# Emotional Intelligence Assessment Tool for Children with Autism Spectrum Disorder

2 authors:

Naila Shah
Shaheed Zulfikar Ali Bhutto Institute of Science and Technology
**1** PUBLICATION   **6** CITATIONS

Faria Jameel
Shaheed Zulfiqar Ali Bhutto Institute of Science and Technology, Karachi
**5** PUBLICATIONS   **14** CITATIONS

# Emotional Intelligence Assessment Tool for Children with Autism Spectrum Disorder

Naila Shah and Faria Jameel
SZABIST, Department of Computer Science, Karachi, Pakistan
Email: {naila.shah, faria.jameel}@szabist.edu.pk

*Abstract*—**Researchers are working immensely in different areas of Artificial Intelligence, by developing human like intelligent machines that can understand human emotions and can also improve an individual's emotional quotient. As fostering EI has the potential of making civilized society and eradicating negativity for the betterment of society and the world. We cannot disregard people with disabilities from this improvement; unfortunately, difficulty in recognizing emotions and intense negative emotions are one of the characteristic of people with Autism Spectrum Disorder ASD. However, research has proved that majority of people with ASD have above-average skills of problem solving, logic building and mathematics. This research focuses on designing a prototype tool which can assess the emotional intelligence and social cognition of children with ASD, the tool makes use of visual cues to introduce emotion invoking scenarios to them and evaluates the result. Children with ASD can be presented with social stories based on their results, so that their social and emotional cognitive abilities can be improved and help them replace their negative, self-destructive emotions with positive emotions. Hence making them successful, optimist and an active part of our society.**

*Index Terms*—**emotional intelligence, autism spectrum disorder, social cognition, emotional quotient assessment, visual-cue based learning, social stories**

## I. INTRODUCTION

Ever since the psychologist Daniel Goleman emphasized on the importance of emotional intelligence EI and the science behind emotional quotient EQ, the world took over his revolutionary idea by incorporating EQ into organizational and school curriculum level. Fostering EI at young age has proved to significantly improve individuals' communication skills, emotional management, handling of negative situations; hence, making them more empathetic and compassionate to others as well as having greater self-awareness.

Emotions are a primary idiom for defining and negotiating social relations of the self in a moral order [1]. Emotions can be best described as our automatic reaction/response to certain events or objects, and are a major part of our cognitive response. An individual's cognitive abilities and emotional knowledge are interlinked, the higher the cognitive skills the higher the emotion understanding. Emotions not only facilitate an individual to problem solving, they also help in

prioritizing multiple goals of an individual. Hence, emotions management affect not only our intellectual abilities but also shape our quality of life.

### A. Emotional Intelligence

The ability to perceive, generate, understand emotions and regulate emotions, so as to promote emotional and intellectual growth is known as emotional intelligence [2]. The emotional intelligence of an individual operates on the emotional information, the reflection of the relationships and the emotional patterns. According to EI theory, individuals mature in their capacity for processing and applying emotional information over the course of their development. Emotions tend to have systematic effects on an individual and on others; therefore, managing negative emotions effectively is important. Furthermore, studies have been carried out in providing evidence that better emotional Intelligence also help in academics, EI correlates with school grades and intellectual problem solving. Therefore, incorporating EI improvement strategies can help children in their academics, professional and personal relationships.

Unfortunately, children with developmental disabilities tend to suffer more from negative emotions as compared to other children without disabilities. Due to the communication problems they often fail at communicating their emotions resulting into increased anxiety levels and self-destructive behavior. However, early assessment of emotional intelligence can help children with Autism Spectrum Disorder (ASD) improve their emotion understanding and help them manage their emotions in a productive manner.

### B. Autism Spectrum Disorder (ASD)

ASD is a spectrum condition that affects individuals differently and to varying degrees. ASD is a complex developmental disability, affects a person's ability to communicate and interact with others. ASD is a neurodevelopmental disorder that begins in the first few years of life and is often accompanied by other disorders and problems. People with ASD may experience sensory problems, social communication and interaction, repetitive patterns of behavior, interests or activities. The term spectrum in ASD reflects the wide range of challenges and strengths possessed by each person with autism.

