SLR2

EMBOA

Emotions in robot-based interventions in children with autism

A collection of papers
extracted from systematic literature review
under Erasmus+ EMBOA project

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#T06

Title	Living and Robotic Dogs as Elicitors of Social Communication Behavior and Regulated Emotional Responding in Individuals with Autism and Severe Language Delay: A Preliminary Comparative Study					
Authors and full reference	Silva, K.; Lima, M.; Santos-Magalhães, A.; Fafiães, C.; de Sousa, L., Anthrozoos, Volume 32, Issue 1					
DOI	10.1080/08927936.2019.1550278		**Year**	2019		
Children	**with autism:**	10	**without autism:**	0	**Robot:**	Zoomer dog
Emotions covered	n.a.					
Skills	opportunities for greeting, responding to name, engaging in turn-taking, following eye gaze, and sharing					
Value brought Challenges Recommendations	Paper contains a table with description of procedures, social communication opportunities, and appropriate responses.; „In children, the living dog was more effective than the robotic dog in promoting social communication behavior." Challanges: - the fact that two adult dogs were compared with a puppy robot is also a limitation of this study, Recommendation: – children with ASD tended to engage more positively with smaller animals, – to expose each participant to multiple dogs is recommended, – it would be interesting to test for the effects of pre-test preferences for a particular dog breed, – it would also be important for future studies to consider the use of different robotic-animals, – more comparative research is needed with larger sample sizes, individuals diagnosed with ASD with different characteristics (e.g., different degrees of functioning), and testing over time and across different settings.					

#T02

Title	Personalized Robot Interventions for Autistic Children: An Automated Methodology for Attention Assessment					
Authors and full reference	Alnajjar, Fady; Cappuccio, Massimiliano Lorenzo; Renawi, Abdulrahman Majed; Mubin, Omar; Loo, Chukiong, International Journal of Social Robotics					
DOI	10.1007/s12369-020-00639-8			**Year**	2020	
Children	**with autism:**	11	**without autism:**	0	**Robot:**	Nao
Emotions covered	happy, sad, angry, surprised, and neutral					
Skills	social attention abilities					
Value brought **Challenges** **Recommendations**	Paper contains tips to set sound response parameters. "The parent feedback form had two scale questions: “How do you rate your child interaction with the robot today?” and “How do you rate your child interaction at home?,” (...) The parent feedback was important to rate the interactions of the children with the robot compared to their interactions with their families, and to detect whether interacting with the robot influenced their interactions at home.„ Challanges: - only one-on-one interaction is possible, - there was small number of patients, - the proposed interaction system is only applicable to patients with moderate severity and who have at least minimal verbal response capabilities, - some children may become distracted by the mobile phone display on the robot. Recommendations: - sessions with patients would ideally be conducted in a quiet room without interruptions or noise, - broadening the set of available types of interaction and increasing the degrees of freedom that define such interactions, - multiple cameras could be employed where a fixed observation setup is possibleto preserve the robot’s mobility while broadening their interactive capabilities, - a large set of patients would be desirable					

#T05

Title	Concordance between physiological arousal and emotion expression during fear in young children with autism spectrum disorders					
Authors and full reference	Zantinge, G.; van Rijn, S.; Stockmann, L.; Swaab, H., Autism, Volume 23, Issue 3					
DOI	10.1177/1362361318766439			**Year**	2019	
Children	**with autism:**	21	**without autism:**	45	**Robot:**	No name
Emotions covered	fear					
Skills	n.a.					
Value brought Challenges Recommendations	„This study at least provides some suggestion of poor connectivity between emotional arousal and emotional expression, and might fit with the idea that ASD symptoms may arise as a consequence of disconnection between various functional brain systems, rather than impairments in one single area." Challanges: - the sample sizes were small, - the current sample included a limited amount of girls with ASD which limited comparability between genders, - study included no other indices of arousal than heart rate and expressive behaviour in response to fear. Recommendations: - before the visit, participants were explicitly prepared with a visual information brochure and a copy set of the electrodes to familiarize, - research took place in a carefully selected room with limited stimuli, - children were given time to familiarize before and after the electrodes were applied by playing an age appropriate game, while seated in an adapted car seat to have a stable position suited for physiological measurement, - for future studies, it is recommended to repeat the moderation analysis with larger groups, - it would be recommended for future studies to also include measures of emotion regulation, cognitive measures, self-report, a broader range of emotions and other indices of ANS functioning.					

#T08

Title	Affect Recognition in Autism: A single case study on integrating a humanoid robot in a standard therapy					
Authors and full reference	Conti, D.; Trubia, G.; Buono, S.; Di Nuovo, S.; Di Nuovo, A., Qwerty, Volume 14, Issue 2					
DOI	10.30557/QW000018			**Year**	2019	
Children	**with autism:**	1	**without autism:**	0	**Robot:**	NAO
Emotions covered	happiness, sadness, anger, fear, disgust and neutral					
Skills	n.a.					
Value brought **Challenges** **Recommendations**	Very detailed step by step description of the procedure even containing information about the size of the table and images. There was used the NEPSY–II Affect Recognition subtest (devised for ages 3-16) to evaluate the child's skills, before and after the robot-led training. This subtest, pertaining to the Social Perception sub-domain, includes facial emotion recognition and theory of mind, i.e. the capability to understand others' perspectives, intentions, and beliefs. Challenges: - it should be kept in mind that this results are limited to a single child with ASD. Recommendations: - to minimize the novelty effect the robot was preliminarily presented to the child for 10 minutes in a nontherapeutic context, when the child was encouraged to do as much interaction as he wanted without any specific training purpose, - In the future, it could be essential to increase the sample of participants, - it could be important to define and/or quantify the spontaneous requests for interaction/communication by the child towards the humanoid robot.					

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#T13

Title	Adaptive Framework for Emotional Engagement in Child-Robot Interactions for Autism Interventions					
Authors and full reference	Javed, H.; Jeon, M.; Park, C.H., 15th International Conference on Ubiquitous Robots, UR 2018					
DOI	10.1109/URAI.2018.8441775		**Year**	2018		
Children	**with autism:**	3	**without autism:**	3 neurotypical	**Robot:**	Darwin Mini, Romotive
Emotions covered	anger, disgust, fear, happiness, sadness and surprise					
Skills	child's engagement in the activity					
Value brought Challenges Recommendations	Paper contains description of the five sensory stations that were set up on top of a table in an experiment room, each of which presented a unique sensory stimulus to which the robot reacted in an interactive, socially acceptable manner. „Video recordings from the sessions were post-processed through manual annotations to derive 6 quantitative engagement measures. These included eye gaze focus, vocalizations, imitation, triadic interactions, self-initiated interactions, and smiles. Lack of eye contact is a well-known behavioral trait in children with ASD, which makes it an important factor to track during this activity. Deficits in imitation skills have also been widely reported making it a behavior of interest for an ASD study. Vocalizations, selfinitiated interactions and triadic interactions are all used as measures of engagement in the activity, while smiling is used as an indication of enjoyment or amusement as a consequence of the robot's various behaviors."					

