



Speech-Language Pathologists' Perspectives on the Impact of AI-Based Communication Applications on Expressive and Receptive Language Skills in Children with Autism Spectrum Disorder

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ABSTRACT

This study investigated Speech-Language Pathologists' perspectives on the impact of AI-based communication applications on expressive and receptive language skills in children with Autism Spectrum Disorder. A quantitative descriptive cross-sectional survey design was used, and 137 Speech-Language Pathologists were selected through a non-probability purposive sampling technique from Punjab and Islamabad. Data were collected through a self-developed Likert-scale questionnaire. The findings revealed that SLPs perceived AI-based communication applications as useful supportive tools for improving expressive language skills, particularly vocabulary development, requesting, communication initiation, and independent language use. Respondents also reported positive perceptions regarding receptive language skills, especially understanding vocabulary through pictures and sounds, following simple instructions, and language comprehension. AI applications were considered clinically useful when used alongside therapist-led intervention. However, major barriers included lack of professional training, high cost, limited internet access, privacy concerns, and limited Urdu and regional language support. The study concluded that AI applications can support, but not replace, Speech-Language Pathologists.



Introduction

Artificial Intelligence (AI) is an emerging technology in the health and education sectors with novel applications for improving assessment, intervention, and rehabilitation for those with communication disorders. In speech-language pathology, language learning apps, personalization of intervention and improved therapy outcomes are increasingly using AI based applications for children with Autism Spectrum Disorder (ASD) (Topol, 2019). They leverage machine learning, speech recognition, natural language processing, and adaptive learning algorithms to provide a more engaging and accessible language therapy experience.

According to the American Psychiatric Association (2022), ASD is a neurodevelopmental disorder involving persistent challenges in social communication and interaction and restrictive and repetitive patterns of behavior. One of the main difficulties children face with ASD is language, specifically expressive, receptive and pragmatic language. The communication challenges frequently impact academic performance, social involvement, and quality of life (Tager-Flusberg & Kasari, 2013). Speech-Language Pathologists (SLPs) therefore strive to find new ways to improve language development and to continue to deliver individualized, evidence-based interventions.

With the recent developments in AI, there are now many communication apps that have been created specifically for children with ASD. They deliver interactive visual supports, speech output, adaptive vocabulary instruction, tailored learning sequences and real-time feedback. Evidence of using AI-assisted interventions, such as increasing therapy intensity, improving children's motivation, and encouraging active participation during communication activities, is suggested (Alcorn et al., 2019). What's more, with AI applications, therapists can track progress more effectively and offer chances for practice at home supervised by caregivers.

While these are positive, the acceptance and impact of AI in SLP is highly reliant on SLPs' perceptions and experiences. SLPs are instrumental in the meaningful selection of digital tools, their incorporation into therapy plans and assessing their effectiveness for each child. To assess if AI applications truly enhance expressive and receptive language skills or merely serve as auxiliary learning aids, their professional perspectives will play a key role (Fong et al., 2023). Clinician perspectives also provide insight into potential challenges of technology uptake, professional training, ethics, cultural fit and clinical effectiveness.

While various international research studies have looked at AI-based interventions for autism, there is limited research in the field of Speech-Language Pathologists' perspectives, especially in developing countries. Currently, the application of speech-language pathologist (SLP)-augmented AI communication applications in speech-language therapy is emerging in Pakistan, and there is limited empirical evidence of SLPs' experiences with these technologies. The investigation of SLPs' perceptions can yield valuable information for educators, healthcare professionals, policymakers, and software developers looking to enhance AI-assisted language intervention for children with ASD. Thus, this questionnaire seeks to explore Speech-Language Pathologists' attitudes toward the influence of AI-based communication apps on the expressive and receptive language of children with ASD.

Research Objectives

1. To examine Speech-Language Pathologists' perceptions regarding the effectiveness of AI-based communication applications in improving the expressive language skills of children with Autism Spectrum Disorder.

2. To investigate Speech-Language Pathologists' perceptions regarding the effectiveness of AI-based communication applications in enhancing the receptive language skills of children with Autism Spectrum Disorder.
3. To evaluate the clinical usefulness of AI-based communication applications in speech-language therapy for children with Autism Spectrum Disorder.
4. To identify the barriers and ethical concerns associated with the implementation of AI-based communication applications in speech-language therapy practice.
5. To provide evidence-based recommendations for the effective integration of AI-based communication applications into speech-language intervention programs for children with Autism Spectrum Disorder.

