteria in the Diagnostic and Statistical Manual of Mental Disorders and criteria taken from the DISCO (Diagnostic Interview for Social and Communication Disorders)	Quantitative: They measured salivary cortisol levels (it's a non invasive metric of stress). All the participants completed the Autism Spectrum Quotient (Japanese version) in order to evaluate their specific behaviours and symptoms. Their QI level was measured using Wechsler Adult Intelligence Scale - fourth edition. The severity of social anxiety symptoms was measured using the Liebowitz Social Anxiety Scale (LSAS). The nonverbal communication skills were measured with ANOVA. Qualitative: They measured the changes in self-confidence, the acquisition of nonverbal communication and metrics of stress.	Manual and Physiological	RESEARCH LABORATORY
2019	Chung et al.	Therapy: Enhancement of social skill engagement (social skill training)	Humanoid: NAO robot	2 Cameras	N.D.	N.D.	- a diagnosis of ASD was confirmed by a registered psychologist or medical practitioner (DSM - V) - no hearing or vision impairment - able to follow simple commands - aged between 9 and 11 - IQ higher than 70 - no self-injury or aggressive behavior. - score 66 T or higher in the Social Responsiveness Scale - declare that they were not receiving other clinical interventions during the study period.	Quantitative: Frequency of the eye contact: movement of the head and eyes detected by two cameras Duration of eye contact. Frequency of verbal initiation.	Manual	CLINICAL SETUP.

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2019	Yoshikawa et al.	Therapy: Communication training (eye contact)	Humanoid: Female android robot (Actroid F)	Eye tracker Tobii X2 - 60 Camera	N.D	Wizard of Oz	ASD participants - clinical diagnosis of ASD based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) - Confirmed by Pervasive Developmental Disorder – Autism Society Japan Rating Scale - Confirmed by diagnostic interview scale for ASD developed in Japan - To exclude other psychiatric diagnoses, the Mini-International Neuropsychiatric Interview for Children and Adolescents Control participants: - Check for autism using Childhood Autism Rating Scale–Tokyo Version - They all had problems at school. - To exclude other psychiatric diagnoses, MINI Kids was administered.	Quantitative: time spent looking to the face of the interviewer(looking face ratio); time spent looking to the eyes(looking eye bias).	Manual and Automatic	RESEARCH LABORATORY Approved by the ethics committee of University of Fukui.
2019	Cao et al. (2)	Therapy: Implementation of RET (Robot Enhanced Therapy) - enhancement of social skills. How much RET can improve joint attention, imitation and turn-taking skills + comparison to standard interventions.	Humanoid: NAO robot	3 RGB cameras 2 Kinect sensors	feedback based on the child's performance	Semi-autonomous and adaptive: In case the action autonomously decided by the robot is not proper, the therapist can deny the suggested action and manually select a more appropriate one. We have proposed a learning-from-demonstration method called supervised progressively autonomous robot competencies (SPARC), so that the robot can learn from the manual actions of the therapist and improve its suggested actions for the next interaction [21]. As shown in Figure 7, SPARC aims at maintaining high level of performance throughout the interaction (e.g., in WoZ) while ensuring a light workload for the therapist (i.e., autonomous learning).	Verified with Diagnosis of autisms with Autism Diagnostic Observation Schedule	Quantitative: Baseline sessions to identify the initial level of skills and their variability Measurement of children's performance through task-solving accuracy (accuracy during the imitation task, correct gazing during the joint-attention task, and appropriate pauses during the turn-taking task)	Manual and Automatic	CLINICAL SETUP.
2019	Melo et al.	Therapy: Improve the quality of life of children with ASD and their family	Non-humanoid: ASTRO robot	Kinect Microphones LIDAR RFID T-shirt wearable sensors (ECG and accelerometers) for physiological data	Vocal and sounds stimulus in the game	Wizard of Oz Semi-autonomous Fully autonomous Autonomous and adaptive	Database from hospital	Quantitative: - Final long term study: physiological data analysis; behavioural analysis	Manual and Physiological	CLINICAL SETUP Hospital Garcia de Orta, in Portugal

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2019	Wan et al.	Design: Physical robot design	Humanoid: 3 robots humanoid robots with different sizes (Dabao, XiaoE, Mika)	Video recordings: 3 cameras; Touch reacting sensors	feedback when touching the screen	Wizard of Oz: one operator controlled the three robots	N.D.	Qualitative: questionnaires done by parents; Quantitative: Face detection and two gaze estimation angles to see the attention of the children to the robots; time spent on paying attention to different robots; time spent paying attention to each behaviour); video analysis of exploring part	Manual and Automatic	CLINICAL SETUP Different rehabilitation facilities/institutions.
2019	So et al.	Therapy: compare the learning outcomes in children with ASD from robot-based intervention on gestural use to those from human-based intervention.	Humanoid: Two NAO robots	Video recordings	Snacks or access to toys	Fully autonomous: the audio and the gestures started at the same time	Confirmed through interview and respecting the DSM-IV	Qualitative: Asked to a research assistant to watch the videos and count the numbers of trials in which they recognized the gesture and which were correct according to 4 parameters (use of hands, hand-shape, direction of movements, and placement) Quantitative: eye contact evaluation with robot or human (>2s)	Manual	CLINICAL SETUP
2019	Anzalone et al.	Therapy: Explore the dynamics of Joint Attention (JA) in children with Autism Spectrum Disorder (ASD) during an interaction task with a small humanoid robot	Humanoid: NAO robot	Video recordings: Cameras RGB-D sensors Microphones Wearable systems for electroencephalographic (EEG) and electrocardiogram (ECG) signals recording	Robot feedbacks based on gazing, pointing and vocalizing	Semi-autonomous: the behaviours of the robot are offline scripted, being designed offline by mimicking the interpersonal interplay between humans. The robot activity and interaction are governed by hidden controllers	- Assessment of ASD using Autism Diagnostic Interview Revised - Wechsler Intelligence scales , the Kaufman-ABC or the Psychoeducational Profile Revised were used for cognitive assessment	Quantitative: The main parameters considered are: - Head movement response to joint attention induction - Gazing std magnitude - Gazing std yaw - Gazing std pitch - Gazing frequency towards the front focus of attention - Gazing frequency towards the left focus of attention - Gazing frequency towards the right focus of attention - Displacement std magnitude - Displacement std left-right - Displacement std front-back - Body energy median - Head energy median	Automatic	RESEARCH LABORATORY SETUP.
2019	Silva et al.	Therapy: comparison between the potential of living vs robotic dogs to elicit social communication behavior and regulated emotional responses in individuals with ASD	Non-humanoid: Animal - Zoomer dog from SpinMasterTM	Wearable ECG Video recordings: Camera	Feedbacks to touch and gesture	Fully autonomous: react to the environment autonomously , through the activation of its sensors; respond to an array of voice commands	- aged from 5 to 10 years (in children) or above 20 years (in adults) - a clinical diagnosis of ASD based on the DSM-V (retrieved from participants' clinical case files and in each case confirmed by a psychologist - severe language delay (preverbal/single words, as assessed by a speech pathologist at study enrollment); - no other psychiatric diagnoses; no motor, visual, or auditory impairments; no pet ownership; no allergies nor fear of dogs	Qualitative: Percentage of appropriate responses for each group in each experimental condition Quantitative: heart rate variability parameters (RR: successive inter-beat intervals; RMSSD: square root of the mean of the squares of successive RR intervals; SDNN: the standard deviation of normal RR intervals; HFnu: normalized units of high frequency bands; LFnu: normalized units of low frequency bands)	Automatic	CLINICAL SETUP Inclusion of animals and robots in therapeutic interventions
2019	Mehmood et al.	Therapy: Joint attention and imitation skills training	Humanoid: Two NAO robots	Kinect EEG	Vocal reward in case the performance is correct	Hybrid: Preprogrammed movements on two robots which are actuated based on the attention (gaze) of the child, a researcher supervised behind a wood partition	N.D	Quantitative: number of eye contacts with the robots; imitation accuracy; power spectral density analysis of EEG	Automatic and Physiological	RESEARCH LABORATORY Supported by the National University of Sciences and Technology (NUST), Islamabad, Pakistan.