Communication becomes a challenging task for people with ASD, and when they are unable to convey their

message correctly the level of their anxiety emotion increases hence resulting into deviant behavior, either hurting themselves or others. Sometimes, a change in the routine of people with ASD can lead to deviant behavior. In order to avoid such incidents occurrence, parents and therapists work with children by applying different strategies to help them control and manage their emotions efficiently. When the parents anticipate any change in their children social settings they work in coordination with the therapists to make them aware of the situation before hand so that their emotions could be better managed and appropriate response could be explained to them.

Children with ASD mainly suffer from emotional disturbance; research has shown that there is increasing evidence that children with ASD experience more negative and less positive emotions in comparison with typically developing children. Emotional disturbances leading to elevated levels of anxiety and anger such as meltdowns, tantrums and aggressions that pose a substantial risk factor for the development of mental health problems.

## II. LITERATURE REVIEW

There has been profound research done in developing interactive video games, applications, tools to enhance the social and emotional cognitive abilities of individuals with disabilities such as Alzheimer's disease, Down Syndrome and various others [3]. Research has been done on the effectiveness of introducing early intervention programs focusing on the understanding and assessment of emotional skills of people with Down Syndrome with the aid of assistive technology [4].

Research has elaborated the importance of social stories when combined with multimedia to help children with ASD learn interpretation of different social situations, and emotions of other in a given context [5]. Researchers have seen significant improvement in behavior of children with ASD when provided with social stories.

Moreover, one of the study has proved effectiveness of frequent social stories resulting in increased social interaction among the children with ASD [6]. It has been observed that children with ASD tend to learn appropriate social behavior more efficiently with the use of interactive multimedia based social stories [7].

There has been research done also on the effectiveness of using interactive songs, soothing music and graphical symbols for teaching communication skills to children with ASD [8].

In one of the study researcher concluded that children with ASD show affiliation and attention towards visual-cue content based on cartoon images rather than human images, summarizing that cartoon based learning material can greatly benefit children with ASD [9].

Real-time gesture tracking system have also been developed by different researchers to help enhance the sensory skill development of low-functioning ASD children focusing on the sound stimuli. The augmented interaction of sound with gesture tracking system proved to help children accustomed to real environment [10].

Studies have proved that social stories based on augmented reality with 3-D animations can produce significant results in improving social skills of children with autism [11].

Furthermore, a study investigated usage of information technology devices to enhance the behavior therapy of children with autism, the study involved learning social skills with IT devices and profound results were found [12].

Researchers have also emphasized on the study of social sensibility (pragmatic) skills of ASD individual's such as understanding of humor and metaphors used in social communication (e.g. I feel on top of world today). In a research, they focused on investigating how ASD children comprehend difficult situations involving understanding of social and pragmatic inference [13].

Interactive video game has been developed to enhance cognitive, language and intellectual skills of children with Down Syndrome. The game was designed by creating real world scenarios focusing on comprehension and visual skills, children showed improved results with this game [14].

However, research in the area of assessment tool for emotional and social cognitive abilities of children with Autism Spectrum Disorder is still lacking. Therefore, in our study we decided to design a prototype tool for the assessment of emotional and social cognitive skills for ASD children, and then making use of multimedia social stories to improve their emotional intelligence.

In this research we found significant increase and interest in responses during the intervention of music for all the participants.

## III. AIM OF THE STUDY

Researchers are working on enabling machines to have social and emotional skills that may help people develop different abilities and determine their behaviors. The proposed research focuses on designing a prototype to develop an assessment tool for Emotional Intelligence specifically for the children with ASD. This prototype will help in developing specialized social stories for them to boost their abilities and manage emotions.

The purpose of this article is to present preliminary evidence for the reliability and validity of a new assessment tool for measuring emotion skills among children. Researchers have shown that social and emotional skills can be taught as part of an early intervention program, the social-emotional behavior can be fostered using various techniques such as storyboarding, social stories, role play in children with ASD.

Conventionally, parents provide information about the pattern of their children to therapists, such as things that make them anxious, their social and intellectual abilities, any characteristic of ASD repetitive behavior (such as flapping hands, spinning etc.) deviant behavior (banging head, or desire to touch sharp objects), this individual screening process usually consists of questions asked by therapists, parents response make therapist aware of child's mental age and guide them in designing their

individual education plan (IEP). Children are then provided with individual training program by therapists that help them overcome their deviant behavior and also learn social, intellectual, emotional and sensory skills along with emphasizing on their academics. This process is not only time consuming but also difficult for parents to better understand from the textual information of the context in which the question is asked.

