Culture as a Driver for the Design of Social Robots for Autism Spectrum Disorder Interventions in the Middle East

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Abstract. In this paper, we discuss the prevalence of Autism Spectrum Disorder (ASD) in the Gulf region. We examine the importance of providing state-of-the-art ASD interventions, and highlight social robots as therapeutic tools that have gained popularity for their use in ASD therapy in the West. We also elaborate on the features of social robots that make them effective and describe how they can be used in such settings. We then emphasize the significance of taking cultural context into account in order to develop indigenous tools for ASD therapy, and explain the different ways in which social robots can be made culturally adaptive to maximize their potential impact on children with ASD.

1 Introduction

Autism Spectrum disorder (ASD) is a neurodevelopment disorder [1], usually diagnosed during the first 3 years of life and may be accompanied by other physical or psychological disorders [2]. It is traditionally characterized by impairments in social communication, social interaction and imagination abilities [3], and can be attributed to an absence of the mentalizing ability in a person diagnosed with ASD [4,5].

Impairments in social communication include difficulties in processing language, and in interpreting facial expressions, body language and the tone of voice [6]. Children on the spectrum also tend only to focus on the literal meanings rather than the underlying meanings of metaphors or figures of speech used in communication.

Children diagnosed with ASD often appear withdrawn and aloof. They tend to be uncomfortable in most social settings and have problems forming deep social relationships. This is a direct result of their inability to process emotions easily. They are also unable to maintain eye contact because they feel overloaded with information coming in simultaneously through a number of channels (speech, body language and facial expressions). To avoid such sensory overload,

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they retreat into their own world of familiarity and clarity, thus appearing uninterested and rude to those around them. This marks the impairments in social interaction.

Deficits in the ability to understand abstract ideas and imagine situations outside the daily routine form the impairments in social imagination. These impediments tend to confine a child to his own mind, not allowing him or her to deal with any changes to routine. For this reason, such children tend to engage in rigid and repetitive activities and are unable to indulge in imaginative or interpersonal play [7].

2 Autism in the Gulf States

According to the Centers for Disease Control and Prevention (CDC) report in 2014 [8], 1 % of the world's population has autism spectrum disorder (ASD). In the United Kingdom, one child out of 100 children has ASD [9]. In the United States, the autism prevalence rate is 1 in 68 births [8]. In South Korea, it is 1 in 38 [10]. A large number of epidemiology studies have been conducted globally, bringing forth a wealth of information regarding the prevalence of the condition [11–13]. However, with majority of these studies being conducted in western countries, prevalence statistics for the Gulf States and other developing countries in the world remain largely unknown.

Table 1 lists the available statistics for some Gulf states. The overall ASD prevalence in these countries appears to be lower than generally found in the west. Samadi [14] reports a social stigma attached to disabilities in the Arab culture, which may be a reason that prevents parents from fully reporting a child's difficulties [15]. In addition, children with such disabilities may discontinue education early, preventing them from being screened during studies conducted in elementary schools [16]. The differences in environmental triggers, and in parental practices and expectations must, however, be taken into account as well. Cannell [17] has even suggested a connection between autism and vitamin D deficiency in pregnant women, attributing the low prevalence of autism in the region to adequate exposure to the sun. It must also be noted that no uniform diagnostic methodology was employed throughout the studies listed in Table 1, making it difficult to compare their results.

Table 1. Prevalence data for ASD in some Gulf States

Study	Country	No. of cases/10,000	Subjects ages	Diagnosis
Al-Farsi (2011)	Oman	1.4	Up to 14 years	ASD
Naqvi (2012)	Saudi Arabia	60	Up to 16 years	ASD
Eapen (2007)	UAE	12	3 years	PDD
Alshaban (2011)	Qatar	16	Up to 18 years	ASD

3 Importance of Intervention for the State of Qatar

The state of Qatar is currently witnessing a sharp rise in the demand for ASD support from local and expatriate communities. Table 2 below shows all the centres in Qatar that cater to individuals with ASD from 1992 to the present. From only 4 centres in the 1992 to 2003 period, there has been a 250 % increase in the number of centres in the succeeding years up to the present. Furthermore, a 2012 study from Qatar University, Shafallah Special Needs Center, and Hamad Medical Corporation [18] showed that children with autism largely stay indoors, spending about 17 h a day in their own homes, with most of their time spent sleeping or watching television.