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2019	Petric and Kovacic	Diagnosis: Since the diagnosis of Autism Spectrum Disorder (ASD) relies heavily on behavioral observations by experienced clinician, the authors seek to investigate whether parts of this job can be autonomously performed by a humanoid robot, using only sensors available on-board	Humanoid: NAO robot	NAO sensors Audio and video recording	Stimuli (vocal and sound) in game Light	Semi-autonomous	N.D.	Quantitative: Audio and video recordings of all sessions were analyzed offline and all actions of the robot and social cues exhibited by the children were extracted: the outcomes are obtained offline by using observed action-observation pairs to calculate the final belief state of the robot	Manual and Automatic	RESEARCH LABORATORY : laboratory with a fully equipped examination and observation room.
2019	Taheri et al.	Therapy: There were two purposes: 1) Teach fundamentals of music via a xylophone/drum-player robot as a teacher assistant 2) Improve social/cognitive skills through active music games in children with autism	Humanoid: NAO robot	Video recordings: 3 cameras 1 or 2 Kinect sensor(s)	Vocal Sounds	Semi-autonomous: governed by a robot operator	N.D.	Quantitative: - "Identification" and "expression" of colors were assessed for the autistic participants three times - Stambak's rhythm test results were acquired in the baseline-test, the pre-test and the post-test - The scores of socio-cognitive items were acquired in the pre-test and in the post-test (passing criteria is a score greater than or equal to 2/3) - The questionnaires were filled in by parents in the baseline-test, the pre-test, the post-test and the follow-up test	Manual	CLINICAL SETUP
2019	Knight et al.	Teaching: The purpose of the current study was to evaluate the effects of teaching one code explicitly, using model-lead-test on the following dependent variables: - Acquisition of the explicitly-taught code (i.e.: robotic movement) - Generalization of the explicitly-taught code to other novel codes (i.e.: robotic sounds, light effects, complex movements) - Self-generated novel sets of codes	Non-humanoid: OZOBOT robot	N.D.	User feedbacks are directly: - Robot movements - Robot sounds - Robot lights	Fully autonomous: Students could directly program the robots using block-based codes to: - Move (i.e.: move forward, backward, change speed) - Have light effects (i.e.: traffic lights, rainbow lights, Christmas tree lights) - Create loops (i.e.: repeating the pattern) - Emit sounds (i.e.: numbers, directional cues, laughs)	All students met the following inclusion criteria: - Educational label of ASD - Co-morbid educational determination of emotional/behavior disorder (EBD), specifically poor adaptive behaviors, communication deficits, socialization deficits and maladaptive behavior (e.g.: obsessive compulsive disorder) - Adequate vision and hearing to interact with materials - Consistent response mode to communicate (i.e.: verbal, gestures) - Enrollment in high school (i.e.: grades 9–12)	Quantitative: There were 3 DEPENDENT VARIABLES measured in the current study and they were all measured based on the percent correct on a task analysis of chained skills: - Movement code; - Generalization; - Self-directed coding	Manual	SCHOOL SETTING All sessions occurred in a large, common area outside of the participants' classrooms in an urban school district in a southern state.

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2019	Marino et al.	Therapy: Cognitive Behavioral Therapy mediated by a social robot - RCT	Humanoid: NAO robot	3 cameras	emotional and social prompts in the form of body movements and recorded verbal scripts, head and gross-motor orientation of gaze shifts as well as coordinated arm and hand points.	Semi-autonomous: supervised control by the therapist	Clinical diagnosis of ASD based on the DSM-5 criteria from a licensed clinical child neuropsychiatrist; DSM-5 severity scores from mild (level 1) to moderate (level 2) in both social communication and Restricted Interests and Repetitive Behaviours domains; a verbal and performance Developmental Quotient above 70; no current problems with aggressive behaviour or severe oppositional tendency; no hearing, visual, or physical disabilities that would prevent participation in the intervention; not being on psychiatric medication; and not receiving any other intervention directly related to emotional and/or social skills during the trial.	Qualitative: Test of Emotional Comprehension (TEC) and the Emotional Lexicon Test (ELT) assessed by blinded therapists.	N.D.	CLINICAL FACILITY
2019	Fuglerud et al.	Teaching: explore using of a social robot as an assistive tool for learning and teaching basic concepts and words	Humanoid: NAO robot	N.D.	The robot "cheers" and gives a positive feedback when it recognised a correct answer (naming).	Hybrid: Controlled by the session leader	N.D.	Qualitative: qualitative analysis of the video	N.D.	SCHOOL SETTING The use of the robot was integrated in the pedagogical approach that was used in all the kindergartens in the Grorud district of Oslo. The robot-assisted sessions were piloted in one kindergarten department.
2019	Zaraki et al.	Therapy: To stimulate interaction and collaboration between children while teaching the robot, and also provide them tangible examples to understand that sometimes learning requires several repetitions. Also to improve social skills.	Humanoid: Kaspar robot	N.D.	Verbal feedbacks	Semi-autonomous: They had implemented a reinforcement learning Algorithm on KASPAR. Kaspar points autonomously towards several directions and says the name of the object and then the child gives a feedback to the robot	N.D.	Quantitative: robot choice uncertainty Qualitative: questionnaires were made to the typical development children about their interactions with the robot	Automatic	RESEARCH LABORATORY
2019	Arent et al.	Diagnosis: diagnostic methods for autism through the application of a social interactive robot	Humanoid: NAO robot	no sensors, Camera SONY HDR-AX2000	robot verbal instruction vs. robot dance	Wizard of Oz: one engineer remotely monitor the state of the robot and influence manually on interaction, a teacher took care about safety of the child and robot, helped child focusing on robot activity	N.D.	Quantitative: Video analysis by competent raters and extraction of the percentage of performed instructions and imitations	Manual	RESEARCH LABORATORY. They used the play scenario that engages a social robot and a child to play together.
2019	Attawibulkul et al.	Therapy: supporting personal-social and language development in children with autism and other special needs.	Non-humanoid: BLISS robot	Interactive screen RFID cards	LED light Sound	N.D.	N.D.	Qualitative: Questionnaire developed by parents about the personal-social development; the level of experimenter prompt. Quantitative: Scores in daily routine games recoiled by the robot	Automatic	SCHOOL SETTING. All participants are the students at the Play & Learn school by Krunong, Bangkok, Thailand.

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2019	Cervera et al.	Therapy: improve social and communication domain	Humanoid: NAO robot	N.D.	verbal feedback ("very well" or repetition of the question if wrong)	Hybrid: Controlled by the caregiver	DSM-V and ADOS-G	Quantitative: video coding in number of gazing, pointing and utterances through videoanalysis Qualitative: developmental scale (Battelle Developmental Inventory BDI), based on observations of the child and interviews with parents and caregivers	Manual	CLINICAL SETTING
2019	Telisheva et al.	Therapy: Imitation, joint attention and emotional skills training	Humanoid: NAO robot	web camera - video recording	N.D.	Hybrid: controlled by one of the researchers in the room, some of the behaviours were already programmed in the robot	N.D.	Qualitative: two semi- structured interviews with parents after the first and the last sessions	N.D.	CLINICAL SETTING The study was conducted at Republican Children's Rehabilitation Center which provides a 21-day hospitalization for children and their parents on voluntarily basis.
2019	Kumazaki et al. (2)	Design: comparison of response rates for different types of robots	Humanoid: 2 humanoids robot evaluated separately (ACTROID F - android female and CommU- visually simple humanoid)	3 cameras	N.D.	Wizard of Oz: Controlled by another researcher	Previous diagnosis with DSM-V confirmed with ADOS -2	Quantitative: frequency with which the child turned his/her head and/or eyes toward the agent following the social press	N.D.	RESEARCH LABORATORY
2019	Zhang et al.	Diagnosis: Impairments on the Theory of Mind	Humanoid: NAO robot	Video recordings	gaining tokens	N.D.	Previous diagnosis with DSM-IV-TR, ADOS, ADI-R, SRS	Quantitative: Pass- rate - percentage of children responding correctly to the false belief question in each task; Accuracy - percentage of correct answers to the false beliefquestions per child; Qualitative: categorization of the robot in toy, human, animals or machine	N.D.	RESEARCH LABORATORY University's Committee for Protecting Human and Animal Subjects School of Psychological and Cognitive Sciences of Peking University
2019	Wanglavan et al.	Therapy: promote child development through triadic interactions	Non-humanoid: BLISS robot	Interactive screen RFID 1 Camera	LED light Sound	Autonomous and Adaptive: stimulates or gives a reward to the child depending on her attention level	N.D.	Quantitative: The time spent to answer a question; The distance between the face and the reference point; The size of the face; The gazing status: closed or distanced; The direction status of gazing: looking straight at the robot or looking in other directions;The percentage of accuracy when answering a question; The status of consecutive correct answering (more than 3 times); The status of consecutive incorrect answering (more than 3 times); The status of frequent screen touching (more than 5 times in less than 15 seconds); User emotion status (happy = 1 / unhappy = 0)	Automatic	N.D.
2019	Pérez et al.	Teaching: use of the robot for learning the emotional management of students with ASD	Non humanoid: Bee-bot	N.D.	N.D.	N.D.	DSM-V	Qualitative: identification of emotions, emotional understanding, expression of emotions	Manual	RESEARCH LABORATORY Controlled setup
2019	Ishak et al.	Therapy: improve communication skills	Humanoid: Rero Robot	N.D.	N.D.	Wizard of Oz	N.D.	Qualitative: questionnaires (not specified)		CLINICAL SETTING
2019	Roberts-Yates and Silvera-Tawil	Design: introduction to SARs technology to improve social and communication skills	Humanoid: NAO robot Non humanoid: Paro robot	Audio recorder Robot's LED (NAO robot)	N.D.	N.D.	N.D.	N.D.	N.D.	RESEARCH LABORATORY Controlled setup
2019	Axelsson et al.	Design: teaching assistive sign language	Humanoid: InMoov robot	1 camera	Movement (thumbs up)	Wizard-of-Oz: an operator controlled the robot	N.D.	Quantitative: eye-gaze and imitation success rate; Qualitative: survey about interaction with the robot	Manual	N.D.