#T14

Title	Using a social robot to teach gestural recognition and production in children with autism spectrum disorders					
Authors and full reference	So, W.-C.; Wong, M.K.-Y.; Lam, C.K.-Y.; Lam, W.-Y.; Chui, A.T.-F.; Lee, T.-L.; Ng, H.-M.; Chan, C.-H.; Fok, D.C.-W., Disability and Rehabilitation: Assistive Technology, Volume 13, Issue 6					
DOI	10.1080/17483107.2017.1344886			**Year**	2018	
Children	**with autism:**	13	**without autism:**	0	**Robot:**	NAO
Emotions covered	angry, scared, annoyed					
Skills	recognize and produce eight pantomime gestures that expressed feelings and needs: angry, smelly, noisy, hot, dizzy, scared, hungry, annoyed					
Value brought Challenges Recommendations	In this paper is tabel contains list of the eight gestures produced by NAO, their meaning (feelings and needs) and their consistency rates. To ensure that these gestures conveyed feelings and needs, a separate group of 28 students were presented with eight silent videotaped gestures produced by a human model, each lasting for three to four seconds on a computer screen in a speechless context. They were given five seconds to write a single word that best described the meaning of each gesture. Challenges: - the small sample size examined and the limited number of post-tests performed, - it is not clear whether or not the robot was better than humans at administering the assessments and training gestures for the children with ASD. Recommendations: - a real social robot, which is more engaging than an animated one, should be adopted, - a small reward by the way of reinforcement (snacks or access to toys) was offered by the teacher at the end of each pretest, post test and training session, - we should teach children should be teached with ASD the meanings of gestures before asking them to imitate these gestures, - in future studies, the children with ASD should be provided with more training sessions regarding gestural production, - in addition to enlarging the sample size, it should also be investigated whether or not the learning outcomes can be maintained for a longer period of time (i.e., beyond two weeks)<.					

#T15

Title	Emotion recognition in a social robot for robot-assisted therapy to autistic treatment using deep learning					
Authors and full reference	Joseph, L., Pramod, S., & Nair, L. S. (2017, December). Emotion recognition in a social robot for robot-assisted therapy to autistic treatment using deep learning. In 2017 International Conference on Technological Advancements in Power and Energy (TAP Energy) (pp. 1-6). IEEE.					
DOI	10.1109/TAPENERGY.2017.8397220		**Year**	2017		
Children	**with autism:**	0	**without autism:**	0	**Robot:**	None
Emotions covered	Anger	Fear	Disgust	Sadness	Surprise	
Skills	No skills trained on.					
Value brought Challenges Recommendations	The paper proposes an algorithm for detection emotion from face in real-time. No robots used but the paper proposes emotion recognition algorithm that are suitable for use with robots, running on a single board computer called Raspberry Pi 3, which is running on 1.2 GHz quad-core processor with 1 GB RAM. The camera used here is called Raspberry Pi cam					

#T16

Title	Effects of robots' intonation and bodily appearance on robot-mediated communicative treatment outcomes for children with autism spectrum disorder					
Authors and full reference	van Straten, C. L., Smeekens, I., Barakova, E., Glennon, J., Buitelaar, J., & Chen, A. (2018). Effects of robots' intonation and bodily appearance on robot-mediated communicative treatment outcomes for children with autism spectrum disorder. Personal and Ubiquitous Computing, 22(2), 379-390.					
DOI	10.1007/s00779-017-1060-y		**Year**	2018		
Children	**with autism:**	8	**without autism:**	0	**Robot:**	Nao
Emotions covered	Happiness, interest					
Skills	The child played a puzzle game with a robot. In this game, the child completed three animal-shaped puzzles of their choice. Crucially, the child could not complete any of the puzzles on their own and needed to cooperate with the robot. Learning moments were created using prompts (i.e., encouragement cues) of increasing explicitness. The participants' task performance was assessed via the percentage of prompts that a participant received during a trial.					
Value brought Challenges Recommendations	Affective states were evaluated on three dimensions: demonstrated interest (towards the game as a whole, i.e., not solely towards the robot), happiness (judging from a child's facial expressions and other behavioral observations), and appropriate behavior (i.e., performing the task without showing disruptive behavior). Influence of Intonation and bodily appearance of robot on participants' affective states is analyzed. i.e Mechanical appearance vs humanized appearance of the robot, monotonous intonation vs normal intonation of the robot. Congruent appearance and intonation vs incongruent appearance and intonation.					

#T16

Title	Effects of robots' intonation and bodily appearance on robot-mediated communicative treatment outcomes for children with autism spectrum disorder					
Authors and full reference	van Straten, C. L., Smeekens, I., Barakova, E., Glennon, J., Buitelaar, J., & Chen, A. (2018). Effects of robots' intonation and bodily appearance on robot-mediated communicative treatment outcomes for children with autism spectrum disorder. Personal and Ubiquitous Computing, 22(2), 379-390.					
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#T17

Title	Robot-Assisted Socio-Emotional Intervention Framework for Children with Autism Spectrum Disorder					
Authors and full reference	Javed, H., Jeon, M., Howard, A., & Park, C. H. (2018, March). Robot-assisted socio-emotional intervention framework for children with Autism Spectrum disorder. In Companion of the 2018 ACM/IEEE International Conference on Human-Robot Interaction (pp. 131-132).					
DOI	10.1145/3173386.3177082			**Year**	2018	
Children	**with autism:**	7	**without autism:**	4	**Robot:**	Romo Robotis Mi Robotis Darwin OP-2
Emotions covered	Anger, Disgust, Sadness, Surprise, Scared, Excited, Curious, Proud, Shy, Pleased, Frustrated, Tired, Hapiness,nervous					
Skills	Getting into interaction, turn-taking - Focus on self-initiated interaction					
Value brought Challenges Recommendations	Emotional interaction and regulation game was employed where a character-based computer game was designed with the Romo's penguin character.					

#T18

Title	Humanoid robot intervention with autism: The conceptual model in demonstrating the emotional responses of children with autism					
Authors and full reference	Abd Aziz, A., Moganan, F. F. M., Mokhsin, M., Sakamat, N., & Ismail, A. (2018, March). Humanoid robot Intervention with Autism: The Conceptual Model in Demonstrating the Emotional Responses of Children with Autism. In International Conference on Kansei Engineering & Emotion Research (pp. 574-579). Springer, Singapore.					
DOI	10.1007/978-981-10-8612-0_60		**Year**	2018		
Children	**with autism:**	N/A	**without autism:**	N/A	**Robot:**	N/A
Emotions covered	N/A					
Skills	A novel behavioural model, named as the Modified Fogg's Behavioural Model, is presented where it demonstrates how different type of learning modules are able to induce different emotional responses from the autistic children.					
Value brought Challenges Recommendations	For the collection of the emotional responses, teachers are entrusted to interpret and extract the emotional responses throughout the intervention session. As the teachers are said to be the one closest to the children, the recorded emotional responses is seen as secondary data which is not genuinely interpreted directly from the children's point of view. It relies directly on the teacher's accuracy to correctly interpret the emotion and it may lead to faulty data, such as misinterpretations made by the teachers and also delays in capturing the right emotions at the accurate time					