It is important to note that a large portion of this demand comes from the expatriate community. Qatar's population is composed of a number of different nationalities. This implies the same variety in the languages and cultures of people, and hence, also in their needs. This is especially relevant to therapy and intervention practices for ASD, which are largely child-specific in nature and can have their efficacy affected by minute details. Therefore, in such cases, including culturally relevant features in therapy practices can potentially improve results.

Table 2. Centers in Qatar for special needs children (including Children with ASD)

No	Year Established	Name of the Center	Languages
1	1992	Qatar Society for the Rehabilitation of Special Needs	Arabic, English
2	1996	Awsaj Institute of Education	Arabic English
3	2001	Shafallah Center for Children with Special Needs	Arabic, English
4	2003	Sunbeam Center of Excellence	Arabic, English
5	2005	HOPE Qatar	Arabic, English
6	2007	Special Needs Center, Qatar University	Arabic, English
7	2009	Al Tamakon Comprehensive School	Arabic, English
8	2009	The Next Generation School	Arabic, English, Urdu
9	2010	Qatar Autism Center	Arabic, English
10	2011	Step by Step Center	Arabic, English
11	2013	Child Development Center	Arabic, English
12	2013	Hand in Hand Center	Arabic, English
13	2014	Omega Center for Special Needs Education	Arabic, English
14	2014	Alkhuzama Special School for Special Needs	Arabic, English

4 Importance of Social Robots

Socially assistive robotics is aimed at addressing the gaps in care given to humans by providing assistance in the form of social interaction. The large user base that can benefit from the automated companionship, supervision, mentorship and motivation includes stroke survivors, the elderly, patients with dementia and children with ASD. Socially Assistive Robots (SAR) have, hence, been at the front end of ASD therapy in developed countries for some years now [19].

The reasons for the integration of SARs in ASD therapy are manifold. Children with ASD have been observed to show a deep interest in technology in general and robots in particular. The nature of their disorder inhibits their social, emotional and interactive abilities, making human-human interaction a challenge for them. True to their nature, humans communicate not just with words, but also with facial expressions, body language, tone of voice and eye contact. To complicate things further, the words are not always intended literally, such as when humor or sarcasm is involved. Such subtleties often elude a child on the spectrum, discouraging him from indulging in such interactions. For such a child, interacting instead with a robot that exhibits only a small subset of the human emotions, and does so with minimal use of complex communicative mechanisms typical of humans is much easier to do.

In addition to this, the toy-like size and appearance of most SARs prevent them from intimidating a child, and their abilities to repeat mundane tasks and to indulge in interactive gameplay enable the children to view them as friendly playmates that pass no judgment on their unconventional behavior. Their use does not have to be limited to a session in a clinic, but can be extended to homes and classrooms to strengthen the bond with the child.

Many previous studies [20–24] have reported improvements in social performances of children on the spectrum after continued interaction with such robots. These interactions are designed especially to be simple, interactive and enjoyable, involving gameplay and learning both. Robots take up the roles of playmates, social actors, teaching agents and social mediators.

This robotic therapy has been used as a supplement to the conventional therapy model involving only a therapist and the child subject. This model, though more effective than the conventional one, may however be prevented from attaining its true potential in multicultural environments, where the child and the therapist may belong to different cultures. In such scenarios, it becomes important to take the cultural context into account in order to maximize the impact of therapeutic practices. Some of the popularly used social robots are shown in Fig. 1.

5 Importance of Cultural Context in ASD Intervention

There is no shortage of studies based on autism: prevalence and epidemiology studies, renowned works on the nature of the disorder, and ample research on the most advanced therapy methods. There is plenty of available published material, case studies and surveys, discussing the role of social robots in autism therapy as well. However, the one factor lacking in a majority such works is the lack of social context taken in account during the course of the study.