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2019	Kumazaki et al. (3)	Diagnosis: development of a quantitative and precise measure of the autistic traits using the birthday party scene of the scale ADOS as reference	Humanoid: 2 CommU robots	3 cameras	Vocal Feedback	Hybrid: scripts were developed for each robot in advance and the therapist just had to click once and then the robot would work autonomously	- male - age 5-6 y.o. - K-ABC (Kaufman Assessment Battery for Children) ≥ 80 - for the IQ level - verification of the autism criteria: ADOS-G and DSM-V - SRS score done by the parents	Quantitative: social communication score scale developed by a psychiatrist and a psychologist based on the interaction of the child with the robot	Manual	CLINICAL SETTING
2019	Cai et al.	Design: testing a multi-modal data sensing and analysis for a new robotic therapy	Humanoid: NAO robot	3 cameras 2 RGBD cameras	Vocal feedback	Semi-autonomous: the robot is autonomous and transfers the control to the therapist whenever it is required	ADOS-2 SCQ	Quantitative: face/emotion recognition; gaze assessment; action recognition	Automatic	RESEARCH LABORATORY
2019	Alhaddad et al.	Design: comparison of train toys with social robots	Humanoid: NAO robot and Paro robot	N.D.	N.D.	Wizard of Oz: simple dances up and seat functionalities	N.D.	Quantitative: Experiment duration, Interaction duration, Preference, Unclear	Manual	N.D.
2018	Nuovo et al.	Design: Estimating child's visual focus in imitation training - integration on the TEACCH treatment (Treatment and Education of Autistic and related Communication Handicapped Children)	Humanoid: NAO robot	NAO cameras	Vocal feedback (good or right) and physical feedbacks (a caress) from the therapist	Wizard of Oz	psycho-diagnostic instruments: Leiter-R, WISC, PEP-3, VABS, ADI-R, and CARS-2	Quantitative: Visual focus of attention - Is the child monitoring the robot or not?	Automatic	CLINICAL SETUP They tested the protocol in the standard therapy of hospitalized children with ASD and ID.
2018	Rudovic et al.	Design: Recognize and imitate emotive behaviour	Humanoid: NAO robot	Cameras EDA, Heart rate Body temperature	N.D.	Wizard of Oz	N.D.	Quantitative: Engagement, Arousal, Valence	Manual and Automatic	RESEARCH LABORATORY Preapproved by the Institutional Review Boards of Chubu University (Japan), Massachusetts Institute of Technology (United States), and Mental Health Institute (Serbia)
2018	Del Coco et al.	Diagnosis: Diagnosis, assessment and treatment	Humanoid: Zeno (R25) + tablet	Video recordings: Tablet camera	N.D.	Wizard of Oz	Diagnostic assessment (DSM-5, ADOS-2, GMDS)	Qualitative: considering the affective state as a whole Quantitative: frame by frame analysis; computation of head position, gaze, facial action units is sent to the data analysis module to detect and label the temporal intervals containing the relevant affective behaviours of the child.	Manual and Automatic	CLINICAL SETUP ASD children were tested at the clinical facilities within the National Research Council of Italy (CNR), Messina, Italy.
2018	Saadatzai et al.	Teaching: Teach reading skills through VR + robot	Humanoid: NAO robot	Video recordings: Webcam	When receiving feedback from the PA, the RP was programmed to demonstrate random happy gestures. Vocal feedback	Semi-autonomous	- Medical diagnosis of ASD - could vocally describe a wide range of stimuli within the environment - identified as primarily a sight word reader - reported to have no known visual or hearing impairments.	Quantitative: Percentage of words correctly read + number of errors + data on the generalization and maintenance of words. Follow-up sessions 2 months after after the post-assessment session. Final generalization probe at the child's home (words on flash cards)	Manual	RESEARCH LABORATORY
2018	Kumazaki et al.	Therapy: Joint attent skills	Humanoid: CommU Robot	Video recordings: 3 cameras	N.D.	Wizard of Oz with a prepared script	Diagnostic assessment (DSM-5, ADOS-G, Kaufman Assessment Battery for Children, DISCO, Social Communication Questionnaire, MINI Kids)	Quantitative: decoding of videos to observe the number of times the subject looked to an image after the robot looking into it	Manual	RESEARCH LABORATORY Research Center for Child Mental Development, Kanazawa University.

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2018	Scassellati et al.	Therapy: The objectives of this study were to investigate how a social robot may deliver behavioral intervention to children with ASD both autonomously and effectively outside clinical settings, as well as how such robot-assisted intervention can improve these children's social-communicative abilities	Non-humanoid: JIBO robot	2 cameras	Eye contact, verbal, little movements feedbacks	Autonomous and adaptive: eye tracker control the robot's behaviour, schedule the intervention and adapted the level of the games	- age between 4 and 12 years old - good medical health - cooperative with testing - English is a language spoken in the family - having been diagnosed with ASD through ADOS or ADI-R	Quantitative: Many data were recorded: video and audio data, head orientation of both child and caregiver, interaction logs containing the robot utterances and actions, game logs for the tablet-based games and caregiver survey responses. performance joint attention caregiver survey	Manual	HOUSE SETTING
2018	Albo-Canals et al.	Design: To explore the feasibility of using the KIBO Robot as an engaging platform to positively impact social and emotional development in children with ASD.	Non-humanoid: A toy robot KIBO	Video recordings: 3 cameras	It is screen-free and it has an easy visual interface. It has a slot for only 4 sensors.	Wizard of Oz: Controlled by the therapist/child: The KIBO kit uses wooden blocks to program the robot	- Age between 6-14 yo - Diagnosed with severe ASD and cognitive impairments - Previous contact with LEGO robots, but no with KIBO	Qualitative: They do an assesment of engagement and disengagement in all participants. Two observers take notes about what is happening during the session and about each child. Quantitative: Two observer fill in modified PTD (Positive Technology Development) Observational checklist during the session. Video data are analyzed using the BORIS OC application with ratings by an independent observer.	Manual and Automatic	SCHOOL CASPAN center in Panama.
2018	Zheng et al.	Therapy: Joint attention skills training	Humanoid: NAO robot	4 cameras	Vocal prompts and movement (pointing), reward: cartoon videos	Autonomous and adaptive: Fully autonomous closed loop system-based on the gaze of the child	DSM- V; ADOS-2; Social Responsiveness Scale; Social Communication Questionnaire	Quantitative(percentage of time looking to the robot, target monitor and non target monitor, number of trials to hit the target monitor, number of prompts) Qualitative: subjective analysis of the researchers during the sessions - mode of interaction with the robot and feedbacks from children	N.D.	RESEARCH LABORATORY From Vanderbilt Kennedy Center,
2018	Van Straten et al.	Design: study the effects of intonation (normal vs. monotonous) combined with different bodily appearance of a robot (mechanical vs.humanized) on treatment outcomes of therapy sessions for children with ASD	Humanoid: NAO robot	1 camera	N.D	N.D	- diagnosed provided before by DSM - IV - diagnosed confirmed using ADOS - could speak at least with single words - speak primarily dutch - IQ > 70 (Wechsler Intelligence Scale for Children or the Wechsler Preschool and Primary Scale of Intelligence) - no history of audiovisual or additional neurological deficits	Qualitative: task performance was assessed via the percentage of prompts that a participant received during a trial and participants' affective states were assessed using the Affect Rating Scale. Five outcome variables: the average percentage of required prompts, the mean general affect score, the mean interest score, the mean happiness score, and the mean behavior score.	Manual	CLINICAL SETUP
2018	Khamassi et al.	Therapy: present an algorithm to adapt the robot's expressivity parameters of action (mutual gaze duration, hand movement expressivity) in an online manner during the interaction.	Humanoid: NAO robot	N.D.	chose a reward component to be given by a dynamical system which is based on the virtual engagement of the human in the task	Semi-autonomous	N.D.	Qualitative The engagement estimation: in this pilot study, was provided in real-time by an expert who observed the child considering five discrete levels of engagement (0 to 4, with 0 meaning absence of engagement and 4 meaning full engagement and attempt to offer help); in simulations, the quantified engagement arbitrarily starts at 5, increases up to a maximum EM = 10 when the robot performs the appropriate actions with the appropriate parameters, and decreases down to a minimum Em = 0 otherwise	Manual	RESEARCH LABORATORY