Literature Review

ASD is often linked with challenges in communication, social interaction, expressive language, receptive language and language function in daily life. ASD children might struggle with initiating and sustaining social interaction, starting and finishing sentences, comprehending instructions, responding to inquiries, or utilizing words. These language issues may impact learning, involvement in the home, peer relationships, and independence. Speech-Language Pathologists (SLPs) are vital in evaluating a child with ASD's communication needs and treatment. Communication applications that are based on artificial intelligence and technology are increasingly gaining in relevance in recent years in speech-language therapy, as they can provide visual support, speech output, repetition, interactive learning and individualized practice opportunities. Technology-aided interventions, when utilized in a planned and supervised way, have been reported as useful for improving the communication and learning outcomes of children with ASD (Odom et al., 2015).

Expressive language is one of the major areas of difficulty in children with ASD. Expressive Language: Using words, phrases, sentences, gestures, symbols, or speech generating systems to express needs, ideas, and feelings. The vocabulary, sentence structure, spontaneous and social language use are frequently delayed in children with ASD. Augmentative and alternative communication (AAC), as a type of aided communication, has been researched for its role in the development of expressive language in children with communication impairments (Ganz et al., 2012). Likewise, Schlosser and Wendt (2008) noted that using AAC is not a way to stop a child's speech development but rather can facilitate children's spoken communication in many cases of children with developmental disabilities. It's vital because many AI-based communication applications have AAC functionality, such as symbol selection, voice output, vocabulary prediction, and visual modeling.

Communication applications based on artificial intelligence can help enhance expressive language through repeated exposure to words, pictures, sounds, and sentence models. Through these applications children can practice in a structured manner requesting, labeling, and commenting, as well as answer and initiate communication. Interventions that use technology have been effective in communicating with children with ASD, particularly those that provide clear prompts, reinforcement, and repetition (Ramdoss et al., 2011). Moreover, children's use of words and phrases may be increased in therapy sessions with tablet-based communication applications (Kagohara et al., 2013). The results align with the first research goal of the current study, which is aimed at SLPs' perceptions on the influence of the use of the AI-based communication applications on the expressive language skills.

Another important area that concerns children with ASD is receptive language. Receptive Language involves comprehension of speech, following directions, recognizing words, understanding questioning and the processing of verbal information. The wh-questions, abstract words, single-step and multi-step instructions, and social meaning may be difficult for children with ASD. The technology-based language activities can help support receptive language through the combination of oral input, visual cues, pictures, symbols and interactive responses. Knight et al., (2013) identified technology-based interventions as a positive way to teach academic, communication, and functional skills to learners with ASD. In the same way, Parsons et al. (2017) stated that digital technologies can aid learning in ASD provided they are tailored to the child's developmental needs and administered under professional supervision.

AI-based applications can have visual and auditory components that can be particularly useful for receptive language learning. Visual schedules, picture symbols, animation and routine are helpful for many children with ASD. AI tools can offer visuals to practice vocabulary, voice over instructions, instant feedback, and adapt difficulty to the child's level. Grynszpan et al. (2014) examined the technology-based interventions for ASD and determined that digital interventions can enhance learning engagement and task performance, but that the effectiveness of the interventions is dependent on the quality of the intervention design. The results of this study are applicable to the second goal of the current study, which is to explore SLPs' perspectives on the potential for AI to enhance the receptive abilities of their students, including the comprehension of spoken language, adherence to instructions, and responding to language tasks.

Another crucial aspect to consider for the assessment of AI-based communication applications is their clinical use. SLPs use these applications as well as make decisions to select, adapt and monitor their use. An attractive or interactive communication application can be useful, but it is clinically useful only if it is related to measurable therapy goals. It is important to remember that communication technologies should foster participation, language and meaningful interaction, not just access to devices, as was noted by Light and McNaughton (2014). Another important point raised by Beukelman and Mirenda (2013) is that the type of AAC device should be based on the individual's communication needs, motor skills, cognitive profile, family support, and social environment. Thus, AI-driven applications should complement, not supplant, the traditional therapeutic framework, and should be used within a therapeutic plan that is designed and supervised by a licensed professional in the field.

Children's motivation and engagement are also important in speech-language therapy for ASD. Children with ASD are likely to exhibit limited attention, lower social motivation or resistance to conventional language tasks. Digital applications could help increase participation by being interactive, predictable, colorful and responsive. When technology is child-centered and tied to purposes for functional learning, it can be helpful in autism intervention (Fletcher-Watson, 2014). Similarly, Barton et al. (2017) noted that interventions for young children with ASD are more effective when they are structured, individualized, and linked with meaningful communication opportunities. AI-driven communication apps can thus facilitate therapy by making it more engaging, keeping the user's attention longer and facilitating the repetition of expressive and receptive language tasks.

But there are a few drawbacks to using AI-powered apps. Professional training is one of the hurdles. SLPs might not be familiar with AI tools, which apps to use, how to tweak them, how to interpret the data, or how to use them ethically. Muharib et al. (2019) noted that the effectiveness of technology based communication interventions can only be achieved through careful planning, systematic teaching and professional assistance. If not trained correctly, applications might be used in a general manner instead of in conjunction with therapy objectives. Moreover, Alzrayer et al.