#T19

Title	Getting Engaged: Assisted Play with a Humanoid Robot Kaspar for Children with Severe Autism					
Authors and full reference	Zorcec, T., Robins, B., & Dautenhahn, K. (2018, September). Getting engaged: assisted play with a humanoid robot kaspar for children with severe autism. In International Conference on Telecommunications (pp. 198-207). Springer, Cham.					
DOI	10.1007/978-3-030-00825-3_17			**Year**	2018	
Children	**with autism:**	2	**without autism:**	0	**Robot:**	Kaspar
Emotions covered	Sadness, Happiness, afraid					
Skills	Greeting skills, Getting into interaction, Singing, Follwing movements					
Value brought Challenges Recommendations	Limited number of Participants. Since autism is extremely heterogenous, it is important to cater to individual needs					

#T20

Title	A Feasibility Study Evaluating the Emotionally Expressive Robot SAM					
Authors and full reference	Koch, S. A., Stevens, C. E., Clesi, C. D., Lebersfeld, J. B., Sellers, A. G., McNew, M. E., ... & Hopkins, M. I. (2017). A feasibility study evaluating the emotionally expressive robot SAM. International Journal of Social Robotics, 9(4), 601-613.					
DOI	10.1007/s12369-017-0419-6		**Year**	2017		
Children	**with autism:**	13	**without autism:**	35	**Robot:**	N/A
Emotions covered	Anger, Fear,, Disgust, Sadness, Surprise, Happiness					
Skills	The objective was to investigate how children with ASD engage with and respond to Robot SAM during a social interaction session (human–robot interaction) as compared to a similar human–human interaction. In addition, the level of enjoyment of children with ASD was assesse to examine the acceptability of SAM					
Value brought Challenges Recommendations	The overarching goal of this study was to design a novel social robot, SAM, with a unique mix of humanoid and animal-like features allowing for the expression of complex emotional states Analysis of the accuracy with which the Robot SAM can produce facial expressions depicting various emotional states. This analysis was done by "typically developing children" filling a "Identifying Emotion Questionnaire"					

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Children	**with autism:**	13	**without autism:**	35	**Robot:**	N/A
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#T21

Title	Robot-Enhanced CBT for dysfunctional emotions in social situations for children with ASD					
Authors and full reference	Costescu, C. A., Vanderborght, B., & David, D. O. (2017). ROBOT-ENHANCED CBT FOR DYSFUNCTIONAL EMOTIONS IN SOCIAL SITUATIONS FOR CHILDREN WITH ASD. Journal of Evidence-Based Psychotherapies, 17(2).					
DOI	10.24193/jebp.2017.2.7		**Year**	2017		
Children	**with autism:**	27	**without autism:**	0	**Robot:**	Keepon
Emotions covered	Anger, Sadness,					
Skills	The objective was to improve the strategies that children with ASD use in different social situations, reducing intensity of negative emotions, and in modifying irrational beliefs. The children are also taught adaptive behaviors in situations associated with anger and sadness, to help them understand and control their anger and sadness in social situations					
Value brought Challenges Recommendations	The study aims to show that Robot Enhanced Therapy (RET) can represent an effective way to reduce the negative emotion intensity associated with negative social events and also can help children with ASD to think in a more rational way compared to "Treatment as Usual" (TAU) 1. found significant differences between children's rational beliefs in RET group as compared to TAU group in post treatment 2. found significant differences from pre to post-treatment in the RET group concerning rational beliefs 3. found significant differences between children's emotion intensity in RET group as compared to TAU group in post treatment 4. found significant differences from pre to posttreatment also in case of emotion intensity in the RET group					

#T22

Title	Audio-based emotion estimation for interactive robotic therapy for children with autism spectrum disorder					
Authors and full reference	Kim, J. C., Azzi, P., Jeon, M., Howard, A. M., & Park, C. H. (2017, June). Audio-based emotion estimation for interactive robotic therapy for children with autism spectrum disorder. In 2017 14th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI) (pp. 39-44). IEEE.					
DOI	10.1109/URAI.2017.7992881		**Year**	2017		
Children	**with autism:**	0	**without autism:**	0	**Robot:**	Romo Robotis Mi Robotis Darwin OP-2
Emotions covered	Valence, Arousa, Dominance, Anger, Fear , Disgust, Sadness, Suprise, Neutral, Excited, Frustrated, Happiness					
Skills	N/A					
Value brought **Challenges** **Recommendations**	Employed the Interactive Emotional Dyadic Motion Capture (IEMOCAP) database to extract emotional speech features to train an emotion classifier. The robot should be aware of the child's emotion and change the way it is interacting in order to comfort the child. This is where automatic emotion classification through audio and speech analysis becomes important to the robotic system. Moreover, this robotic system will also play music in the background corresponding to the emotions being displayed by the robots in order to strengthen the connections a child makes between the emotions being expressed and the cues used to convey.					

#T23

Title	Social skills training for children with autism spectrum disorder using a robotic behavioral intervention system					
Authors and full reference	Yun, S. S., Choi, J., Park, S. K., Bong, G. Y., & Yoo, H. (2017). Social skills training for children with autism spectrum disorder using a robotic behavioral intervention system. Autism Research, 10(7), 1306-1323.					
DOI	10.1002/aur.1778			**Year**	2017	
Children	**with autism:**	15	**without autism:**	0	**Robot:**	iRobQ CARO
Emotions covered	Anger, Sadness, Suprise, Shy, Happiness					
Skills	Stroop paradigm was applied to facial emotion recognition as a stimulating tool. The robot was configured with a preconfigured script to four query types (Qtype: answer requests regarding the facial expressions of the robot), speed of speech (Sspd), number of changes in the expression (Nexp), expression time limit (Texp), and response time limit of the children (Tres). The task had four difficulty levels. When the subject gave three or more consecutive correct answers, the robot raised the difficulty level to the next level. If the subject failed in three or more consecutive trials, the robot lowered the difficulty level by one.					
Value brought Challenges Recommendations	A limitation of the therapeutic effects in terms of the generalization of acquired skills should be noted. Only one subject spontaneously practiced the emotion recognition task at home subsequent to the treatment. That subject's quality of eye contact improved significantly on the post-treatment ADOS compared to baseline, but a dramatic decrease was observed compared with the last session. These results suggest either a limitation of the extension of the improvements from robots to humans, innate characteristics of ASD in terms of a poor ability to generalize learned behavior, or the need for a longer duration of treatment to improve eye contact with humans.					

#T24

Title	Robot-assisted therapy for learning and social interaction of children with autism spectrum disorder					
Authors and full reference	Bharatharaj, J., Huang, L., Mohan, R. E., Al-Jumaily, A., & Krägeloh, C. (2017). Robot-assisted therapy for learning and social interaction of children with autism spectrum disorder. Robotics, 6(1), 4.					
DOI	10.3390/robotics6010004		**Year**	2017		
Children	**with autism:**	9	**without autism:**	0	**Robot:**	KiliRo
Emotions covered	Big6, -Joy +happiness,					
Skills	Getting into interaction Objective was to evaluate the effects on improvements in learning and social interaction abilities of children with autism spectrum disorder through a novel method Adapted Model-Rival Method (AMRM) and parrot-inspired robot using simulated experiments and use the results for robot's further development.					
Value brought Challenges Recommendations	**Robot can hurt children** Limited participants interview with parents was conducted as a group interview, and there are possibilities that the opinion of one respondent could have influenced the other. Secondly, the closed-format questionnaire was designed specifically for this study. Hence, reliability of the questionnaire has limitations. Thirdly, the age of the parents, who were interviewed and responded to the questionnaire were not recorded in this pilot study. We consider this as an important limitation of our work as the opinion could widely differ among various age groups.					