The approach that we followed to identify different range of emotions was by eliciting emotion invoking scenarios, in this way children were better able to understand and respond. With our proposed prototype, parents can easily provide information by involving their children in the scenario based questions, scenarios not only make them better understand the situation, it can also keep their children engaged in the process.

## IV. METHODOLOGY

The qualitative research methodology was used; an Emotional Intelligence assessment prototype tool was designed. The process followed to design the prototype for emotional intelligence assessment involved two main phases, analysis of needs of children with ASD, and the patterns/behaviors of such children and then identifying scenarios/situations for addressing the needs and identifying emotions, followed by providing means to improve the emotional intelligence of children with ASD.

The questions used in the tool were developed combining the four-branch ability model of MSCEIT [15] and the Trait Emotional Intelligence Questionnaire Child Form (TEIQ-CF). The Trait Emotional Intelligence is defined as a constellation of emotion-related self-perceptions and dispositions at the lower levels of personality hierarchies [16]. Whereas, the four-branch ability model of Mayer-Salovey-Caruso Emotional Intelligence Test categorizes the abilities and skills of EI into four areas (Table I.)

TABLE I.    MSCEIT FOUR BRANCH MODEL

| *Four-branch Ability Model* | *Description* |
|---|---|
| Perceiving emotions | Understanding facial expressions through visuals such as; happiness, sadness, anger, excitement, disgust etc.<br>Audio and video based recognition of emotions in a conversation. |
| Using emotions to facilitate thought | Situational based emotion changing scenarios were presented, participants were asked to label their thoughts as emotions. |
| Understanding emotions | Participants were presented with different scenarios where they were asked to understand and identify the actual cause of a person's emotion<br>Video-based scenarios were used where participants were asked about the feelings and emotions of people involved. |
| Managing emotions | Participants were involved in a decision making situation through scenarios and they were asked about how they would perform in such challenging situations.<br>Visual content was displayed, where they were assessed on the basis of effective decision making. |

In our research, our focus was on children because in early age they develop their emotions hence making this age group a predominantly important target for early intervention aiming to increase emotional management and functioning.

Trait Emotional Intelligence Questionnaire Child Short Form was used instead of the Trait Emotional Intelligence Questionnaire Child Form, as it was a challenge to keep participants engaging as majority of autistic children has short attention span. The TEIQ covers all the four-branch ability models of MSCEIT targeting children, in addition to that it aims at catering the social skills and behavior of children in different context.



Figure 1.    Screenshots of the prototype, questions were asked on the basis of autistic children likes and dislikes. Middle one image represents a scenario which was given at the end of social stories session.

Scenario based questions were added along with visual facial expression recognition in the emotional intelligence assessment prototype; all the scenarios were designed keeping the children with ASD in mind (Fig. 1). Moreover, the occupational, behavioral and speech therapist were also involved in the scenario designing phase.

The OCC model was considered for scenario based questions of this proposed prototype as the taxonomy can be applied to analyzing emotional reactions. The OCC (Ortny, Clore, Collins) model [17] presents taxonomy of 22 emotions that are classified into reaction to events, other people and objects, targeting both positive and negative emotions.

A simplified view of the OCC taxonomy (Fig. 2) [18] which describes that an individuals' response to events depends on the consequence of own self or on others either positively or negatively, and then there is an impact on both (our own self or on others) of emotional event such as resentment, pity, satisfaction, relief etc. Response to objects can be attributed to like or dislike or stronger emotion such as love/hate.
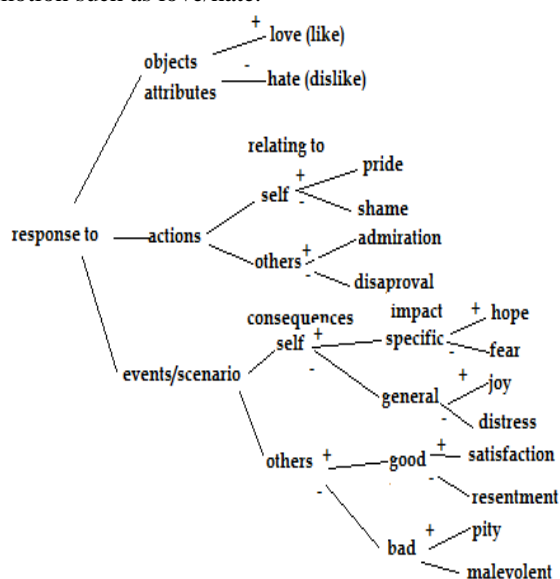


Figure 2.   OCC Model Taxonomy decision tree for classifying emotions

One of the important need presented by Abraham Maslow in theory of motivation, is safety (feeling safe and being in a safe environment that is protected from threat to self or harm. The OCC taxonomy for emotions and motivation theory was used with modification as a tool for identifying and creating scenario based questions of the prototype.