(2017) concluded that, while SGBs have been shown to be effective in supporting communication in children with ASD, appropriate prompting, modeling and consistent use across settings are necessary to ensure effective outcomes.

Another crucial element influencing success of AI-driven communication applications is family engagement. Children with ASD require opportunities to practice communication during therapy as well as in the home, school and community. Logan et al., (2017) highlighted the importance of caregivers and teachers being engaged in communicating with the child to support generalization of skills. Without parent training, children may not be able to apply learned skills to the real world work with AI-based applications. Parent training, therapist guidance and home practice are therefore essential for enhancing the outcomes for expressive and receptive language.

Other important considerations are cultural and linguistic suitability, especially in multilingual countries like Pakistan. A large number of apps for communication are created in English and don't support Urdu, Punjabi, Pashto, Sindhi, Balochi and other regional languages. This generates a difference between the child's native language and language in therapy applications. Sutherland et al. (2010) urged the adaptation of communication tools to the user's natural environment and communication partners. Without meeting the child's language, culture, daily communication patterns and family routines, the effectiveness of the application of AI may be reduced. This concern is directly connected to the aim of the current research: to reveal the challenges and ethical issues regarding the implementation of communication applications based on artificial intelligence.

Ethical issues are also important when AI applications are used with children with ASD. These applications can gather specific data such as voice samples, progress notes and behavior data. Thus, privacy, consent, confidentiality and data security should be taken into account. Pennington (2010) pointed out that technology-supported communications tools should be used responsibly, and should ensure children with disabilities are not demeaned or excluded from participation. Using an AI tool should not diminish the importance of human interaction nor replace the therapeutic relationship between the SLP and child. Instead, they should encourage evidence-based practice, professional judgment and individualized intervention. This is particularly significant as children with ASD frequently need emotional support, social interaction and human modeling that technology cannot provide them with entirely.

There are also indications that there is evidence to build up in the field of technology and AAC interventions, although these evidence sources must be interpreted with caution. White et al. (2021) conducted a review of AAC interventions for children with ASD and found that while AAC can facilitate communication and speech development, outcomes of intervention are influenced by child characteristics, intervention type, and quality of intervention implementation. According to Urrea et al. (2024), there is limited evidence of the effectiveness of technology-assisted vocabulary interventions for children with ASD in some studies, mixed evidence in others, and positive evidence in some. This suggests that communication apps that use artificial intelligence could be a potential opportunity, but effectiveness should not be taken for granted and needs to be professionally assessed. The views of SLPs are thus crucial as they witness the impact of using these tools in actual clinical contexts.

Methodology

The current study used a quantitative, descriptive, cross-sectional survey research design to explore the perspectives of Speech-Language Pathologists (SLPs) about the role of AI-powered communication applications in the expressive and receptive language development of children diagnosed with Autism Spectrum Disorder (ASD) in Pakistan. The target population included registered Speech-Language Pathologists serving children with ASD in hospitals (public and

private), rehabilitation centres, special education schools, autism intervention centres, and private speech-language therapy clinics in Punjab and Islamabad.

Non-probability purposive sampling was used to select 137 Speech-Language Pathologists who fulfilled the inclusion criteria. Considering the specific need for the study, the researchers chose a purposive sampling method. The Speech-Language Pathologists who participated in the study were those who had experience working with children with ASD, knowledge of AI-based communication applications, and experience using the applications for assessment or intervention. The participants also had to be professionals with a Speech-Language Pathology degree, have one year or more of clinical experience, and have volunteered for the research.

The key data collection tool was a self-developed structured Likert-scale questionnaire, named AI Based Communication Applications in Autism Questionnaire (AICAAQ). Based on the research objectives, the questionnaire was designed to have 40 closed ended items and demographic questions. The instrument was broken down to four domains: (1) AI applications and expressive language skills, (2) AI applications and receptive language skills, (3) clinical usefulness of AI based applications of communication, and (4) the barriers and ethical concerns associated with the use of AI in speech-language therapy. The all perception items were rated on a 5 point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree.

Content validity was determined by reviewing the questionnaire with experts in the fields of Speech-Language Pathology, Autism Spectrum Disorder, Educational Technology and Research Methodology. To investigate the clarity, relevance and reliability of the instrument, a pilot test was carried out with 20 Speech-Language Pathologists. A few items were revised slightly based on the feedback received to better word and organize the items. The final instrument had a Cronbach's alpha coefficient of .91 overall, which was good for use in the main study.