#T25

Title	Recognition of Gestural Behaviors Expressed by Humanoid Robotic Platforms for Teaching Affect Recognition to Children with Autism - A Healthy Subjects Pilot Study					
Authors and full reference	English, B. A., Coates, A., & Howard, A. (2017, November). Recognition of gestural behaviors expressed by humanoid robotic platforms for teaching affect recognition to children with autism-a healthy subjects pilot study. In International Conference on Social Robotics (pp. 567-576). Springer, Cham.					
DOI	10.1007/978-3-319-70022-9_56		**Year**	2017		
Children	**with autism:**	0	**without autism:**	137	**Robot:**	NAO Mini Darwin
Emotions covered	Agner, Fear, Sadness, Suprise, Happiness					
Skills	The objective was to assess the accuracy of affect recognition with our gesture set on the robotic platforms. No other skills were addressed.					
Value brought Challenges Recommendations	The NAO robot performed sadness better while the Mini Darwin performed happiness better Adult participants had to identify the emotion that the robot was attempting to portray based on guesture sets depicted. Gesture recognition rates of participants was analyzed to validate that the gesture set created was easily recognizable					

#T26

Title	Robotic behavioral intervention to facilitate eye contact and reading emotions of children with autism spectrum disorders					
Authors and full reference	Yun, S. S., Choi, J., & Park, S. K. (2016, August). Robotic behavioral intervention to facilitate eye contact and reading emotions of children with autism spectrum disorders. In 2016 25th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN) (pp. 694-699). IEEE.					
DOI	10.1109/ROMAN.2016.7745194		**Year**	2016		
Children	**with autism:**	15	**without autism:**	0	**Robot:**	iRobiQ CARO
Emotions covered	No specific emotion was mentioned, however, the children were trained to read emotions from the robots speech and facial expression under different configurations of difficulty levels in terms of of speaking speed, number of facial expression changes, and time-limit of the expression and response time-limit of children					
Skills	Getting into interaction,					
Value brought **Challenges** **Recommendations**	The proposed intervention approach is vulnerable to failure in exceptional cases such as a child-centered approach to teaching or unilateral verbal expression toward the robot. In addition, there are questions about whether the children with ASD can perform social interaction with the robot without the therapist Study with larger sample size and long term treatments to be conducted					

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DOI	10.1109/ROMAN.2016.7745194		**Year**	2016		
Children	**with autism:**	15	**without autism:**	0	**Robot:**	iRobiQ CARO
Emotions covered	No specific emotion was mentioned, however, the children were trained to read emotions from the robots speech and facial expression under different configurations of difficulty levels in terms of of speaking speed, number of facial expression changes, and time-limit of the expression and response time-limit of children					
Skills	Getting into interaction,					
Value brought **Challenges** **Recommendations**	The proposed intervention approach is vulnerable to failure in exceptional cases such as a child-centered approach to teaching or unilateral verbal expression toward the robot. In addition, there are questions about whether the children with ASD can perform social interaction with the robot without the therapist Study with larger sample size and long term treatments to be conducted					

#T27

Title	Design of a robotic agent that measures smile and facing behavior of children with Autism Spectrum Disorder					
Authors and full reference	Hirokawa, M., Funahashi, A., Pan, Y., Itoh, Y., & Suzuki, K. (2016, August). Design of a robotic agent that measures smile and facing behavior of children with Autism Spectrum Disorder. In 2016 25th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN) (pp. 843-848). IEEE.					
DOI	10.1109/ROMAN.2016.7745217			**Year**	2016	
Children	**with autism:**	10	**without autism:**	5	**Robot:**	NAO
Emotions covered	N/A					
Skills	Relationship/synchronization between smiling and facing behavior was analyzed					
Value brought Challenges Recommendations	Relationship between robot's behavior and child's social/emotional response has to be analyzed to get insights in order to design the behaviour pattern of the robotic agent and personalization of it for each individual with ASD.					

#T28

Title	Matching Robot KASPAR to Autism Spectrum Disorder (ASD) Therapy and Educational Goals					
Authors and full reference	Huijnen, C. A., Lexis, M. A., & de Witte, L. P. (2016). Matching robot KASPAR to autism spectrum disorder (ASD) therapy and educational goals. International Journal of Social Robotics, 8(4), 445-455.					
DOI	10.1007/s12369-016-0369-4		**Year**	2016		
Children	**with autism:**	10	**without autism:**	5	**Robot:**	Kaspar
Emotions covered	No specific emotion was analyzed or discovered.					
Skills	Turn-taking, Getting into interaction, Greeting Skill					
Value brought Challenges Recommendations	Multidisciplinary ASD practitioners and professionals indicate that these are the skills/objectives where a role for KASPAR is expected. Professionals stressed that instead of focusing on the problems these children have, it is important to devote attention to creating a safe and pleasant environment for them so that they can develop towards a (more) independent life.					

#T29

Title	Transitional Wearable Companions: A Novel Concept of Soft Interactive Social Robots to Improve Social Skills in Children with Autism Spectrum Disorder					
Authors and full reference	Özcan, B; Caligiore, D; Sperati, V.; Moretta, T.; Baldassarre, G.; INTERNATIONAL JOURNAL OF SOCIAL ROBOTICS, Volume 8, pages 471–481					
DOI	https://doi.org/10.1007/s12369-016-0373-8			**Year**	2016	
Children	**with autism:**	-	**without autism:**	-	**Robot:**	-
Emotions covered	------					
Skills	Social skills					
Value brought **Challenges** **Recommendations**	The paper present a novel concept of interactive devices, called “transitional wearable companions” (TWCs), usable to support therapy and foster social skill development in children with autism spectrum disorder (ASD).					

#T30

Title	Multisensory Robotic Therapy to Promote Natural Emotional Interaction for Children with ASD					
Authors and full reference	R. Bevill et al; 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Christchurch. pages 571					
DOI	10.1109/HRI.2016.7451861			**Year**	2016	
Children	**with autism:**	-	**without autism:**	-	**Robot:**	Romo, Robotis-Mini
Emotions covered	------					
Skills	Communication skills					
Value brought Challenges Recommendations	The paper presents an interactive robotic system that delivers emotional and social behaviors for multi-sensory therapy for children with autism spectrum disorders. The robotic system includes emotion-based robotic gestures and facial expressions, as well as vision and audio-based monitoring system for quantitative measurement of the interaction.					

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Title	Multisensory Robotic Therapy to Promote Natural Emotional Interaction for Children with ASD					
Authors and full reference	R. Bevill et al; 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Christchurch. pages 571					
DOI	10.1109/HRI.2016.7451861		**Year**	2016		
Children	**with autism:**	-	**without autism:**	-	**Robot:**	Romo, Robotis-Mini
Emotions covered	------					
Skills	Communication skills					
Value brought **Challenges** **Recommendations**	The paper presents an interactive robotic system that delivers emotional and social behaviors for multi-sensory therapy for children with autism spectrum disorders. The robotic system includes emotion-based robotic gestures and facial expressions, as well as vision and audio-based monitoring system for quantitative measurement of the interaction.					