This prototype focuses on identifying the likely emotional state of the user in a given application context. According to the CASA (Computer as Social Actor) effect [19], people have the tendency to react to even minimal human presence on computers (i.e. virtual agent, character, cartoonist images, still images of a human) this idea has been influential in selecting the visual content with different facial expression, and use of color and sound for the prototype scenarios to evoke appropriate emotional

responses such as fear, anger, surprise etc. in children with ASD.

## V.   EVALUATION

A total of eleven children took part in this study, five of these children (aged 7.5-10) had ASD and six were typically developing children (aged 5-9). The research was targeted to cater more than eleven children, due to the unavailability of verbal children with ASD, five children were considered as possible candidates for this study. The occupational therapists helped in providing information regarding ASD children mental age, current abilities, language skills and verbal skills.

This proposed emotional intelligence assessment prototype tool comprised of twenty-five questions, all the questions aimed at studying how children manage to derive conclusion by interpreting and retrieving world and social emotional knowledge.  The ASD children filled the questionnaire with the help of their therapists, out of twenty-five questions thirteen questions were provided with Likert scale response, for each emotion therapists were asked to rate on a scale of 1 to 5, where 1 represented not at all present (particular emotion) and 5 represented present to a great context. Whereas the remaining twelve questions were open ended, comprising of statements like "how would you feel?" "what would you do? also "why" statements to see how they derived the answer. The smart phone device was used as a medium to present the emotional intelligence assessment questionnaire to each ASD child individually in a quiet room as the autistic children have noise sensitivity [15], they try to block out noise. The duration of the session varied from thirty to forty-five minutes with ASD children, whereas twenty to twenty-five minutes with typically developing children.

The aim was to design a system that is user-friendly, interesting and according to the cognitive skills of children with ASD being targeted. The color scheme, number of pictures presented, sound and the number of questions asked were all designed with the assistance of therapists. One of our challenges was to keep the ASD children engaging during the session, in order to accomplish this task small social skills based two short-animation songs were played in between the session. For encouraging children to complete the session, after responding to each question an audio of praise was played saying "good job!".

However, in order to better assess the emotional capabilities, we developed a prototype, which makes use of visual cues and little text to present different scenarios to children which involves their understanding of emotions and also prompts them to respond to how well they manage their emotions in different situations.

When they started answering the questions, their responses were saved at the back-end of the prototype and were being calculated at the end of the session. After completing the session, children were given with following responses; "need improvement", "average" and "low emotional quotient". Results were later discussed with their therapists and based on their response children

with ASD were then presented with interactive social stories to improve their social emotional skills in areas where they lacked based on MSCEIT four-branch ability.

It was observed that children with ASD were as good as typically developing children in perceiving the emotions, only one out of five children with ASD performed below average in emotion perceiving. Similarly, when we compared the results of the second branch of MSCEIT, where the children were asked to answer questions like "how would you feel?", they responded with correct identification of emotion they were feeling. Although, when we compared typically developing children with ASD children, ASD children showed intense negative emotions while responding to the sensation and identification of emotion.

There was noteworthy difference between typically developing children and children with ASD, in understanding of others emotions. Children with ASD could not respond correctly in understanding other people's emotion given in a scenario. However, when they were scenarios and situations where they had to respond to their emotional behavior, four out of five children with ASD responded with deviant behavior, to the extent of self-hurting and showed no empathetic feeling towards others in difficult situations. However, typically developing children responded with anger, anxiety and ignorance type of emotions, in the emotion management scenarios.

Whereas, when analyzing results of the social emotional questions of TEIQ, two out of five children with ASD showed interest in interacting with new people and possessed same social skills as of typically developing children. When later asked by the therapists about their improved social skills, it was observed that not all children with ASD lack interest in social engagement, as ASD refers to wide spectrum of disorder hence they can have interest in socializing and have tendency to talk to people.