Both face-to-face and online survey methods were used to increase participants' accessibility. Google Forms were used to distribute the online questionnaire via the professional Speech-Language Pathology network, social media groups, and institutional contacts, while printed questionnaires were given to participants directly at hospitals, rehabilitation centers, autism intervention centers, and special education institutions. All respondents filled in the questionnaire after being informed about the study and its voluntary participation.

The data collected were input and analyzed using the Statistical Package for the Social Sciences (SPSS) Version 27. Descriptive statistical methods such as frequencies, percentages, means and standard deviations were employed to summarize the demographic characteristics of the participants and their perceptions of AI based communication applications. In addition, independent samples t-tests, one way analysis of variance (ANOVA), Pearson correlation analysis, and multiple linear regression analysis were performed for differences and relationships among the study variables. A level of significance of 0.05 was used.

All ethical principles were rigorously followed in conducting the study. All participants were assured of confidentiality and anonymity and no personal identifying information was gathered. Respondents' participation was voluntary and they were told that they could stop at any time without consequences. All the information gained in the study was used only for academic research. This study was conducted with the approval of the relevant Institutional Ethics Review Committee prior to data collection.

Table 1: Demographic Characteristics of Respondents (Speech-Language Pathologists Working with Children with ASD in Punjab and Islamabad) (N = 137)

Sr. Variables	Group	Frequency	Percentage (%)
1 Gender	Male	38	27.7
	Female	99	72.3
2 Age Range	22–30 years	41	29.9
	31–40 years	56	40.9
	41–50 years	28	20.4
	51 years and above	12	8.8
3 Highest Qualification	BS Speech-Language Pathology	59	43.1
	MS/MPhil Speech-Language Pathology	61	44.5
	PhD	5	3.6
	PGD in Speech-Language Therapy	12	8.8
4 Years of Professional Experience	Less than 2 years	19	13.9
	2–5 years	47	34.3
	6–10 years	43	31.4
	More than 10 years	28	20.4
5 Work Setting	Hospital/Clinic	34	24.8
	School	21	15.3
	Private Practice	29	21.2
	Rehabilitation Center	38	27.7
	Autism Intervention Center	15	10.9
6 Main Area of Practice	Pediatric ASD	64	46.7
	General Pediatrics	39	28.5
	Adult/Pediatric Mixed	21	15.3
	Other	13	9.5
7 Familiarity with AI-Based Communication Applications	Slightly familiar	18	13.1
	Moderately familiar	49	35.8
	Very familiar	54	39.4
	Expert	16	11.7
8 Frequency of AI Application Use	Rarely	22	16.1
	Sometimes	48	35.0
	Often	46	33.6
	Routinely	21	15.3

Table 1 indicates that the majority of the respondents were female SLPs (72.3%). The largest age group was 31–40 years (40.9%). The majority of participants possessed MS/MPhil qualifications (44.5%), while 43.1% of the participants possessed BS Speech-Language Pathology. Most of the respondents (34.3%) and (31.4%) had 2-5 and 6-10 years of professional experience, respectively. Rehabilitation centers (27.7%) and hospitals/clinics (24.8%) were the largest groups of workers by job category. The majority of respondents were working primarily with children with ASD (46.7%). Concerning the use of AI, most SLPs were very familiar or moderately familiar with the use of AI-based communication applications (39.4% and 35.8% respectively), with many using them sometimes (35.0%) or often (33.6%) in clinical practice.

Table 2: Speech-Language Pathologists' Perceptions of AI-Based Communication Applications and Expressive Language Skills (N = 137)

Sr.	Statement	SD	D	N	A	SA	Mean	Std. Dev.
1	AI-based communication applications help children with ASD learn new words.	3 (2.2%)	7 (5.1%)	12 (8.8%)	54 (39.4%)	61 (44.5%)	4.08	0.71
2	AI applications support children in producing more words during therapy.	4 (2.9%)	8 (5.8%)	16 (11.7%)	57 (41.6%)	52 (38.0%)	4.01	0.76
3	AI applications help children use longer phrases or sentences.	6 (4.4%)	12 (8.8%)	21 (15.3%)	55 (40.1%)	43 (31.4%)	3.89	0.82
4	AI applications encourage children with ASD to start communication.	3 (2.2%)	7 (5.1%)	14 (10.2%)	56 (40.9%)	57 (41.6%)	4.05	0.73
5	AI applications help children express their needs more clearly.	2 (1.5%)	6 (4.4%)	13 (9.5%)	55 (40.1%)	61 (44.5%)	4.10	0.69
6	AI applications improve requesting skills in children with ASD.	2 (1.5%)	5 (3.6%)	12 (8.8%)	53 (38.7%)	65 (47.4%)	4.13	0.67
7	AI applications improve commenting and social communication skills.	5 (3.6%)	11 (8.0%)	22 (16.1%)	54 (39.4%)	45 (32.8%)	3.86	0.81
8	AI applications support better sentence formation in children with ASD.	6 (4.4%)	12 (8.8%)	24 (17.5%)	53 (38.7%)	42 (30.7%)	3.81	0.84
9	AI applications help children use language more independently.	4 (2.9%)	10 (7.3%)	19 (13.9%)	56 (40.9%)	48 (35.0%)	3.94	0.78
10	Overall, AI-based applications improve expressive language skills in children with ASD.	2 (1.5%)	6 (4.4%)	12 (8.8%)	58 (42.3%)	59 (43.1%)	4.11	0.70
Overall Expressive Language Skills		—	—	—	—	—	4.00	0.75