#T31

Title	Interactive Robotic Framework for Multi-sensory Therapy for Children with Autism Spectrum Disorder					
Authors and full reference	R. Bevill et al., 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Christchurch, pages 421-422					
DOI	10.1109/HRI.2016.7451786			**Year**	2016	
Children	**with autism:**	-	**without autism:**	-	**Robot:**	Romo, Robotis-Mini
Emotions covered	Sadness, Excited, Curious, Frustrated, Happiness, Wanting					
Skills	Music-based movements					
Value brought Challenges Recommendations	The paper presents an interactive robotic framework that delivers emotional and social behaviors for multi-sensory therapy for children with autism spectrum disorders The robotic framework includes emotion-based robotic gestures and facial expressions, as well as vision and audio-based monitoring system for quantitative measurement of the interaction. The paper also discusses the special aspects of interacting with children with autism with multi-sensory stimuli and the potentials of their approach for personalized therapies for social and behavioral learning.					

#T31

Title	Interactive Robotic Framework for Multi-sensory Therapy for Children with Autism Spectrum Disorder						
Authors and full reference	R. Bevill et al., 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Christchurch, pages 421-422						
DOI	10.1109/HRI.2016.7451786			**Year**	2016		
Children	**with autism:**	-	**without autism:**	-	**Robot:**	Romo, Robotis-Mini	
Emotions covered	Sadness, Excited, Curious, Frustrated, Happiness, Wanting						
Skills	Music-based movements						
Value brought Challenges Recommendations	The paper presents an interactive robotic framework that delivers emotional and social behaviors for multi-sensory therapy for children with autism spectrum disorders The robotic framework includes emotion-based robotic gestures and facial expressions, as well as vision and audio-based monitoring system for quantitative measurement of the interaction. The paper also discusses the special aspects of interacting with children with autism with multi-sensory stimuli and the potentials of their approach for personalized therapies for social and behavioral learning.						

#T32

Title	A robot-assisted behavioral intervention system for children with autism spectrum disorders					
Authors and full reference	Yun, SS.; Kim, Hyuksoo; Choi, JS; Park, SK; ROBOTICS AND AUTONOMOUS SYSTEMS; 76, pages 58–67					
DOI	http://dx.doi.org/10.1016/j.robot.2015.11.004		**Year**	2016		
Children	**with autism:**	8	**without autism:**	-	**Robot:**	iRobiQ, CARO
Emotions covered	-------					
Skills	Social skills of basic eye contact					
Value brought **Challenges** **Recommendations**	The paper presents and examines 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. The paper presents the following challenges: 1) Precisely determining the child's various responses to training stimuli is challenging 2) Validation of the feasibility of the robot-assisted behavioral intervention system for facilitating social skills targeting preschoolers with a high functioning level through discussion with therapists. Thereby, trained therapists, with expertise in the diagnosis and treatment of children with autism, selected specific children who rarely made eye contact with others and who spontaneously understood or made facial expressions in daily life but had a minimum competency level of age-appropriate cognitive skills (e.g., the ability to distinguish between expressions).					

#T34

Title	Examine the Potential of Robots to Teach Autistic Children Emotional Concepts: A Preliminary Study					
Authors and full reference	Wang, H.; Hsiao, PY.; Min BC; In: Agah, A; Cabibihan, JJ; Howard, A; Salichs, M; He, H;(eds) Social Robotics, ICSR 2016. Lecture Notes in Computer Science, Volume 9979. Springer, Cham					
DOI	https://doi.org/10.1007/978-3-319-47437-3_56		**Year**	2016		
Children	**with autism:**	-	**without autism:**	-	**Robot:**	Bio
Emotions covered	Anger, Fear, Sadness, Happiness					
Skills	Dancing					
Value brought Challenges Recommendations	The paper presents to teach autistic children emotional concepts using humanoid robots with dancing capabilities. The paper recommends the following issues:1) more efforts will be needed to make the robot body expression more general, 2) the design should use smaller motions to express emotion in real life 3) the wording of the verbal instruction is suggested to be short, brief, simple and concrete 4) using photos of real facial expression card since it is easier for children to understand, and 5) tailoring the content for different autistic learners is important.					

#T36

Title	Potential Clinical Impact of Positive Affect in Robot Interactions for Autism Intervention					
Authors and full reference	Kim, ES; Daniell, CM; Makar, C; Elia, J; Scassellati, B; Shic, F; International Conference on Affective Computing and Intelligent Interaction (ACII), Xi'an, pages 8-13					
DOI	10.1109/ACII.2015.7344544			**Year**	2015	
Children	**with autism:**	24	**without autism:**	-	**Robot:**	Dinosaur Robot Pleo
Emotions covered	-----					
Skills	Social and Conversational interaction					
Value brought Challenges Recommendations	The paper presents the potential clinical utility of social robot interaction for communication and social skills intervention for ASD, by comparing affective valence during interaction with the robot versus with the adult interaction partner. The recommendations regarding the robot used in this paper are 1) the robot was capable of rich social interaction, the robot expressed positive (e.g., excitement and joy) and negative (disappointment or dislike) affect and attention to particular objects using pseudo-verbal vocalizations (e.g., "Oooooohh!" to indicate interest in an object, and, "Awwww" to indicate disappointment), head turns, body movements and chose a cartoonish vocal character to make the interaction more enjoyable. Furthermore, a general recommendation is given in the paper as when designing for children with ASD, technologists should take care to differentiate between encouraging interaction with the technology itself, and facilitating more adaptive interaction with other people.					

#T37

Title	A comparison of the effects of rhythm and robotic interventions on repetitive behaviors and affective states of children with Autism Spectrum Disorder (ASD)					
Authors and full reference	Srinivasan SM, Park IK, Neelly LB, Bhat AN. Res Autism Spectr Disord. Volume 18, pages 51-63					
DOI	doi:10.1016/j.rasd.2015.07.004		**Year**	2015		
Children	**with autism:**	36	**without autism:**	-	**Robot:**	Rovio (WowWee)
Emotions covered	-----					
Skills	Greeting, Turn-Taking, Warm up game, Action game, Drumming game, Action themes such as start and stop, slow and fast, moving on a count, moving on a steady beat					
Value brought Challenges Recommendations	The paper compares the effects of two novel interventions - rhythm and robotic therapies, with those of a standard-of-care intervention, on the repetitive behaviors and affective states of children with ASD between using a randomized controlled trial design. The challenges mentioned in this paper are variability in the level of functioning of children, shorter training duration, lack of follow-up sessions, variability in the compliance levels of parents with training. The recommendations in this paper are inclusion of object-free, creative movement interventions involving rhythm, dance, yoga, and play therapies into the standard-of-care treatment of children with autism.					

#T39

Title	Robotic Sonification for Promoting Emotional and Social Interactions of Children with ASD					
Authors and full reference	Zhang, R; Jeon, M; Park, CH; Howard, AM; Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction, pages 111–112					
DOI	https://doi.org/10.1145/2701973.2702033		**Year**	2015		
Children	**with autism:**	-	**without autism:**	-	**Robot:**	Romo
Emotions covered	Anger, Suprise					
Skills	Turn-Taking, Sound Making					
Value brought Challenges Recommendations	The paper presents the development of an orchestration robot platform. The sonification is used in the intervention sessions. The paper also describes the development a facial expression detection system and implementing a platform-free sonification server system.					