Most of the available studies presenting statistics on the prevalence of autism have been conducted within the developed part of the world [11–13]. Only a handful of such studies have been conducted in developing countries, with most being small-scale, and not country-wide. It is important to note that the diagnostic and screening tools used in developing countries have been arbitrarily adopted

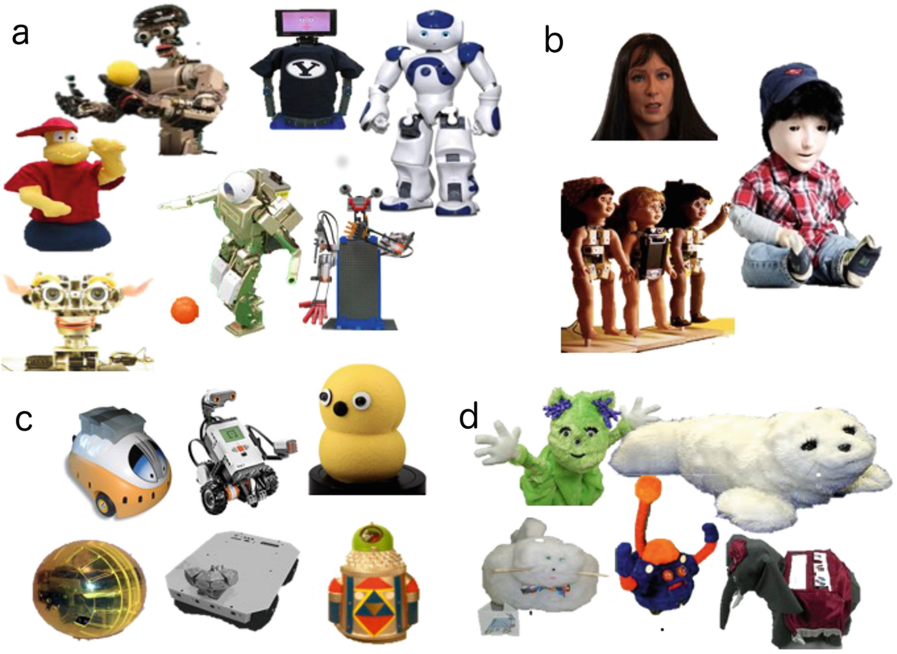

Fig. 1. Socially interactive robots that have been used for the therapy of children with autism in the literatures. The 4 types of form-factors used are: (a) humanoids, (b) human-like robots, (c) mobile or toy-like, and (d) animaloids.

from the studies conducted in the developed countries, negating the cultural differences between the two. Hence, research that addresses the cultural context is necessary in the development of screening and therapy tools that are sensitive to the local culture, helping also to devise new, culturally relevant frameworks and methodologies for autism therapy.

In addition, only a few cross-cultural studies can be found on the response of culturally different individuals towards robots in general [25–28]. To the best of our knowledge, none, however, is focused in particular on social robots for autism therapy. It is obvious that cultural context must be considered in order to maximize the impact and integrity of the research efforts.

We have been unable to find any published research on equipping SARs with the ability to become cultural mediators. Using culturally adaptive robots for ASD therapy is truly a unique idea with potential to play a transformative role for children with ASD. This would immensely facilitate therapists in their struggle to mediate cultural differences when interacting with children of cultures that are different from their own. This allows them instead to focus entirely on therapy goals by sharing the requirement for multicultural and multilingual competence with a robot. This enables a single robotic entity to play a critical role in the therapy for children belonging to diverse cultural backgrounds, and

to be effective for children with varying needs. Culturally relevant interactions also present us with the opportunity to further our understanding of ASD, and evaluate just how deep-rooted the impact of culture can be on the behavior of a child with autism.