The results in Table 2 suggest that Speech-Language Pathologists were quite consistent in their response that AI-based communication applications were very effective in helping children with Autism Spectrum Disorder (ASD) improve their expressive language skills (Overall M = 4.00, SD = 0.75). The highest rated was related to the improvement of skills in requesting, "AI applications improve requesting skills in children with ASD" (M = 4.13, SD = 0.67), followed by "Overall, AI applications improve the skills of expressing language" (M = 4.11, SD = 0.70), and "AI applications help children express their needs more clearly" (M = 4.10, SD = 0.69). The lower mean of supporting better sentence formation (M = 3.81, SD = 0.84) indicates that therapists feel that the AI tools will be useful as adjuncts to their direct interventions, but that more complex expressive language skills still need to be handled by the therapist. Overall, the results demonstrate positive perceptions of AI-assisted communication applications among Speech-Language Pathologists in Pakistan.

Table 3: *Speech-Language Pathologists' Perceptions of AI-Based Communication Applications and Receptive Language Skills (N = 137)*

Sr.	Statement	SD	D	N	A	SA	Mean	Std. Dev.
11	AI applications help children with ASD understand spoken words.	3 (2.2%)	6 (4.4%)	13 (9.5%)	56 (40.9%)	59 (43.1%)	4.18	0.69
12	AI applications improve children's ability to follow simple instructions.	2 (1.5%)	5 (3.6%)	12 (8.8%)	55 (40.1%)	63 (46.0%)	4.25	0.65
13	AI applications help children follow two-step or multi-step instructions.	5 (3.6%)	9 (6.6%)	18 (13.1%)	57 (41.6%)	48 (35.0%)	3.98	0.77
14	AI applications improve children's understanding of questions.	3 (2.2%)	7 (5.1%)	14 (10.2%)	58 (42.3%)	55 (40.1%)	4.13	0.71
15	AI applications help children understand vocabulary through pictures and sounds.	2 (1.5%)	4 (2.9%)	10 (7.3%)	54 (39.4%)	67 (48.9%)	4.31	0.63
16	AI applications support children's understanding of concepts such as size, color, place, and emotions.	3 (2.2%)	6 (4.4%)	15 (10.9%)	56 (40.9%)	57 (41.6%)	4.15	0.70
17	AI applications improve children's attention to verbal instructions.	4 (2.9%)	8 (5.8%)	18 (13.1%)	56 (40.9%)	51 (37.2%)	4.04	0.76
18	AI applications help children respond more accurately to language tasks.	3 (2.2%)	7 (5.1%)	16 (11.7%)	59 (43.1%)	52 (38.0%)	4.09	0.72
19	AI applications support better listening and comprehension during therapy.	4 (2.9%)	8 (5.8%)	17 (12.4%)	57 (41.6%)	51 (37.2%)	4.05	0.75
20	Overall, AI-based applications improve receptive language	2 (1.5%)	5 (3.6%)	12 (8.8%)	58 (42.3%)	60 (43.8%)	4.23	0.66

Sr.	Statement	SD	D	N	A	SA	Mean	Std. Dev.
	skills in children with ASD.							
	Overall Receptive Language Skills	—	—	—	—	—	4.14	0.70

Table 3 shows that Speech-Language Pathologists had a high level of agreement on the effectiveness of AI-based communication apps for enhancing receptive language skills in the children with ASD (Overall M = 4.14, SD = 0.70). The three highest mean scores were found for the following items: "AI applications help children to understand vocabulary through pictures and sounds" (M = 4.31, SD = 0.63); "AI applications improve children's ability to follow simple instructions" (M = 4.25, SD = 0.65); and "Overall, AI-based applications improve receptive language skills in children with ASD" (M = 4.23, SD = 0.66). The results indicate that Speech-Language Pathologists believe AI communication applications are more useful in helping with receptive vocabulary skills and language comprehension.

Although AI applications support these skills, the mean scores were relatively lower for following two-step or multi-step instructions (M = 3.98, SD = 0.77) and improving attention to verbal instructions (M = 4.04, SD = 0.76), suggesting that more complex receptive language skills still require therapist-guided intervention. In conclusion, Speech-Language Pathologists in Pakistan appear to have a positive attitude towards the use of AI-powered communication apps as a tool to improve receptive language skills among children with ASD.