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2018	Costa et al.	Therapy: Emotional abilities teaching and effect on repetitive behaviors	Humanoid: QTrobot	Video recordings: 1 Camera	N.D.	Hybrid	- oreviously diagnosed with DSM criteria - social impairments assessed through Social Responsiveness Scale 2 and IQ assessed with Wechsler Non Verbal Scale of Ability	Qualitative: parents questionnaires Quantitative: Video annotation and assessment of children attention; number of children's gaze toward the interview partner and duration of each gaze; number of imitation; number of chains of repetitive and stereotyped behaviors and number of repetitions within each chain	Manual	CLINICAL SETUP
2018	Askari et al.	Design: Comparing the facial expression recognition abilities of children with ASD with typically developing using a humanoid robot, in order to understand how it can be used as a socially assistive robotic agent.	Humanoid: rear-projected robot Ryan.	N.D.	N.D.	N.D.	- Age between 8-16 yo - Formally diagnosed from a doctor or psychiatrist - High functioning level - confirmed with ADOS and SRS-scale	Quantitative: ADOS (Autism Diagnosis Observation Schedule) examinations were performed in order to confirm their diagnosis. All the children's parents were asked to fill SRS (Social Responsiveness Scale).	Manual	RESEARCH SETTING, In the social robotics laboratory at the University of Denver.
2018	Zaraki et al.	Design: To provide an overview of the design and implementation of a robotic system called Sense-Think-Act which converts the remote-controlled scenarios of humanoid robot into a semi-autonomous social agent with the capacity to play games autonomously (under human supervision) with children in the real-world school settings.	Humanoid: Kaspar robot	Video recordings: 1 camera from the robot 3 IMUD 1 Kinect	Movement feedbacks	Semi-autonomous: able to propose behaviours but the ultimate decision is made by the therapist.	N.D.	Qualitative Shared attention between therapist-robot-child. Quantitative --The reaction time --3D Orientation of Cube and Turn Table Tracking;this module has been design to estimate the 3D orientation of a cube and the rotation angle of a turn table with the final aim of recognizing the animal pictures on the cube sides as well as the animal toy that is placed on a section of the turn table between the dividers. --Human gesture and voice analysis: this perception task has been achieved by integrating the Microsoft Kinect Software Development Kit (SDK) v2.0 into the sense layer. It is able to simultaneously detect up to five humans in the robot's field of view (FOV) and track the 3D positions of 25 body joints for each person, in real-world coordinates.	Manual and Automatic	SCHOOL SETTING Local specialist secondary school in UK
2018	Nie et al.	Therapy: prediction of RJA performance in Human - Human Interaction based on head pose patterns in Robot - human interaction	Humanoid: NAO robot	Video recordings: 4 cameras	video reward	Autonomous and Adaptive: Fully autonomous closed loop system-based on the gaze of the child	N.D.	Quantitative: For both group: 1-ESCS test videotaped and offline coding; 2- RJA skills scoring based on number of target attention prompts administered by the robot.	Manual	RESEARCH LABORATORY
2018	Moghadas and Moradi	Diagnosis: Autism screening	Non-humanoid: Animal - Robot Parrot	2 cameras	N.D.	Wizard of Oz: the robot is controlled remotely by a tablet	N.D.	Quantitative features extracted: ratio of presence in front of the robot; presence in several points of the room; percentage of time the child was present in each cell of the room	Automatic	CLINICAL SETTING The study was conducted in the Center for Treatment of Autistic Disorders
2018	Marinoiu et al.	Design: fine-grained action and emotion recognition tasks	Humanoid: Zeno robot	1 Kinect	N.D.	Hybrid: Controlled by the therapist	N.D.	Quantitative: Valence and arousal	Automatic	CLINICAL SETTING
2018	Javed et al.	Therapy: sustaining the child's engagement in a designed activity and design of intervention strategies that can be adapted to suit the specific needs of every child	Humanoid: Darwin Mini robot	1 Kinect	N.D.	N.D.	N.D.	Quantitative: eye gaze focus, vocalizations, imitation, triadic interactions, self-initiated interactions, and smiles.	Manual	RESEARCH LABORATORY

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2018	Giannopulu et al.	Therapy: Analyse the verbal and nonverbal communication of neurotypical and ASD children vis a vis a human or a robot. Because of its simplicity the robot would better assist the verbal and nonverbal communication of ASD children than the human, the emotional feeling reported was expected to be higher 'after' than 'before' the interaction with the robot.	Non-humanoid: Plant - InterActor toy robot called Pekkoppa.	Heart rate sensor Audio recorder	The Pekkoppa's leaves and stem make a nodding response based on speech input	Fully autonomous: Pekkoppa nodes when someone is talking to it.	Diagnosed by experienced psychiatrist with DSM-IV-TR	Quantitative: Analysis was based on the heart rate Qualitative: at the end of the session the child is invited to estimate its own emotions after the contact with the robot and the human.	Automatic	The study took place in a room which was familiar to the children.
2018	Taheri et al.	Therapy: social skills training (imitation and joint attention)	Humanoid: 1 NAO robot; 1 Alice robot	2 cameras Microsoft Kinect	Applauses and verbal reinforcement	Wizard of Oz: the imitation commands were passed directly through Kinect and haptic Phantom-Omni encoders.	GARS questionnaire	Quantitative: Video coding for the classification of gaze-shifting; joint attention; imitation; maladaptive behaviors; Verbal Communications Qualitative: Interview with Subject's Parents; assessment of autistic behaviours before and after the program by a child psychologist; GARS and ASSP questionnaires	Manual	RESEARCH LABORATORY
2018	Kumazaki et al. (2)	Therapy: promotion of self disclosure	Humanoid: 2 humanoids robot evaluated separately (ACTROID F - android female and CommU- visually simple humanoid)	1 microphone	N.D.	Wizard of Oz: teleoperated robots	Questionnaires to parents: Social Communication Questionnaire and Social Responsiveness Scale POst test: questionnaire done by the adolescents about their level of enjoyment, embarrassment, stress and boredom	Qualitative: self- report survey using a 9-point Likert scale to rank their level of enjoyment, embarrassment, stress, and boredom while communicating with each agent. Quantitative: length of disclosure statements from audio recordings; ratio of number of words used in self disclosure between interactions with each robot vs human interviewer	Manual	CLINICAL SETTING Sequence of three interaction conditions in random order, all of which were guided and took place in a standard clinical assessment room.
2018	Carlson et al.	Therapy: improve joint attention (initiating joint attention INJ and responding joint attention RJA)	Non-humanoid: Animal - embodied robot CuDDler, A*Star	N.D.	verbal feedback ("good job") to verbal answer regarding the target	Wizard of Oz: controlled by the experimenter	N.D.	Qualitative: Sections of the abridged Early Social Communications Scale, ESCS (the Object Spectacle Task (1 x), the Gaze Following Task (2 x) and the Book Presentation Task (2 x)).	N.D.	CLINICAL SETTING The THK EIPIC Centre (Singapore).
2018	Kim, S., Hirokawa, M., Matsuda, S., Funahashi, A., & Suzuki, K.	Therapy: Investigate the potentials of robot assisted interventions to facilitate helping behaviors. Explore the relationships between smiles and helping behaviors. In this study, they considered smiles as an indicator of positive moods before helping behaviors to a robot were shown, and investigated the number of smiles and the duration of helping behaviors.	Humanoid: NAO robot	4 ceiling cameras (for helping behaviours) 1 robot on board camera	It can express nonverbal communication behaviours through its movement, made possible by its various joints.	Wizard of Oz: a human operator observes interactions between each child and NAO and makes more interactive behaviors, which can increase positive moods, depending on child's responses.	N.D.	Quantitative: analyzed the number of smiles and the duration of helping behaviors. To analyze behaviors related to helping and smiles, they identified the starting points and ending points of help-seeking behaviors.	Manual	RESEARCH LABORATORY They obtained approval by the Ethical Committee based on the ethical rules established by the Institute of Developmental Research.
2018	So et al.	Therapy: gesture recognition	Humanoid: NAO robot	3 head touch sensors and 2 feet touch sensors Camera	Snacks or access to toys Vocal feedback	N.D.	Confirmed using DSM-IV	Quantitative: Recognition of gestures; Production of the right gestures	Manual	SCHOOL SETTING Room of a school normally used for activities
2018	So et al. (2)	Therapy: gestural profuction	Humanoid: NAO robot	1 camera	Snaks or access to toys after each session	Hybrid	DSM-V, ADOS, ADI-R	n° gestures produced from a set of 14 intransitive gestures	N.D.	CLINICAL SETTING