### A. Strategy to Improve EI

After long discussions and interviews with therapists and parents, different strategies were considered and evaluated for the improvement of two main areas of emotions; that is, being empathetic towards others and managing emotions in new complex situations.

Therapists discussed that children with ASD always showed positive results when presenting any learning topic to them through social stories.

Social stories are short stories based on any specific social topic that aims to assist in understanding social situations to children with ASD. Social stories are written in a specific format to address certain social rules and illustrate the appropriate ways to behave and respond in different social contexts. Research has shown that social stories significantly improve adaptive behavior in children with ASD. Social stories are written for both an individual child targeting a specific change of social setting, or for group of children, addressing the change. It consists of pictures and text to describe a social situation, as well as explaining/teaching appropriate response to that situation.

According to Gray's (2010) social story guidelines, when creating a social story four main types of sentences should be used;

- Descriptive statements (define the who, what, where, when and why) partial sentences
- Perspective sentences (define behavior and feelings of others) partial sentences
- Directive statements (explains what to say or do)
- Control sentences (offers guidance to understand the situation)

In the descriptive and perspective sentences, the sentences are usually partially written to encourage the child to respond in order to acquire child's pre-knowledge about the social setting. Whereas, the directive and control sentences tend emphasize on guiding the appropriate behavior to them.

### B. Strategy Results

We followed the strategy of improving emotional abilities of children with ASD through the use of social stories. The social stories were taught in a group of two to three children based on their need, daily for a week by three different therapists. Children showed significant learning results with the social stories, in comparison to the traditional flash card based social stories being presented by the school.

After one week of social stories reinforcement the ASD children were again tested using our system with different scenarios and they showed improved emotional management results, they were better aware of their emotions, the situations and they knew how to respond and manage their emotions in complex situations "Fig. 3". One of the problem ASD children face is fixation to certain objects or routines when there is a change in that pattern they tend to get anxious and harm themselves. With our social stories we worked on improving their habit of harming themselves, teaching them emotions management and replacing their self-destructive activities with self-calming skills.
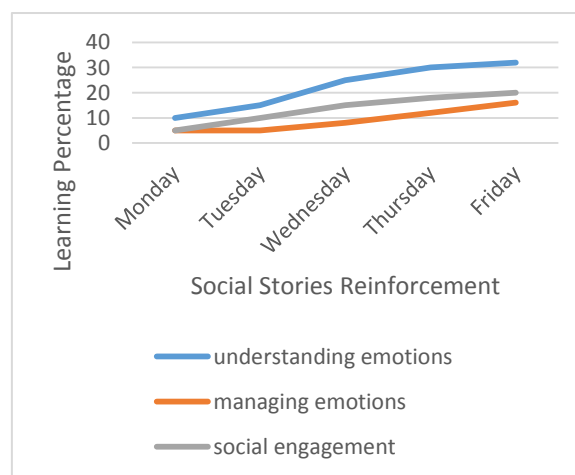


Figure 3. Improvement graph with social stories reinforcement for a week.

In order to improve the weak areas of each participant social stories with digital visual-cue content and music

helped them learn the appropriate behavior and effective emotion management.

We also noticed that during the song play session, children with ASD recorded a noteworthy outcome for joy, showed increased engagement and they were more responsive.

With the use of social stories, we aimed at deflecting or converting potential negative emotions into positive responses; the countermeasure such as for example a dislike converted into like by changing an object or design.

## VI.   FINDINGS

Results revealed pronounced differences between children with ASD and typically developing children, children with ASD were less effective at evaluation phase.

This research has concluded that assessing emotional level of children with ASD and introducing social stories based on their weak areas in early intervention can be beneficial for the emotional quotient of children with ASD.

The prototype can be used as a mean to measure children's emotional intelligence, children with ASD can easily provide feedback if they have developed the reading skills; however, it can be answered with little assistance by their parents or therapists. It was observed that few scenarios contained a large amount of text which was difficult for participants to read and understand, therapists advised us to make use of small sentences for describing a scenario.

The information provided by the prototype can be beneficial for devising an individualized education plan (IEP) for the children with ASD. After this evaluation process, children were provided with interactive social stories to help them learn, understand and manage their emotions with the aim to improve their emotional intelligence.