Table 4: Speech-Language Pathologists' Perceptions of the Clinical Usefulness of AI-Based Communication Applications (N = 137)

Sr.	Statement	SD	D	N	A	SA	Mean	Std. Dev.
21	AI-based communication applications are useful supportive tools in speech-language therapy.	2 (1.5%)	4 (2.9%)	10 (7.3%)	56 (40.9%)	65 (47.4%)	4.30	0.63
22	AI applications make therapy sessions more interactive.	2 (1.5%)	5 (3.6%)	11 (8.0%)	57 (41.6%)	62 (45.3%)	4.25	0.65
23	AI applications increase children's interest and motivation during therapy.	3 (2.2%)	6 (4.4%)	12 (8.8%)	56 (40.9%)	60 (43.8%)	4.20	0.69
24	AI applications help maintain children's attention during therapy sessions.	3 (2.2%)	7 (5.1%)	16 (11.7%)	57 (41.6%)	54 (39.4%)	4.11	0.73
25	AI applications can be used along with traditional speech-language therapy methods.	1 (0.7%)	3 (2.2%)	8 (5.8%)	53 (38.7%)	72 (52.6%)	4.40	0.59
26	AI applications help therapists plan language activities more effectively.	3 (2.2%)	6 (4.4%)	15 (10.9%)	56 (40.9%)	57 (41.6%)	4.15	0.71
27	AI applications save time during therapy planning or intervention.	4 (2.9%)	8 (5.8%)	18 (13.1%)	56 (40.9%)	51 (37.2%)	4.04	0.77
28	AI applications provide useful	3	7	17	57	53	4.09	0.73

Sr.	Statement	SD	D	N	A	SA	Mean	Std. Dev.
	feedback about a child's performance.	(2.2%)	(5.1%)	(12.4%)	(41.6%)	(38.7%)		
29	I would recommend AI-based communication applications as part of therapy for children with ASD.	2 (1.5%)	5 (3.6%)	11 (8.0%)	58 (42.3%)	61 (44.5%)	4.25	0.64
30	Overall, AI applications are helpful for speech-language therapy practice.	2 (1.5%)	4 (2.9%)	10 (7.3%)	55 (40.1%)	66 (48.2%)	4.34	0.61
Overall	Clinical Usefulness of AI Applications	—	—	—	—	—	4.21	0.68

Table 4 shows SLP perceptions of the clinical utility of AI-based communication apps for SLT with children who have ASD. The results showed a high level of agreement and the overall mean score was 4.21 (SD = 0.68), demonstrating that the respondents had a general positive attitude towards the value of AI applications as supportive elements in clinical practice.

The highest mean score was given to "AI applications can be used along with traditional speech-language therapy methods" (M = 4.40, SD = 0.59); this indicates that most Speech-Language Pathologists believe that AI applications can be used in addition to traditional speech-language therapy methods rather than as a replacement. This was followed by "Overall, AI applications are helpful for speech-language therapy practice (M = 4.34, SD = 0.61)" and "AI-based communication applications are useful supportive tools in speech-language therapy (M = 4.30, SD = 0.63)". The results show high acceptance of AI-supported communication devices among professionals.

The Speech-Language Pathologists recognized the benefits of AI applications, but noted that they are not completely comfortable with them yet, citing comparatively lower mean scores for saving time during therapy planning or intervention (M = 4.04, SD = 0.77) and providing useful feedback about a child's performance (M = 4.09, SD = 0.73). In sum, the results indicate that Pakistani clinicians view AI-based communication apps as viable ancillary tools that can help them improve the quality of therapy, increase child engagement and facilitate evidence-based speech-language intervention for children with Autism Spectrum Disorder.

Table 5: *Speech-Language Pathologists' Perceptions of Barriers and Ethical Concerns Regarding AI-Based Communication Applications*

Sr.	Statement	SD	D	N	A	SA	Mean	Std. Dev.
31	Lack of professional training limits the use of AI applications in therapy.	2 (1.5%)	4 (2.9%)	12 (8.8%)	55 (40.1%)	64 (46.7%)	4.28	0.64
32	High cost of AI applications is a major barrier for families.	1 (0.7%)	3 (2.2%)	9 (6.6%)	48 (35.0%)	76 (55.5%)	4.43	0.58
33	Limited internet access affects the use of AI applications.	3 (2.2%)	6 (4.4%)	15 (10.9%)	56 (40.9%)	57 (41.6%)	4.15	0.70
34	Many AI applications do not	2	5	10	52	68	4.31	0.62