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2018	Fachantidis et al.	Therapy: social and communication skills training	Non-humanoid: stuffed toy named Daisy resembling a flower	N.D.	N.D.	Wizard of Oz: the operator controlled the robot remotely via a tablet without making that visible to the children	Diagnosis done by a certified organization. WISC III for the IQ evaluation	Quantitative: eye contact; proximity; verbal interaction; difficulty paying attention; inability to sit; difficulty following instructions	Manual	SCHOOL
2018	Sakka et al.	Therapy: social skills training	Humanoid: NAO robot (3 robots one for each pair of children)	N.D.	Voices	Hybrid: the robots were programmed by the three children with a small story at each step. The three stories were activated in a final Show.	N.D.	Qualitative: concentration time, sharing with other, acquiring robot programming skills, voluntary communication, verbal communication, taking care of objects, writing and reading, organization, focus and efficiency	N.D.	Other: Stereolux (performing arts centre)
2018	Pour et al.	Therapy: social skills training - facial expression recognition	Humanoid: Zeno robot (female version Alice)	1 Kinect 2 cameras	N.D.	Wizard of Oz: there was a robot operator in the observation room	N.D.	Qualitative: general observations of the behaviour of the child Quantitative: facial emotion imitation score	Manual Automatic	RESEARCH LABORATORY The ethical committee was approved by the University of Medical Sciences
2018	Silva et al.	Design: evaluation of a game scenario with a robot and a Object based on Playware Technology (OPT)	Humanoid: Zeno robot	N.D.	Vocal and movement feedback	N.D.	N.D.	Quantitative: number of correct answers; time for selecting an answer	Automatic	SCHOOL
2018	Krichmar et al.	Therapy: develop a protocol based on the sensory integration theory	Non-humanoid: CARBO robot	touch sensors	Auditory and movement feedback	Hybrid: the robot was autonomous but there was a laptop in which was possible to give feedbacks to the user and instructions	N.D.	Qualitative: questionnaires and informal interviews to the children Quantitative: number of successful movement, direction, speed and smoothness of the movement	Automatic	SCHOOL
2018	Nunez et al.	Therapy: training of turn-taking skills	Non-humanoid: 2 COLOLO robots	Tilt sensor 1 camera	Tactile and light feedback	Fully autonomous: the robots had embedded sensors to detect when they are being manipulated and send messages to the other robot	PARS (Pervasive Development Disorders Autism Society Japan Rating Scale)	Quantitative: number of manipulation per minute; number of gaze-shifting per minute; ratio of failed attempts among all manipulations; number of turn-taking events per minute	Manual Automatic	RESEARCH LABORATORY
2018	Desideri et al.	Therapy: training of target behaviours	Humanoid: NAO robot	1 camera	N.D.	Hybrid: programmed to answer to the word music, but most of the controls were given through a tablet	N.D.	Quantitative: level of engagement; goals achieved	Manual	CLINICAL SETTING
2017	Bharatharaj et al.	Therapy: Learning and social skills training, psychological benefits to children with ASD through stress reduction.	Non-humanoid: Animal - KiliRo (parrot-inspired robot)	2 wireless cameras 1 USB camera Seven touch sensors 1 Audio recorder for speech recognition	LED lights are turned on when the touch sensors are activated	Hybrid: the speech recognition feature was used to initiate and terminate the robot's speaking module; KiliRo's locomotion was achieved using an android application installed on a smart phone; recognize "yes" and "no" from the participants and act accordingly	- autism confirmed by Childhood Asperger Syndrome Test (CAST) questionnaire	Qualitative: Social Interaction: manual observation method to evaluate improvements in social interaction and learning, Social Network Density (SND) - social interaction (looking, smiling, holding hands, touching, initiating verbal or nonverbal communication, hugging...) among participants Quantitative: letter and number recognition score Physiological analysis: urinary and salivary tests to evaluate biological changes (7 participants from Group 1), protein and alfa-amylase levels, systolic and diastolic blood pressure, heart rate, oxygen saturation level (14 participants from Group 2)	Automatic	SCHOOL SETTING

Table Supplementary Material 1: Analysed papers and robotics categories

Year	Authors	Purpose	Robot	Human Robot Interaction			Measurements			Environment (clinical, house, school, research laboratory)
				Sensors	Feedback (vocal, action, reward)	Control/Autonomy	Autism Inclusion Criteria Diagnosis Evaluation	Analysed (quantitative and qualitative)	Manual / Automatic extraction of quantitative measures	
2017	Kumazaki et al.	Design: Examination of how appearance affects the humanoid robotic preferences of high-functioning individuals with ASD	Humanoid: 3 robots with different appearances: 1- Actroid F (female-type humanoid) 2- Smile Supplement Robot (cartoonish appearance) 3- M3-Synchy (abstract appearance)	M3-Synchyrobot camera on his forehead.	Robots offered greetings	Wizard of Oz: the robots were controlled by researchers on adjacent rooms or located against the wall in experimental room.	- IQ eligibility was confirmed within one day of participation using either the Wechsler Intelligence Scale for Children—Third Edition or the Wechsler Adult Intelligence Scale—Third Edition. - confirm diagnosis through Pervasive Developmental Disorder—Autism Society Japan Rating Scale	Qualitative: Self-report measures: 5-min semi-structured interview at the conclusion of all the trials: interviewer asked "Do you like robots?", "Which was your favorite robot," Which was your second-favorite robot?" --> rank of the preferences		CLINICAL SETTING Standard clinical observation room
2017	Costescu et al.	Therapy: improve the strategies they use in different social situations; modify irrational beliefs; teach them adaptive behaviors in social situations associated with anger and sadness and to reduce the intensity of negative emotions	Non-humanoid: robot My Keeper	Camera: all sessions were videotaped	winning sound and by two popping movements/ losing sound and by bending the head twice	Wizard of Oz: controlled by an operator	Diagnosis of ASD was confirmed by a clinical psychologist involved in the study using the Autism Diagnostic Observation Schedule – Generic ADOS-G and the criteria outlined in DSM IV-TR.	Quantitative: frequency of correct strategies to be used in a social situation; frequency of used rational beliefs or irrational beliefs; emotional intensity rating scale for angry and sadness (on a scale from 0 to 10) and frequency of using adaptive and dezadaptive behaviors	Manual	N.D.
2017	Rudovic et al.	Design: Study how levels of autism's behavioral engagement vary as a function of (i) context (the task, culture, and behavioral severity of the children) and (ii) different facets of the children affective engagement (the perceived valence and arousal levels and the face expressivity) across cultures. They used a robot to induce a context in which the children's engagement can be measured in a structured way.	Humanoid: NAO robot	1 High resolution webcam with a microphone in order to record the interactions.	N.D.	Wizard of Oz	CARS	Quantitative: code the engagement with a 5 point Likert scale; code valence and arousal and children's face expressivity	Manual	CLINICAL SETTING The protocol was recorded as a part of occupational therapy for the children.
2017	Yun et al.	Therapy: evaluate and verify the effects of behavioral interventions that used a robot as a facilitator for behavior in children with ASD (focused on eye contact and facial emotion recognition)	Humanoid: iRobiQ robot and CARO robot (changed at the 5 session)	Kinect 1 camera Touch sensors	Vocal feedbacks: Compliments or song Movement feedbacks: nodding or waving	Semi-autonomous: When the subject gave three or more consecutive correct answers, the robot raised the difficulty level; If the child made appropriate eye contact, the robot gave a Reward (RW) and proceeded to the facial emotion recognition tasks. When the child did not make eye contact, the robot provided Encouragement (EN). The therapist gave some supervision in relation to the correctness of the answers.	- Diagnosis of ASD by an experienced child psychiatrist based on criteria of the DSM-V - ability to communicate in sentences - with a verbal intelligence quotient (IQ) of 60 or more according to a standardized intelligence test - no current problems with aggressive behavior or severe oppositional tendency - no hearing, visual, or physical disabilities that would prevent participation in the treatment process.	Qualitative: the parents' answers to the questionnaires(Social communication questionnaire, Social responsiveness scale) on problems that are directly related to ASD and direct observations of the children according to the ADOS; secondary outcome measure: The Korean version of the Child Behavior Checklist (KCBCL) to quantify the general behavior characteristics of the children Quantitative: Frequency of eye contact and accuracy of facial emotion expression.	Manual	N.D.