This tool is helpful in providing result of children's social and emotional intelligence for both typically developing children as well as children with ASD. Therapists and doctors make use of text based questionnaire to assess the emotional abilities of children which are usually filled by parents and is time consuming and need assistance. However, in this tool we have focused more on the scenarios with visual content as autistic children are visual learners they find visual content easy to learn as compared to textual information. Furthermore, the scenarios make the situations more realistic and relatable which helps in providing better state of their emotions.

The OCC decision tree helped to identify emotions and their causes by asking questions about the source of the problem and the consequences of the problem on their emotions. Moreover, it helped in identifying and perceiving emotions in any previous related experiences.

Children with ASD often benefit from interventions that incorporate visual supports as they are visual learners. Visual content is considered effective in improving their communicative and behavioral functioning. Visual supports provide them with concrete support to enhance their learning and understanding (Arthur-Kelly *et al*,

2008). During this research, it was also observed that children with ASD involve more interest when presented with cartoons as compared to human faces. Whereas, the typically developing children show more interest with human faces than cartoons.

## VII.   CONCLUSION

We are living in the era of Artificial Intelligence, where scientists are working on developing human-like machines, that can act, think and can perform chores like humans. From playing games to self-parking cars there has been incredible work done in this field. However, these human-like machines lack the human-like emotions such as empathy and ethics. Developing emotionally intelligent machines and applications that can boost individual's emotional intelligence not only helps in one's own self building it can also result into a civilized society where individuals are able to manage negative emotions in a better way and are more empathetic to others which is the major need of the time.

From this research, it is concluded that the proposed prototype will be beneficial in making children with ASD emotionally intelligent, as early intervention of emotional intelligence boosting strategies can result in better understanding; hence, producing successful, confident and optimist individuals. Profound research is being carried in the areas of face detection for emotional changes, interactive games are being developed for autistic children, but not much work is done on assessment of emotional abilities of ASD individuals. By introducing this tool in early intervention program for autistic children, they can become emotionally intelligent and become successful in their relationships as well as in academics and in professional life. In addition to their emotional intelligence assessment, children with ASD can benefit from social stories aimed at improving their emotion understanding. With this strategy deviant and self-destructive behavior which is predominant in autistic children can be replaced with productive behavior. As there is an increasing demand for social emotions computing applications with privacy and security implications, this tool can be used to categorize children in a group for Individualized Education Plan (IEP).

## VIII.   FUTURE WORK

We plan to introduce more emotion invoking scenarios for ASD children in future; furthermore, different levels of social and emotional quotient assessment can be provided according to their mental age so that they can become an active member of society by improving their emotional management skills.

As individuals with ASD, face a broad spectrum of disorders and limitations, therefore a detailed tool or smart device application may be designed for them addressing whole wide range of limitations and fostering their emotional intelligence.

Providing text to speech option in Urdu language would be added in our future work, because children show more affiliation towards native language also as we

targeted the younger age group, majority of them were not fluent in English language.

Unfortunately, due to the unavailability of verbal children with ASD for this research, the prototype could not be tested for increased number of children. An interactive scenario based game may be developed for children with ASD, that may describe the desired positive emotion e.g. pleasurable experience with the aim to encourage people with ASD.