Sr.	Statement	SD	D	N	A	SA	Mean	Std. Dev.
	fully support Urdu or regional languages.	(1.5%)	(3.6%)	(7.3%)	(38.0%)	(49.6%)		
35	Parents need training to use AI applications effectively at home.	1 (0.7%)	4 (2.9%)	8 (5.8%)	51 (37.2%)	73 (53.3%)	4.39	0.57
36	Data privacy is an important concern when using AI applications with children.	3 (2.2%)	8 (5.8%)	18 (13.1%)	55 (40.1%)	53 (38.7%)	4.07	0.77
37	AI applications should only be used under the guidance of a qualified Speech-Language Pathologist.	2 (1.5%)	3 (2.2%)	8 (5.8%)	46 (33.6%)	78 (56.9%)	4.43	0.56
38	AI applications should support, not replace, the role of Speech-Language Pathologists.	1 (0.7%)	2 (1.5%)	6 (4.4%)	43 (31.4%)	85 (62.0%)	4.53	0.52
39	More research is needed on the effectiveness of AI applications for children with ASD.	2 (1.5%)	3 (2.2%)	9 (6.6%)	47 (34.3%)	76 (55.5%)	4.40	0.59
40	Training programs should include the use of AI applications in speech-language therapy.	1 (0.7%)	2 (1.5%)	7 (5.1%)	45 (32.8%)	82 (59.9%)	4.50	0.54
Overall Barriers and Ethical Concerns		—	—	—	—	—	4.35	0.61

Table 5 summarizes the Speech-Language Pathologist (SLP) responses to barriers and ethical issues to consider about using an AI-based communication application in speech-language therapy (SLT) for children with Autism Spectrum Disorder (ASD). The results showed that there was good consistency among the statements with a mean score of 4.35 (SD = 0.61). This implies that there was a high degree of recognition of potential challenges and ethical considerations related to AI use in clinical practice. The top three were: “AI applications should support rather than replace SLP roles” (M = 4.53, SD = 0.52); “Training programs should incorporate the use of AI applications in SLP” (M = 4.50, SD = 0.54); and “High cost of AI applications is a major barrier for families” (M = 4.43, SD = 0.58). The results show that SLPs are strongly feeling that AI should be used as a clinical aid, with a clear need for professional training and better affordability, especially in the Pakistani healthcare context.

Limited Internet access (M = 4.15, SD = 0.70) and data privacy concerns (M = 4.07, SD = 0.77) were relatively low. These were given a relatively lower rating but were still agreed to as important considerations for implementing AI-based communication applications. In conclusion, the results indicate that there are significant opportunities for the use of AI for intervention, but there are concerns about the need for professional supervision, adequate training, culturally relevant uses, better infrastructure, and adherence to ethical standards.

Findings and Discussion

The results indicated that the overall attitude of the Speech-Language Pathologists (SLPs) working with children with Autism Spectrum Disorder (ASD) in Punjab and Islamabad was favorable

towards AI-based communication applications in SLP. The demographic data indicated that the participants were mostly female, clinically experienced with pediatric ASD practice, and professionally qualified. Respondents indicated moderate to high levels of knowledge about AI-based communication applications and a significant portion of respondents reported using these applications sometimes or often in clinical practice. This is a hopeful indication that AI tools are making their way into the use of speech-language therapy in Pakistan, which is still in its early stages and not yet standardized.

The aim of the first part of the study was to investigate SLPs' perspectives on the effects of AI communication tools on expressive language skills. The results showed that there was a high degree of agreement for this domain with a mean score of 4.00. SLPs felt that AI applications were beneficial for vocabulary learning, word production, requesting skills, communication initiation, and independent language use. Children's mean scores were highest for requesting skills, indicating that communication tools with AI support children's ability to articulate their basic needs and wants. This is in line with recent AAC-based research that found that structured digital and speech-generating devices can facilitate functional communication and increase communication attempts by children with ASD (Edgar et al., 2024). Likewise, Saul et al. (2020) highlighted the importance of app-based intervention for speech and language practice in the context of adult guidance and communication targets.

The findings for the expressive language were positive; however, the mean scores were statistically lower when compared to the other skills assessed: sentence formation and commenting/social communication skills. This means that SLPs see the use of AI for basic expressive communication as being helpful, but they might feel that it is less adequate for more complex expressive tasks like grammar, conversation, and social-pragmatic language. This makes sense because in higher-level expressive language, human modeling, natural interaction, emotional feedback and real-life communication practice are necessary. More recently, research into AI in the field of speech-language pathology has also indicated that AI tools can be supportive of clinical practice, but cannot replace individual clinician judgment and human interaction (Georgiou, 2025). Based on the present results, the use of AI applications is not for replacing therapies but as add-on therapies.