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2017	Bharatharaj et al.	Therapy: to evaluate the effects on improvements in learning and social interaction abilities of children with ASD through AMRM (adapted model-rival method) and parrot-inspired robot	Non-humanoid: Animal - KiliRo Parrot inspired robot	2 wireless cameras with microphone	N.D.	Wizard of Oz: a remote operator controlled robot locomotion and the several behaviours like speaking to people.	The Childhood Autism spectrum disorder Spectrum Test'(CAST) questionnaire was used to evaluate the severity of autism spectrum disorder symptoms in the participants	Qualitative: informal and semi-formal interviews with nine parents of participating children, a pediatrician and a child psychologist. Questionnaires with 5 point Likert scale. Quantitative: emotion recognition technique, Oxford emotion API to classify facial images of participating children into one of eight different types of emotions	Automatic	N.D.
2017	Chevalier et al.	Therapy: To develop a new personalized robot/virtual-agent-based social interaction model, in addition to standard therapy, for individuals suffering from ASD.	Humanoid: NAO and R25 (ZENO); they also used a female virtual agent (= avatar)	1 camera Force Platform	N.D.	N.D.	N.D.	Quantitative: developed EMBODI-EMO (video database of expressions of emotions) in order to evaluate individuals' skills to recognize body and facial expressions of emotions on different supports with increasing visual difficulties and to analyze relationships between these skills (recognition scores) and a user's profiles.	N.D.	RESEARCH LABORATORY
2017	Boccanfuso et al.	Therapy: To design and implement a teleoperated mode and two interactive games in a social robot in order , during the therapy, to promote joint attention, imitation and turn-taking in children with ASD.	Humanoid: CHARLIE - A toy-like robot.	1 webcam	Lights and vocal feedbacks	Wizard of Oz: the robot was teleoperated	Diagnosed with ASD and speech deficiency, confirmed by ADOS VABS-II and Social Communication Questionnaire were used during the pretest.	Quantitative: mean length spontaneous utterance Qualitative: VABS-II questionnaire; unstructured imitation assessment; motor imitation scale; Expressive Vocabulary Test	Manual	RESEARCH CENTER The sessions with the robot took place at the USC Speech and Hearing Research Center, by the Department of Neuropsychiatry and Behavioral Sciences, at the University of South Carolina - School of Medicine.
2017	Golestan et al.	Therapy: developing social and communication skills	Non-humanoid: Sphero robot	1 camera	actions (changing color, jumping, dancing, and rotating)	Wizard of Oz: controlled by an operator through a smartphone or tablet via Bluetooth	N.D.	Qualitative: questionnaires done by parents; questionnaire done by a specialist	N.D.	CLINICAL SETTING Robots are used in therapy sessions in order to encourage children with autism to be more engaged in therapeutic activities and social skills such as eye gaze, joint attention, and touch.
2017	Short et al.	Therapy: understand the role of robot's agency in interaction with children with autism	Humanoid: Mobile humanoid robot; Non-humanoid: mobile box robot non mobile toy	1 camera infrared emitters	Vocalizations and gestures	Semi-autonomous: there are a set of rules that the robot executes autonomously and just a specific behaviour was controlled by an operator	N.D.	Quantitative: video decoding in 2 robot behaviours, 9 child behaviours, and one parent behaviour (number of times that each behaviour occurred- ex: number of child vocalization, number of times the robot moved; number of times of robot bubble blowing, etc); number of times a button was pressed Qualitative: analysis of the children behaviours	Manual	RESEARCH LABORATORY
2017	Robins et al.	Therapy: Social skills	Humanoid: Kaspar robot	2 cameras 1 Kinect	N.D.	Wizard of OZ	N.D.	N.D.	N.D.	SCHOOL SETTING 2 schools in different towns in Hertfordshire, UK.
2017	Desideri et al.	Therapy: exploring whether a humanoid robot implemented in routine clinical practices could improve engagement of children with ASD during educational activities	Humanoid: NAO robot	1 camera	dance or produce music, upon a specific request ("music")	Hybrid: educator used a tablet to initiate the chosen activity	Pre test; adaptive behavior using the Adaptive Behavior Scale – Short form (SABS)	Qualitative: positive effect of robot on engagement and goal achievement	Manual	RESEARCH LABORATORY

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2017	Petric et al.	Diagnosis: a functional imitation task aimed at facilitating Autism Spectrum Disorder (ASD) diagnostics in children	Humanoid: NAO robot	1 camera 1 robot on board camera	actions and vocal feedbacks	Wizard of Oz: Behind the two-way mirror, another therapist and a robot operator were observing the experiment. Based on instructions by the therapist, the robot operator could initiate or inhibit certain actions of the robot.	Before starting the study, a group of seven typically developing children was recruited to validate the planned procedure. Two imitation tasks were performed: drinking gesture imitation and frog jumping imitation. Both tasks were administered by the robot and by a human therapist, for a total of four imitation tasks	Quantitative: number demonstrations performed before a successful imitation by the child	Manual and Automatic	RESEARCH LABORATORY
2017	Nakadoi	Therapy: to assess the effectiveness of the use of animal type robot PARO for ASD in the child and adolescent psychiatric ward	Non-humanoid: Animal - PARO baby harp seal	five sensors: tactile, light, audition, temperature, and posture sensors	vocal; PARO barks happily in response to being petted	N.D.	N.D.	Qualitative: gross observation, not use the objective index	Manual	CLINICAL SETUP
2017	Feng et al.	Design: Social skills training/evaluate an engagement model	Humanoid: NAO robot	Camera ultrasonic sensors microphones (all sensors incorporated on the robot)	Talking and movement	Autonomous and adaptive: the robot adapts its position and actions based on the engagement of the children	N.D.	Quantitative: engagement - the engagement is estimated based on the face detection; distance of the child to the robot; and the sounds made by the child (crying or laughing)	Automatic	N.D.
2017	Bharatharaj et al.	Therapy: Interaction /Therapies	Non-humanoid: Animal - Parrot robot (KiliRo)	Microphones	N.D	Hybrid: Able to recognize speech and act accordingly as well as numbers; to move forward and backward it was operated	Pre test: childhood asperger syndrome test (7 days before the study)	Quantitative: stress levels calculated from protein levels and alpha amylase levels recoiled through urinary and salivary samples, respectively	Manual	RESEARCH LABORATORY.
2017	Ponce et al.	Therapy: Social skills training	Humanoid: Tec-o robot	Pressure sensors, Camera incorporated on the robot	N.D.	Hybrid: The robot is able to follow the child based on the camera and react when his pressure sensors are touched, but most of the therapy is done controlled by the therapist	N.D.	Qualitative: children reaction observations	Manual	CLINICAL SETTING
2017	Kim et al.	Therapy: Implement an experimental protocol with some imitation games into humanoid robots in order to promote an improvement in social communication and interaction skills, joint attention, response inhibition and cognitive flexibility of children diagnosed with Autism Spectrum Disorder (ASD).	Humanoid: NAO Robot	Proposed NAO vision system employs a localized version of Color and Edge Directivity Descriptor (CEDD) and the Bag of Visual Words model to its recognition tasks. In this work, the scientists applied Fuzzy Lattice Reasoning (FLR) techniques on vectors computed by CEDD for pattern recognition.	The robot can give one additional confirmation in case a child succeed in an imitation game. It gives two additional confirmations in case a child fail a game before concluding.	Semi-autonomous: NAO behaves autonomously by choosing the game for the child, being also able to correct he/she. When the game ends and NAO suggests to move on, the therapist has to decide to go on or to stop	Wechsler Intelligent Scale for Children	Qualitative: parents and therapist questionnaires (Likert scale about the behaviour and body movements test);	N.D.	CLINICAL SETTING. The study was carried out in the Music-Therapy room of the PRAXIS Treatment and Counseling Unit.
2017	Arias and Madrid	Therapy: To improve social skills by programming a robotic platform (NAO robot) in order to use the process of systematizing human behavior. Focused on developing the skills for programming making use of the information research, logical thinking and personal skills.	Humanoid: NAO robot		N.D.	Wizard of Oz: the programming was done by the participants	Diagnosis of Asperger condition. They have to attend high school and have some interests in videos or technology.	Qualitative: reports from psychologist and instructors which have collaborated in the project	N.D.	RESEARCH LABORATORY EITA center.