REFERENCES

[1] C. Lutz and G. M. White, "*The anthropology of emotions*," *Ann. Rev. Anthropol.*, vol. 15, pp. 405-36, 1986.
[2] J. D. Mayer, P. Salovey, and D. R. Caruso. (2004). *Emotional Intelligence: Theory, Findings, and Implications*. Lawrence Erlbaum Associates, Inc. [Online]. 15(3). Available: https://www.jstor.org/stable/pdf/20447229.pdf
[3] M. Dawe, *How Young Adults with Cognitive Disabilities and Their Families Adopt Assistive Technologies*, 2006 ACM.
[4] F. Jameel, "An assessment companion tool for emotional intelligence for the people having down syndrome," in *Proc. Conference, Proceedings of the World Congress on Engineering*, vol. 2, London, UK, 2017.
[5] M. A. E. Saad, "The effectiveness of social stories among children and adolescents with autism spectrum disorders: Meta-analysis," *International Journal of Psycho-Educational Sciences*, vol. 5, no. 2, September, 2016.
[6] M. A. Karal and P. S. Wolfe, "Social story effectiveness on social interaction for students with autism: A review of the literature, education and training in autism and developmental disabilities," *Education and Training in Autism and Developmental Disabilities*, vol. 53, no. 1, pp. 44–58, 2018.
[7] S. Sani-Bozkurt, S. Vuran, and Y. Akbulut, "Design and use of interactive social stories for children with Autism Spectrum Disorder (ASD)," *Contemporary Educational Technology*, vol. 8, no. 1, pp. 1-25, 2017.
[8] K. Simpson and D. Keen, "Teaching young children with autism graphic symbols embedded within an interactive song," *Journal of Developmental and Physical Disabilities*, 2010.
[9] C. M. Sedeyn, "Visual attention to photograph and cartoon images in social StoriesTM: A comparison of typically developing children and children with ASD," University of Vermont thesis Paper, 2017.
[10] M. Magrini and O. Curzio, "An interactive multimedia system for treating autism spectrum disorder," ISTI-CNR, Pisa, Italy, 2016.
[11] M. F. Syahputra, D. Arisandi, A. F. Lumbanbatu, L. F. Kemit, E. B. Nababan, and O. Sheta, "Augmented reality social story for autism spectrum disorder," in *Proc. 2nd International Conference on Computing and Applied Informatics*, 2017.
[12] S. Artoni, L. Bastiani, M. C. Buzzi, M. Buzzi, O. Curzio, S. Pelagatti, and C. Senette, *Technology-enhanced ABA Intervention in Children with Autism: A Pilot Study*, Springer-Verlag Berlin Heidelberg, 2017.
[13] S. Loukusa, L. Makinen, S. Kuusikko-Gauffin, H. Ebeling, and E. Leinonen, "Assessing social-pragmatic inferencing skills in children with autism spectrum disorder," *Journal of Communication Disorders*, vol. 73, pp. 91-105, 2018.
[14] M. Corrales-Astorgano, D. Escudero-Mancebo, C. Gonzalez-Ferreras, Y. Gutierrez-Gonzalez, V. Flores-Lucas, V. Cardenoso-Payo, and L. Aguilar-Cuevas, "The magic stone: A video game to improve communication skills of people with intellectual disabilities," INTERSPEECH 2016: Show & Tell Contribution, September 2016.
[15] M. C. Chang, L. D. Parham, E. I. Blanche, A. Schell, C. P. Chou, M. Dawson, and F. Clark, "Autonomic and behavioral responses of children with autism to auditory stimuli," *American Journal of Occupational Therapy*, vol. 66, pp. 567-576, 2012.
[16] S. Mavroveli, K. V. Petrides, C. Rieffe, and F. Bakker, "Trait emotional intelligence, psychological well-being and peer related social competence in adolescence," *British Journal of Developmental Psychology*, vol. 25, pp. 263–275, 2007.
[17] A. Ortony, G. L. Clore, and A. Collins, *The Cognitive Structure of Emotions*, Cambridge: Cambridge University Press, 1988.
[18] A. G. Sutcliffe, "Designing user interfaces in emotionally-sensitive applications," Conference Paper 2017.
[19] B. Reeves and C. Nass, *The Media Equation: How People Treat Computers, Television and New Media Like Real People and Places*, Stanford CA/Cambridge: CLSI/Cambridge University Press, 1996.

**Naila Shah** is a Senior lecturer at Shaheed Zulfikar Ali Bhutto Institute of Science and Technology, Karachi, Pakistan. MSc. Distributed Systems and Networks, University of Kent, UK. Area of interest ubiquitous computing, software engineering, artificial intelligence, assistive technology for people with disabilities.

Ms. Shah has an extensive experience in the field of computer science, she has worked with IBM (International Business Machines) as Management Trainee and at JS Bank, Pakistan as Manager Alternative Delivery Channel in the IT department. She has been associated with academia, and has served as a faculty member at National University of Computers and Emerging Sciences – FAST University Karachi Pakistan. Currently she is a senior lecturer at SZABIST Karachi Pakistan in the Department of Computing.

**Faria Jameel** is an Assistant Professor and Program Manager of BSCS at SZABIST, Karachi, Pakistan. She has extensive teaching experience at SZABIST. She is a PhD candidate and her area of specialization is Software Engineering, Artificial Intelligence and Algorithms, Business Intelligence.