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Authors and full reference	Zhang, R; Jeon, M; Park, CH; Howard, AM; Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction, pages 111–112					
DOI	https://doi.org/10.1145/2701973.2702033			**Year**	2015	
Children	**with autism:**	-	**without autism:**	-	**Robot:**	Romo
Emotions covered	Anger, Suprise					
Skills	Turn-Taking, Sound Making					
Value brought Challenges Recommendations	The paper presents the development of an orchestration robot platform. The sonification is used in the intervention sessions. The paper also describes the development a facial expression detection system and implementing a platform-free sonification server system.					

#T40

Title	Automatic Emotion Recognition in Robot-Children Interaction for ASD Treatment					
Authors and full reference	Leo,M; Coco, MD; Carcagni, P; Distante, C; IEEE International Conference on Computer Vision Workshop (ICCVW), Santiago, pages 537-545					
DOI	10.1109/ICCVW.2015.76			**Year**	2015	
Children	**with autism:**	3	**without autism:**	-	**Robot:**	R25
Emotions covered	Anger, Surprise, Happiness, Fear, Disgust, Sadness, Neutral					
Skills	-----					
Value brought Challenges Recommendations	The paper presents machine-learning strategies during robot-ASD children interactions in order to make possible an objective evaluation of children's behaviours and then to give the possibility to introduce a metric about the effectiveness of the therapy. The paper mainly focuses on the basic emotion recognition skills and it contributed to introduce a facial expression recognition (FER) engine that automatically detects and tracks the child's face and then recognize emotions on the basis of a machine learning pipeline based on HOG descriptor and Support Vector Machines. The recommendations of the paper are the optimization of the algorithms involved in the facial expression recognition (FER) engine in order to exploit the processing resources available on board of the R25 robot and evaluation of the systems along multiple therapeutic sessions involving the same children in order to take advantage of the analysis tools implemented by the meta-data handling module.					

#T41

Title	Autistic Children's Kansei Responses Towards Humanoid-Robot as Teaching Mediator					
Authors and full reference	Aziz, AA; Moganan, FFM; Ismail, A; Lokman, AM; IEEE International Symposium on Robotics and Intelligent Sensors, Volume 76, pages 488 – 493					
DOI	https://doi.org/10.1016/j.procs.2015.12.322			**Year**	2015	
Children	**with autism:**	2	**without autism:**	1	**Robot:**	NAO
Emotions covered	-------					
Skills	Greeting, Singing, Say please, Keeping yourself clean					
Value brought **Challenges** **Recommendations**	The paper presents a pilot study in studying the autistic children's' emotions and feelings upon being triggered by the humanoid-robot, NAO. Kansei Engineering, which is a powerful emotion extraction mechanism is adopted in the study to assess the children's' emotion.					

#T42

Title	An emotion recognition comparative study of autistic and typically-developing children using the zeno robot					
Authors and full reference	Salvador, MJ; Silver, S; Mahoor, MH; EEE International Conference on Robotics and Automation (ICRA), Seattle, WA, pages 6128-6133					
DOI	10.1109/ICRA.2015.7140059			**Year**	2015	
Children	**with autism:**	22	**without autism:**	---	**Robot:**	Zeno R-50
Emotions covered	Anger, Fear, Disgust, Sadness, Surprise, Neutral, Happiness					
Skills	------					
Value brought Challenges Recommendations	This paper presents comparison of the emotion expression recognition abilities of children diagnosed with high functioning Autism (ASD) with those of typically developing (TD) children through use of a humanoid robot, Zeno. It is found in the paper that gestures can significantly impact the prediction accuracy of both ASD and TD children in a negative or positive manner depending on the specific expression. It is demonstrated in the paper that the successful capability of the Zeno R-50 to convey all six basic emotion expressions when using a combination of facial and body gestures. The children diagnosed with Autism did not show any significant impairment for correctly labeling most emotion expressions. Thus it is recommended to investigate whether the children can truly identify the emotional meaning connected to the label and visual cue. To test this, for example the child can be asked to make up a short story explaining why the robot may be showing such emotion expression.					

#T48

Title	Combining psychological and engineering approaches to utilizing social robots with children with Autism					
Authors and full reference	Dickstein-Fischer, L.; Fischer, G.S., 2014, Combining psychological and engineering approaches to utilizing social robots with children with Autism, 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBC 2014, 792-795					
DOI	10.1109/EMBC.2014.6943710			**Year**	2014	
Children	**with autism:**	0	**without autism:**	0	**Robot:**	PABI
Emotions covered						
Skills	ABA therapy					
Value brought **Challenges** **Recommendations**	This paper presents a robot-assisted ABA therapy using: • DiscreteTrial Teaching (DTT) • interfaces wirelessly with a tablet computer displaying various virtual flashcards • instructs the child and providing feedback.					

#T49

Title	Building a game scenario to encourage children with autism to recognize and label emotions using a humanoid robot					
Authors and full reference	Costa, S.; Soares, F.; Pereira, A.P.; Santos, C.; Hiolle, A., Building a game scenario to encourage children with autism to recognize and label emotions using a humanoid robot, 23rd IEEE International Symposium on Robot and Human Interactive Communication, IEEE RO-MAN 2014, 820-825, NEW YORK					
DOI	10.1109/ROMAN.2014.6926354		**Year**	2014		
Children	**with autism:**	1	**without autism:**	1	**Robot:**	Zeno (Zeca)
Emotions covered	fear, joy, sadness, surprise, and anger					
Skills	Emotion recognition					
Value brought Challenges Recommendations	This paper presents robotic study with two teenagers, a Zeca (Zeno Engaging Children with Autism) robot first displays a facial expression and its associated gestures (as a body posture), representing one of the five basic emotions: fear, joy, sadness, surprise, and anger. The child is then prompted to identify the emotion associated with the facial expression, and show a racket with the photo of a person with the emotion and a QR code to the robot. The robot displays a feedback based on the correctness of the answer.					

#T49

Title	Building a game scenario to encourage children with autism to recognize and label emotions using a humanoid robot					
Authors and full reference	Costa, S.; Soares, F.; Pereira, A.P.; Santos, C.; Hiolle, A., Building a game scenario to encourage children with autism to recognize and label emotions using a humanoid robot, 23rd IEEE International Symposium on Robot and Human Interactive Communication, IEEE RO-MAN 2014, 820-825, NEW YORK					
DOI	10.1109/ROMAN.2014.6926354		**Year**	2014		
Children	**with autism:**	1	**without autism:**	1	**Robot:**	Zeno (Zeca)
Emotions covered	fear, joy, sadness, surprise, and anger					
Skills	Emotion recognition					
Value brought Challenges Recommendations	This paper presents robotic study with two teenagers, a Zeca (Zeno Engaging Children with Autism) robot first displays a facial expression and its associated gestures (as a body posture), representing one of the five basic emotions: fear, joy, sadness, surprise, and anger. The child is then prompted to identify the emotion associated with the facial expression, and show a racket with the photo of a person with the emotion and a QR code to the robot. The robot displays a feedback based on the correctness of the answer.					