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2017	Ahmad et al.	Therapy: Present a HRI study that reports on the potential of NAO as a socially assistive robot in Pakistan.	Humanoid: NAO robot	Probably the presence of a camera that make possible to rewatch the session in order to examine some datas.	Capable of autonomously showing three emotions (Happiness, boredom and sadness) through displaying gesture. It can make some introductory questions. Presence of LEDs.	Hybrid: NAO autonomously display behaviours during the interaction. Speech recognition is controlled via Wizard-of-Oz (WoZ) method from another room.	Gilliam Autism Rating Scale-Second Edition (GARS-2) test to identify the level of autism.	Quantitative: Video coding they measured the frequencies and durations of eye gazes, verbal responses, and facial expressions during the sessions. Qualitative: reflection of both teachers and parents views on the potential of NAO as an assistive agent for their children.	Manual	SCHOOL. The study was conducted in a school for special children in Lahore, Pakistan.
2017	Ackovska et al.	Therapy: improving communication and interaction skills, body and spatial awareness	Humanoid: NAO	Robot's tactile sensors on the top of his head	LED light Friendly voice Childhis reactions	N.D.	N.D.	Quantitative: time needed for the completion of the task	N.D.	CLINICAL SETTING
2017	Guedjou et al.	Design: how individual social traits influence the learning process in a robot imitation task	Humanoid: NAO robot	1 camera	N.D.	N.D.	ADI-R WISC-4R Global Assessment Function	Quantitative: number of features (descriptors) required to represent the posture of a subject and its identification; posture score recognition; identity recognition score	Automatic	N.D.
2017	Dickstein-Fischer et al.	Therapy: social skills training - ABA adaptation	Non-humanoid: PABI (Penguin for Autism Behavioural Intervention)	2 Cameras: eyes of the robot	Vocal feedback and movements	Hybrid: the robot is controlled through a tablet but it is able to establish eye-contact with the child and follows his/her eyes in every moment	N.D.	Qualitative: engagement of the child Quantitative: duration of the session	Automatic	N.D.
2017	Chevalier et al. (2)	Therapy: imitation training	Humanoid: NAO robot	2 cameras 1 RGB-D camera	Vocal feedback	Hybrid: The experimenter lauched the program and then the robot did several pre-programmed movements. It was also able to imitate the child.	N.D.	Quantitative: percentage of gazes to the partner; percentage of smiles; imitation score; free initiations of movements	Manual	CLINICAL SETTING
2017	Koch et al.	Design: test the feasibility of the robot SAM	Humanoid: SAM robot	1 eye-tracker	Vocal feedback Movement feedback	Fully autonomous: the robot has several pre-scripts implemented	ADOS-2 KBIT-2 (for evaluating the cognitive ability)	Qualitative: children filled some questionnaires about their interaction with the robot and the willingness to repeat it Quantitative: percentage of engagement during the interaction; percentage of time looking to the face of the partner	Automatic	RESEARCH LABORATORY
2017	Suzuki et al.	Therapy: training the recognition of body parts	Humanoid: NAO robot	N.D.	N.D.	Wizard of Oz	N.D.	Quantitative: social responsiveness scale; social response time; number of correct answers	Manual	N.D.
2017	Matsuda et al.	Therapy: training social play	Non-humanoid: 2 COLOLO robots	Tilt sensor 1 camera	Tactile and light feedback	Fully autonomous: the robots had embedded sensors to detect when they are being manipulated and send messages to the other robot	PARS (Pervasive Development Disorders Autism Society Japan Rating Scale)	Quantitative: eye-contact with the therapist, positive affect, ball contact, looking at the therapist ball	Manual	RESEARCH LABORATORY
2017	Moorthy et al.	Therapy: training of psychomotor skills	Non-humanoid: OWHI robotic arm	1 joystick	N.D.	Wizard of Oz: the child is responsible to control the robot according to the directions of the therapist	N.D.	Qualitative: observations of the therapist and parents Quantitative: percentage of successful trials; percentages of trials with and without assistance; percentage of trials with different types of assistance	Manual	CLINICAL SETTING
2017	Palestra et al.	Design: usuability test of a therapy for training of communication skills	Humanoid: NAO robot	RGB-D camera	N.D.	Hybrid: recognition of gestures and pre-defined programs on the robot.	N.D.	Qualitative: questionnaire that evaluated the usability of the protocol and the interaction quality (promotion of eye-contact, joint attention and communication with therapist)	N.D.	CLINICAL SETTING
2016	Choi et al.	Teaching: Learning words from AAC	Humanoid: educational robot	Cameras	N.D.	N.D.	Communication boars with static augmented and alternative communication; Storybooks (researcher says the words; the child should point to the images)	Quantitative: correct answers to questions done about the story; improvement rate difference Qualitative: questionnaire to a speech therapy about the validity of interventions done; questionnaire to parents about robot	Manual	HOUSE SETTING

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2016	Wijayasinghe et al.	Diagnosis: Objective evaluation of imitation deficits for detection of ASD	Humanoid: Modified Zeno robot	Kinect marker-less motion capture for healthy adults, marker based system for children (12 Eagle-4 IR based cameras and Cortex motion analysis software)	N.D.	Wizard of Oz: through LabVIEW ("Scripted Interaction") Teleoperation of Zeno through Kinect and LabVIEW ("Dynamic Interaction")	Adults group for method validation	Quantitative: Means of the DTW costs and combined DTW costs for each subject, the angles considered for the combined DTW cost for each gesture were selected based on their expected role played in defining the gesture.	Automatic	RESEARCH LABORATORY.
2016	Srinivasan et al.	Therapy: Comparison of the effects of rhythm and robotic intervention approaches on the attentional patterns to standard-of-care.	Humanoid: NAO robot Non-humanoid: Rovio robot	1 camera	N.D.	Adult trainer controlled the robot in the robot intervention	pre: clinical psychology evaluation Pretest/posttest measure of joint attention: modified JTAT (Standardized test of JA) to add 3 more gestural items --> 4 verbal and 5 gestural examiner-initiated bids, score from 0 to 5	Quantitative: Training-specific changes in attention patterns, examination of group differences, intervention-related changes, and activity-related differences in social attention: OpenShapa (Github Inc.) video coding software to code the duration of time across the entire session that children directed attention to: (1) social partners (the trainer, adult model, and caregiver), (2) the robot (for the robot group only), (3) objects (picture board, props, musical instruments, and art-craft supplies), or (4) elsewhere. Comprehensive checklist developed to assess trainer and model behaviors.	Manual and Automatic	RESEARCH LABORATORY and CHILD'S HOME They encouraged parents to provide two additional home sessions per week for about 45 min each.
2016	Han et al.	Therapy: To investigate whether story intervention using educational robots affects the ability to express phrases in children with autism category disorder	Humanoid: IROBI-Q	It has recording functions and also a touch screen panel.	It can give visual and auditory stimulation (such a voice support). The robot and the researcher during the sessions can give positive feedbacks or reinforcements to the child if he's able to answer correctly.	Wizard of Oz	INCLUDING CRITERIA: diagnosed in hospital, acquired the vocabulary equivalent age of 4 years or older; who have obtained an average score of 4 years or older at the KOSECT; with non-verbal intelligence are 50-70; school-age children with the same age.	Qualitative: activity that listens to and tells a story from a robot. The child was evaluated as a new story to be used for mediation before each mediation. They also measured the ability to express phrases from the overall story length, average sentence length and syntax complexity. They examined average communication length, Mean syntactic length, syntactic complexity,	Manual	N.D.
2016	Zheng et al.	Therapy: novel robot-mediated intervention system (RISTA) for imitation skill learning	Humanoid: NAO robot	Kinect 1 camera	verbal reward	Fully autonomous: The supervisory controller (SC) is the primary control mechanism for RISTA and is designed based on a timed automata model	ASD group: clinical diagnosis of ASD based on DSM-IV-TR criteria from a licensed psychologist, Autism Diagnostic Observation Schedule Comparison Score (ADOSCS) + parents questionnaire+ pre test on 7 adults and 3 children to evaluate gesture recognition and eye gaze algorithm accuracy	Quantitative: Gesture performance (imitation performance results :gesture scores - General session performance results) Attention, eye gaze based on head pose	Automatic	RESEARCH LABORATORY Approved by the Vanderbilt Institutional Review Board (IRB).
2016	Giannopulu et al.	Therapy: Evaluate communicative behavior (verbal, non verbal and emotional expression) in healthy and autistic children during speaker-listener communication with a human and a robot	Non-humanoid: "Pekoppa", toy-like minimalistic robot	microphone: speech signal	action: nodding and leaves twitching	Fully autonomous: reaction based on received speech signal	DSM-IV-TR and CARS	Quantitative: - heart rate; - number of nouns and verbs expressed. Qualitative: - intensity of emotional feeling (auto-estimation using questionnaire)	Automatic	The study took place in a room which was familiar to the children.