6 Design Features for Culturally Adaptive Robots for ASD Intervention

There are a number of ways in which culturally adaptive features can be added to social robots to maximize their effectiveness in ASD intervention. It must be noted that a robot, as it is, is a neutral entity. It is neutral in appearance, is independent of culture or nationality, and appeals to all children for its friendly, toy-like appearance. Therefore, at first glance, children are not intimidated by robots and are instead compelled to initiate interactions with them. This already gives them an advantage over a human therapist whose unfamiliar appearance, in some cases, may confuse or overwhelm the child.

In the Middle East region, there are many communities that are comprised of many different nationalities, meaning that it is not uncommon for the therapist and the patient to belong to different cultures. This implies a difference in language, accents, behaviors, style of communication, gestures and many other details that can play a significant role in helping a child feel comfortable and understand instructions during the various activities taking place in a therapy session.

Perhaps the most important capability that can enhance cultural relevance of a robotic agent is the addition of multilingual features that could enable the robot to communicate in a number of languages. This would allow one therapist to conduct therapy with children from backgrounds dissimilar to his and who speak a language other than with which he is familiar. The larger the number of languages spoken by the robot, the larger the supported audience. This facilitates the therapist in conveying instructions to the children since a major part of his or her work is now being done by the robot.

It has been found that people belonging to some cultures have a preference for non-anthropomorphic appearance of a robot, while others prefer anthropomorphic features [25,29]. Robots, as shown in Fig. 1, come in a variety of forms, including human-like, humanoid and toy-like. Therefore, the integration of robots in ASD therapy can cater to such preferences as well, and in doing so, make therapy more subject-specific, as needed.

Gestures form an integral part of expression in every culture. Body language and gestures are frequently used to convey information, alongside vocal communication. Robots are already being used to teach how to communicate using gestures [30–33]. The spectrum of gestures varies widely across cultures. Some gestures do not exist in some cultures, while it can hold drastically different meanings in others. It is thus important to take these into account when interacting with children from foreign cultures, in order to ensure that the correct message has been conveyed. This can also help in enhancing a child's comfort

level by offering a sense of familiarity. For example, a robot that bows to a Japanese child in the beginning of an interaction would be more welcoming than a robot that greets in another way.

In addition, the activities can be infused with cultural relevance as well. Many therapeutic interactions with children with ASD involve short, engaging games such as chase and follow, imitation and turn-taking [34–36]. The same activities can be modified slightly with cultural context to achieve better results. This can be done by designing games that are local to the child's culture and are already familiar to him or her.

Another popular use of robots in ASD therapy is social storytelling [37,38]. This involves a social robot that narrates stories that are intended to teach children appropriate behaviors in socially significant situations. This also offers potential for cultural adaptation, whereby the generic stories can be replaced with more local stories with familiar characters. This could encourage the children to maintain interest in the storyline and also to make more sense of the message being conveyed.

All of these measures help to provide a friendlier environment for the children by offering more familiarity and less intimidation. In such situations, it is natural to expect children to better understand what is being taught to them, in order to observe long-term improvements in their behaviors. The culturally relevant features in a robot help to strengthen the robot's bond with the children by making it appear to be one of their own, and not an outsider.

7 Conclusion

This paper emphasizes the importance of cultural context in ASD therapy. Most of the available tools thus far have been developed in the west and adapted or translated for use in other parts of the world as well. However, the many cultural differences between the Gulf and the West can prevent these tools from being as effective as they potentially can be. There is a need to develop tools sensitive to the local culture, so that all needs can be met and usefulness maximized.

Cultural adaptiveness also facilitates the use of socially assistive robots for ASD therapy in culturally diverse environments, where the therapist and subject may belong to very different cultural backgrounds. A robot that is sensitive to the local culture of a child is able to present a more familiar and friendly environment, and encourage the child to participate in activities. This can enhance the potential of such methods to bring about long-term behavioral improvements in the children.

Multicultural communities in the Middle East region with rising demands for ASD support can especially benefit from culturally adaptive methods. It is vital that this factor be taken into account when designing therapy methods and developing relevant tools, so that, true to the nature of the disorder, its therapy can truly be made as case-specific as possible.

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