#T50

Title	Feasibility of using a humanoid robot to elicit communicational response in children with mild autism					
Authors and full reference	Malik, N.A.; Shamsuddin, S.; Yussof, H.; Miskam, M.A.; Hamid, A.C., Feasibility of using a humanoid robot to elicit communicational response in children with mild autism, IOP Conference Series: Materials Science and Engineering, 5th International Conference on Mechatronics, ICOM 2013, Volume 53, Issue 1, 2013					
DOI	10.1088/1757-899X/53/1/012077			**Year**	2013	
Children	**with autism:**	2	**without autism:**	0	**Robot:**	Nao
Emotions covered	Hungry,happy, mad, scared and love/hug					
Skills	Teach emotions					
Value brought Challenges Recommendations	To teach emotions with a emotion game and a song game with a Nas robot. 2 children are tested. The emotions are correctly recognized. But the game and songs are in English and children had difficulty in understanding some words. Also quantitative analysis is done, but since there are only two subjects, quantitative analysis is not sound. Children did not show negative response to the robot. GARS-2 test is used for evaluation.					

#T51

Title	Can the social robot probo help children with autism to identify situation-based emotions? A series of single case experiments					
Authors and full reference	Anamaria, P.C.; Ramona, S.; Sebastian, P.; Jelle, S.; Alina, R.; Daniel, D.; Johan, V.; Dirk, L.; Bram, V., Can the social robot probo help children with autism to identify situation-based emotions? A series of single case experiments, International Journal of Humanoid Robotics, Volume 10, Issue 3, 2013					
DOI	10.1142/S0219843613500254		**Year**	2013		
Children	**with autism:**	3	**without autism:**	0	**Robot:**	Probo
Emotions covered	Sad, happy					
Skills	Situation based emotion recognition					
Value brought Challenges Recommendations	This paper presents a robot-assisted study where 3 children with ASD are asked to recognize sadness and happiness of the robot in different situations.					

#T53

Title	Development of skills in children with ASD using a robotic platform					
Authors and full reference	Silva, S.; Soares, F.; Costa, S.; Pereira, A.P.; Moreira, F., Development of skills in children with ASD using a robotic platform, 2012 IEEE 2nd Portuguese Meeting in Bioengineering, ENBENG 2012,					
DOI	10.1109/ENBENG.2012.6331347			**Year**	2012	
Children	**with autism:**	14	**without autism:**	0	**Robot:**	Lego Mindstorms NXT
Emotions covered	-					
Skills	Cognitive skills					
Value brought Challenges Recommendations	This paper presents a robot-assisted study involving several tasks for the children such as: - Showing a particular gesture to ask for a ball - Throw the ball to the interviewer - Pick up and throw ball in a particular color, and identify a color Robot has the role of mediator/positive reinforcement during these tasks Challenge: It is better to select small samples. The sample was too big and heterogeneous, the tasks did not fit to all children, and hard to focus, when the sample size is big. Recommendation: it is hard to find a pattern, every child has a different experience and behaviour with the robotic system.					

#T54

Title	Robots for use in autism research					
Authors and full reference	Scassellati, B.; Henny Admoni; Matarić, M., Robots for use in autism research, ANNUAL REVIEW OF BIOMEDICAL ENGINEERING, Volume 14, 2012, pp. 275-294					
DOI	10.1146/annurev-bioeng-071811-150036		**Year**	2012		
Children	**with autism:**	0	**without autism:**	0	**Robot:**	-
Emotions covered						
Skills						
Value brought **Challenges** **Recommendations**	This paper reviews the SAR studies in Autism research and analyses them in terms of robot design decisions, human-robot interactions, and system evaluations. Also comments on the challenges and possible future directions.					

#T55

Title	Using the social robot Probo as a social story telling agent for children with ASD					
Authors and full reference	Vanderborght, B.; Simut, R.; Saldien, J.; Pop, C.; Rusu, A.S.; Pintea, S.; Lefeber, D.; David, D.O., Using the social robot Probo as a social story telling agent for children with ASD, Interaction Studies, Volume 13, Issue 3, 2012, 348-372					
DOI	10.1075/is.13.3.02van			**Year**	2012	
Children	**with autism:**	4	**without autism:**	0	**Robot:**	Probo
Emotions covered						
Skills	Social skills such as saying “hello”, saying “thank you” and “sharing toys”.					
Value brought **Challenges** **Recommendations**	The robot Probo tells Social Stories to teach ASD children how to react in situations like saying “hello”, saying “thank you” and “sharing toys”. Challenge: the story is played on the robot without interruption, so the therapist cannot stop the story when necessary. Recommendation: introducing more interactive stories, so that the robot can respond to the actions and the reactions of a child during the presentation of the social stories.					

#T56

Title	From child-robot interaction to child-robot-therapist interaction: A case study in autism					
Authors and full reference	Giannopulu, I.; Pradel, G., From child-robot interaction to child-robot-therapist interaction: A case study in autism, Applied Bionics and Biomechanics Volume 9, Issue 2, 2012, pp. 173-179					
DOI	10.3233/JAD-2011-0042			**Year**	2012	
Children	**with autism:**	1	**without autism:**	0	**Robot:**	GIPY-1
Emotions covered						
Skills	the child's reactions and positive emotions towards the robot and the therapist are analysed					
Value brought Challenges Recommendations	The robot plays a simple game with the child. Moves toward or away from child, or turn around itself, according to child's attention. The aim is to carry the interaction between the robot and the child to the robot-child-therapist. Five criteria were Defined and analysed in free play scenario, such as: 1) eye contact (looking at the robot), 2) touch (touching the robot without manipulating it), 3) manipulation (operating the robot), 4) posture (changing corporal position toward the robot) and 5) positive emotion (display of enjoyment).The child's reactions and positive emotions towards the robot and the therapist are analysed from the camera recordings.					

#T58

Title	The FACE of autism					
Authors and full reference	Mazzei, D.; Billeci, L.; Armato, A.; Lazzeri, N.; Cisternino, A.; Pioggia, G.; Igliozzi, R.' Muratori, F.; Ahluwalia, A.; De Rossi, D.; Proc. 19th IEEE International Conference on Robot and Human Interactive Communication, RO-MAN 2010, p 791-796					
DOI	10.1109/ROMAN.2010.5598683		**Year**	2010		
Children	**with autism:**	5	**without autism:**	1	**Robot:**	FACE android
Emotions covered	Sadness, Happy, surprise, disgussed, angry, fear					
Skills	Response understand and imitate facial expression					
Value brought Challenges Recommendations	Althoughit only preliminary evaluation done , this paper describe the development of the robot together with the use of various external wearable data capturing devices (e.g. sensorised shirt, eye tracking hat) in order to create an adaptive system capable of expressing and conveying emotions and empathy as a therapeutic intervention setup to enable autistic children and adults to better deal with emotional and expressive information.					

#T68

Title	Children-robot interaction: a pilot study in autism therapy					
Authors and full reference	Kozima, H.; Nakagawa, C.; Yasuda, Y.; 2007, FROM ACTION TO COGNITION Vol.1 p385-400					
DOI	10.1016/S0079-6123(07)64021-7			**Year**	2007	
Children	**with autism:**	3	**without autism:**	52	**Robot:**	Keepon
Emotions covered	Joy, Fear, Excited					
Skills	Joint Attention, Sound making (as a way of communication)					
Value brought Challenges Recommendations	The article present the development and deployment of very simplified robot, that is only capable of expressing its attention (directing its gaze) and basic emotional states (pleasure and excitement). The article shows that even with such basic robot with very limited capabilities in movements and expressions, it can encourage and trigger the emergence of dyadic, triadic, and empathetic interactions in Children with varios developmental disorders (e.g. Autism, Down's syndrome). The article report of three representative case studies (out of studies with over 30 children), where the children spontaneously approached the robot with a sense of curiosity and security, and engaged in dyadic interaction with it, which then extended to triadic interactions where they exchanged with adult caregivers pleasure and surprise they found in the robot.					