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2016	Yun et al.	Therapy: Propose and examine the feasibility of a robot-assisted intervention system capable of facilitating social training for children with autism spectrum disorder (ASD) via human-robot interaction (HRI) architecture.	Humanoid: two robots - Mobile humanoid robot - iRobiQ Clinical assistive robot (CARO)	1 Kinect iRobiQ has a touch screen monitor and different types of sensors (i.e., camera, microphones, touch, IR, ultrasonic, and LEDs). CARO has LCD touch-screen monitor and different types of sensors (i.e., camera, microphones, depth, and LRF).	Vocal feedbacks	Autonomous and adaptive: robotic system require differentiated training stimuli to the participants using a configuration that estimate the children's response through human perception modules and automatically assigning a reinforcement procedure for the execution (3 mode: reward, encouragement and pause).	N.D.	Quantitative: performance evaluation of eye contact recognition via an evaluation matrix of accuracy, precision, and recall.	Manual and Automatic	CLINICAL SCENARIO
2016	Suzuki et al.	Therapy: Explore the prosocial behaviour of children with ASD through a musical play with a humanoid robot.	Humanoid: NAO robot	1 camera 1 robot on board camera Touch sensors	Verbal feedback	Fully autonomous: games touch on my body part and dancing with me	N.D.	Quantitative: As analyses of recorded video, Touch Body Game scores were defined by proxemics information, and the initial response time were measured during the trials. Then are measured the initial response time and the interest by the interacting area (1 the closest, 2 the middle o 3 the farrest) that the child occupies.	Manual	N.D.
2016	Moorthy et al.	Therapy: Using robot-mediated imitation therapy to improve psychomotor skills (grasps, directions and targeted walking)	Non-humanoid: Snatcher robot developed using LEGO NXT 2.0	Ultrasonic sensors for obstacle and movement detection, distance measurement - not used for subject monitoring	From therapist (allowing to move to next exercise when successful)	Fully autonomous: pre-programmed with four different activities for the subjects to imitate.	N.D.	Quantitative: - % successful trials without adult assistance in each session Qualitative: - parent report on child skills	Manual	CLINICAL SETTING At physical therapy centres in Thanjavur, Tamil Nadu, India.
2016	Chevalier et al.	Therapy: Study the Impact of different Sensory Preferences of ASD children in Joint Attention Tasks with humanoid robot to predict response to treatment	Humanoid: NAO robot	Kinect 2 cameras (above the right and left screens)	vocal feedback (congratulations or "let's try with a new card")	Wizard of Oz	Adolescents/Adults Sensory Profile (AASP), Movement Sensory Sensitivity (MSS) and Visual Sensory Sensitivity (VSS)	Quantitative: video analysis of the interactions by a first coder, and a second coder, unaware of the hypothesis of the setup, measuring RJA (response to Joint Attention, correct, missed or uncorrect); Time of response (TRJA) time between the beginning of the movement of the robot and the moment the participant's eyes hit the screen. Mistakes: number of uncorrected answers.	Manual	RESEARCH LABORATORY
2016	Mavadati et al.	Therapy: Design and evaluate a robot-based protocol using NAO to deliver behavioral training mechanism for children with ASD. The main aim is to improve a behavioral response (including pointing and facial expression recognition) in the majority of the participants as a consequence of the behavioral intervention delivered directly through the robot.	Humanoid: NAO robot	4 synchronized cameras	NAO uses positive verbal reinforcer.	Wizard of Oz: A researcher control robot's response from a different room and annotates robot's social and behavioral responses and the child's verbal communication skills, joint attention and expression recognition skills during the interaction.	N.D.	Quantitative: the baseline and intervention results has been compared. In each session a graduate researcher observed and annotated the responses of a child and calculated the accuracy for all five tasks within a range of [0-100]. This accuracy index is a quantitative measure to assess the participant's social skill learning progression over a six month interaction time period with NAO.	Manual	CLINICAL SETUP All children were recruited from different autism treatment organizations.

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2016	Boccanfuso et al.	Therapy: new robot-enabled approach for eliciting and characterizing play and affective response differences between a group of TD children and a group of children with ASD.	Non-humanoid: Sphero robot	2 videocameras 1 microphone	N.D.	Hybrid: robot is autonomous in some activities and tele operated in others	Mullen Scales of Early Learning (MSEL) to assess developmental ability - developmental quotient (DQ)- Autism Diagnostic Observation Schedule (ADOS)	Quantitative: - Accelerometer and gyroscopic signals (to capture information relating to physical play with the robot) - Video coding schema coding 1 for activities and frequencies (push, hold, pick up, kick, drop) and video coding schema 2 for affective responses (point at the robot, look at the facilitator, enjoyment, comfort seeking, refer to robot as he or she) -	Manual	N.D.
2016	Salvador et al.	Therapy: training socio-emotional skills through an ABA-based robotic therapy	Humanoid; Zeno R-50	External button sending info to the robot controller for action execution	child-like face expressions + movements + voice for the following rewards (chosen with ABA reward identification test): - Fist Pump: Raise right arm upwards bent at the elbow - "Hooray": Robot smiles and says "Hooray!" - "Good-Job"+nod: Robot smiles, nods once, and says "Good Job". - Dance: The robot moves both of its arms in a dance-like manner - Fist Bump: Robot raises entire arm	Autonomous and adaptive: computer. Each game task was modeled as a state-machine to enable the robot to choose an action depending on the child's current response.	Doctor diagnosis of Autism; Social Responsive Survey (SRS) with T-score>76	Ranking in emotion recognition tasks	Automatic	N.D.
2016	Tariq et al.	Therapy: Social interaction and communication training	Humanoid: NAO robot	1 camera 1 robot on board camera	Verbal prompts and lights in the eyes	N.D.	Communication tests done just with the therapist/parent to define the baseline. The therapist made questions and children should answer.	Qualitative: questionnaires about social interactions, emotions, activeness and interest; Quantitative: manually coding of videos for HRI markers, eye gaze detachment, verbal communication and engagement duration.	Manual	CLINICAL SETUP In collaboration with the experts at Picture Autism which is an inclusive education and therapy institute.
2016	Liu et al.	Therapy: robot coaching for motor learning	Humanoid: NAO robot	1 Kinect	Speech instructions	Fully autonomous: imitation done using a Kinect	N.D.	Qualitative: performance of the children during the session ; number of times in they did a complete imitation in each session	N.D.	RESEARCH LABORATORY
2016	Beer et al.	Therapy:	Humanoid: NAO robot	Camera	N.D.	Fully autonomous: dances preprogrammed	N.D.	Quantitative: (Video manual decoding) frequency of imitation of the robot from the child; frequency of therapist prompts to the child follow the robot	Manual	CLINICAL SETUP
2016	Simut et al.	Design: It was investigated if the children's interaction with a human differed from the interaction with a social robot during a play task	Non-humanoid: Probo robot	N.D.	Probo is able to direct its gaze (eyes and head), express emotions, movements, facial expressions and is capable of verbal communication	Wizard of Oz: the operator intuitively controls Probo	DSM; The IQ scores were assessed with the Wechsler Preschool and Primary Scale of Intelligence- III.	Quantitative: Detecting preference; Eye contact; Initiation of Joint Attention; Positive affect; verbal utterances; evading task; non-responses	Manual	CLINICAL SETUP The study took place in different therapy rooms (minimum 20 m2) in the three selected schools.
2016	Wong and Zhong	Teaching: social communication skills (i.e., imitation or joint attention)	Non humanoid: CuDDler robot	1 camera Microphone Contact-microphone Tactile and posture sensors	Head, arms and legs movements Sounds (naturalistic rewards)	N.D.	Childhood Autism Rating Scale (CARS) ABILITIES Index	Quantitative: communicative skills (gestural and verbal), eye contact duration, turn-taking duration	Manual and Automatic	N.D.
2016	Bernardo et al.	Therapy: social skills training - turn-taking skills	Humanoid: NAO robot	N.D.	Vocal feedback or gestures	Adaptive and autonomous: the robot considers the number of mistakes done by the child and how long he/she was without playing to give new prompts about a game in a tablet	N.D.	Qualitative: the performance of the child was evaluated	N.D.	N.D.

Table Supplementary Material 1: Analysed papers and robotics categories

Year	Authors	Purpose	Robot	Human Robot Interaction			Measurements			Environment (clinical, house, school, research laboratory)
				Sensors	Feedback (vocal, action, reward)	Control/Autonomy	Autism Inclusion Criteria Diagnosis Evaluation	Analysed (quantitative and qualitative)	Manual / Automatic extraction of quantitative measures	
2016	Chevalier et al. (2)	Design: relation between sensorimotor capabilities and interaction with the robot	Humanoid: NAO robot	1 camera	N.D.	N.D.	N.D.	Qualitative: questionnaire about the sensorimotor capabilities; Quantitative: gaze direction	Manual	N.D.
2016	Palestra et al.	Therapy: multilevel training of different capabilities- joint attention, eye contact, imitation, facial expressions	Humanoid: Zeno robot	RGB-D camera	Vocal feedback	Hybrid: the therapist selects different levels of the exercises and in each of this levels, depending on the exercise the robot is capable of recognizing expressions, body postures, eye contact, and give feedbacks according to it.	N.D.	Quantitative: time for an eye-contact, time to imitate a facial expression, number of facial expressions correctly imitated	Automatic	N.D.
2016	Valadão et al.	Therapy: Training social skills	Humanoid: MARIA robot	1 camera	N.D.	Wizard of Oz: the robot was remotely controlled	N.D.	Quantitative: n° occurrence looking to the robot, touching the robot and imitating the mediator; Qualitative: questionnaire about the interaction	Manual	N.D.

N.D. Not Declared