#T72

Title	Improving social skills in children with ASD using a long-term, in-home social robot					
Authors and full reference	Brian Scassellati, Laura Boccanfuso, Chien-Ming Huang, Marilena Mademtzi, Meiying Qin, Nicole Salomons, Pamela Ventola, Frederick Shic; SCIENCE ROBOTICS Volume: 3 Issue: 21 2018, 2470-9476					
DOI	10.1126/scirobotics.aat7544		**Year**	2018		
Children	**with autism:**	12	**without autism:**	0	**Robot:**	autonomous social robot
Emotions covered	valence derived from a list of KANSEI words: adorable amusing appealing attractive boring cheerful depressing desirable easy-to-adopt enjoyable friendly offensive persuasive responsive lively stimulating understandable					
Skills	Getting into interaction, social gaze behavior, turn taking					
Value brought Challenges Recommendations	The robot provides a social situation, displayed as cartoon-like images on the touch screen, and asks the child to choose what he/she thinks the story character is feeling at different points in the story by selecting one of multiple options displayed on the screen. As the child progresses, the social stories become longer and more complex. To succeed in this game, the child needs to understand the social situations and emotional states of the characters. The robot encouraged engagement, adapted the difficulty of the activities to the child's past performance, and modeled positive social skills. Caregivers reported less prompting over time and overall increased communication.					

#T72

Title	Improving social skills in children with ASD using a long-term, in-home social robot					
Authors and full reference	Brian Scassellati, Laura Boccanfuso, Chien-Ming Huang, Marilena Mademtzi, Meiying Qin, Nicole Salomons, Pamela Ventola, Frederick Shic; SCIENCE ROBOTICS Volume: 3 Issue: 21 2018, 2470-9476					
DOI	10.1126/scirobotics.aat7544			Year	2018	
Children	**with autism:**	12	**without autism:**	0	**Robot:**	autonomous social robot
Emotions covered	valence derived from a list of KANSEI words: adorable amusing appealing attractive boring cheerful depressing desirable easy-to-adopt enjoyable friendly offensive persuasive responsive lively stimulating understandable					
Skills	Getting into interaction, social gaze behavior, turn taking					
Value brought Challenges Recommendations	The robot provides a social situation, displayed as cartoon-like images on the touch screen, and asks the child to choose what he/she thinks the story character is feeling at different points in the story by selecting one of multiple options displayed on the screen. As the child progresses, the social stories become longer and more complex. To succeed in this game, the child needs to understand the social situations and emotional states of the characters. The robot encouraged engagement, adapted the difficulty of the activities to the child's past performance, and modeled positive social skills. Caregivers reported less prompting over time and overall increased communication.					

#T73

Title	Humanoid-Robot as Teaching Mediator: Research Model in Demonstrating the Autistic Children Learning Motivation Based on the Emotional Responses					
Authors and full reference	Aziz, AA; Mokhsin, M; Moganan, FFM; Ismail, A; Sakamat, N; Zainol, AS; Lokman, AM, ADVANCED SCIENCE LETTERS, Volume 24, Issue 4					
DOI	10.1166/asl.2018.10939			**Year**	2018	
Children	**with autism:**	2	**without autism:**	1	**Robot:**	Nao
Emotions covered	valence derived from a list of KANSEI words: adorable amusing appealing attractive boring cheerful depressing desirable easy-to-adopt enjoyable friendly offensive persuasive responsive lively stimulating understandable					
Skills	Greetings, Basic speach (saying „please"), Self-care (self-cleaning), Singing					
Value brought Challenges Recommendations	Although generally not well-written and with little detail, paper proposes an iteresting approach to evaluation of a child-robot interaction based on KANSEI words evaluated by a caregiver who knows a child well. Uses Fogg's behavioural model for analysing child's ability and triggers in order to evaluate motivation.					

#T77

Title	Emotional Robot to Examine Different Play Patterns and Affective Responses of Children with and without ASD					
Authors and full reference	Boccanfuso, L; Barney, E; Foster, C; Ahn, YA; Chawarska, K; Scassellati, B; Shic, F11th ACM/IEEE International Conference on Human-Robot Interaction (HRI), MAR 07-10, 2016, 19 - 26					
DOI	10.1109/HRI.2016.7451729			Year	2016	
Children	**with autism:**	12	**without autism:**	15	**Robot:**	autonomous social robot
Emotions covered	Vaanger, fear, sadness, happiness					
Skills	Getting into interaction, touching, sound making					
Value brought Challenges Recommendations	understanding of characteristic differences between very young typically developing children and children with ASD. This study contributes evidence supporting the potential validity of employing an emotion-simulating robot to elicit play and affective response across a broad and diverse population.					

#S1

Title	Robotic Framework for Music-Based Emotional and Social Engagement with Children with Autism					
Authors and full reference	Park, C.H.; Pai, N; Bakthavatchalam, J, Li, Y. ; Jeon, M; Howard, A.M. AAAI Workshop on Artificial Intelligence Applied to Assistive Technologies and Smart Environments					
DOI				**Year**	2015	
Children	**with autism:**	-----	**without autism:**	---	**Robot:**	Romo1
Emotions covered	Neutral, Angry, Curious, Bored, Happy, Sad					
Skills	------					
Value brought Challenges Recommendations	This paper presents designing of novel forms of musical interaction combined with physical activities t improve social interactions and emotional responses of children with ASD. This paper provides initial design schemes of the robotic framework to utilize musical stimulus for initiating engagement and to deepen interaction in emotional and social relationships through interactive robotic sessions. A robotic framework is proposed that composed of functional components for 1) music-based robot motion generation for physio-musical stimulus, 2) human emotion detection for emotional engagement estimation, 3) human motion detection for physical engagement estimation, and 4) robot intelligence module for increasing engagement and interaction with activity and emotional interaction.					

#S6

Title	The DREAM Dataset: Supporting a data-driven study of autism spectrum disorder and robot enhanced therapy					
Authors and full reference	Billing E, Belpaeme T, Cai H, Cao HL, Ciocan A, et al. (2020) The DREAM Dataset: Supporting a data-driven study of autism spectrum disorder and robot enhanced therapy. PLOS ONE 15(8): e0236939.					
DOI	10.1371/journal.pone.0236939			**Year**	2020	
Children	**with autism:**	61	**without autism:**	0	**Robot:**	Nao
Emotions covered	NA					
Skills	Imitiation, turn-taking, joint atention					
Value brought Challenges Recommendations	This paper presents a dataset which is publicly available form the project DREAM. It caovers 61 children with ASD, and over 3000 sessions of therapy. ABA protocol is followed. Half of children had sessions with Nao and the other half only interacted with the therapist. Scenarios involve imitaiton, turntaking and joint attention skills. Data from 2 RGBD and 3 RGB cameras which do not reveal the children's identity is available in the dataset.					

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Affective loop in Socially Assistive Robotics as an intervention tool for children with autism