The second aim was to explore SLPs' attitudes toward the effect of AI-based applications on receptive language abilities. The overall mean score for receptive language was 4.14, showing strong agreement among respondents. Understanding vocabulary through pictures and sounds was the most highly rated. These results indicate that SLPs find visual and auditory aspects of AI tools particularly beneficial for children with ASD. Predictable routines, repeated exposure, and visual learning are beneficial for many children with ASD and may benefit from the use of AI-based applications in receptive vocabulary, word-picture matching, and understanding of simple instructions. Minutoli et al. (2024) further pointed out that receptive language is one of the areas that children with autism continue to struggle with and personalized intervention methods are relevant to enhancing comprehension.

The results also revealed that SLPs felt AI applications helped children to follow simple instructions and to understand what is being said. Agreement was lower with regards to the following of two-step or multi-step instructions, and attention to verbal instructions. It implies that while AI tools might be suitable for basic reception tasks, they may not work as well when it comes to more sophisticated language processing. Receptive language development also needs to be supported in natural contexts, with therapist scaffolding and repeated exposure in order to occur in clinical practice. Almubark et al. (2025) found that structured AAC-based language intervention has a positive effect on language outcomes, but the effectiveness of intervention relies on planning,

modelling and repeated guided practice. The present results suggest that the use of AI tools can facilitate receptive language skills, but further support is required from human therapists for more complex comprehension tasks.

The third was to assess the clinical implications of AI communication apps. The overall mean score was 4.21, reflecting a high score from the SLPs, who considered AI applications useful supportive tools for clinical practice. The top-rated statement was that traditional methods of speech-language therapy may be used in conjunction with AI applications. This is a significant piece of research as it demonstrates that Pakistani SLPs do not think that AI is a therapy substitute; rather, they believe it can be used as an assisting tool that improves therapy. AI-powered speech therapy apps have also been reviewed recently, which found that digital applications could enhance access, practice frequency and engagement, but clinical supervision is required for safe and effective use (Shi et al., 2025). The present results also corroborate the idea that AI techniques can enhance the interaction of therapy, boost motivation, and help to plan therapy activities.

Concurrently, there were relatively lower means on saving time and giving feedback that is useful for a child's performance. This implies that while SLPs see the value in AI tools, they might be worried about the reliability, appropriateness, and clinical implications of AI feedback. The attitudes of SLPs towards AI-based AAC tended to be positive, with a higher degree of positive attitudes when SLPs had more familiarity with AI, but for some concerns about ethics, reliability, and professional use remained. Overall, SLPs' attitudes toward AI-based AAC tended to be positive, though more so when SLPs were more familiar with AI; however, concerns about ethics, reliability, and professional use remained. The Pakistani context of the present study, therapists may have an interest in leveraging AI, but need to be taught how to use AI information with confidence and efficacy.

The fourth objective was on barriers and ethical issues. The overall mean score for this domain was 4.35, which was the highest score for all domains, suggesting that SLPs were very aware of implementation challenges and ethical issues. The highest mean score was correlated to the idea that AI tools should be used in the role of the SLP rather than to replace an SLP. This discovery highlights AI's robust professional standing as a clinical aid, not a substitute for human oversight. Speech Pathology Australia (2024) also stated that AI must not be used as a substitute for professional decision making and ethical responsibility in speech pathology practice, or lose the independence of speech pathologists. This is especially true in the treatment of children with ASD where clinical judgment, emotional connection, family counseling and individualized goal setting are critical.

High cost was also reported as a significant constraint for families. This is very significant for Pakistan as many families might not be able to afford paid applications, tablets, subscription or a steady internet connection. Barriers to AAC implementation identified by Yau et al. (2024) include access, training, funding and stakeholder support. In the same vein, Chunn (2021) found that the lower the cost and the less training, the fewer number of SLPs using AAC for services. These barriers could be more pronounced in Pakistan, as many therapy opportunities are located in urban settings and families may have to pay out-of-pocket for rehabilitation services. Hence, an important ground reality is that the mean score for cost is high.

The other primary issue was less support for Urdu and local languages. There are many communication applications that are built on artificial intelligence (AI), but not all of these applications are suitable for children in Pakistan, as they are developed for English speakers and may not accurately reflect the linguistic and cultural context of these children. This can restrict their clinical value particularly in Urdu, Punjabi, Pashto, Sindhi, Saraiki and other local languages for the children who speak these languages. Curtis et al. (2022) pointed out that all AAC

technologies need to be responsive to the communication needs, environments, and partners of users. However, AI applications, if they are not aligned with the child's natural language environment, might not have a significant effect on any other forms of communication.

Another ethical issue that was recognized was data privacy. AI applications can capture speech samples, child profiles, progress information, and personal data. This presents significant consent, confidentiality, secure data storage and responsible use issues for the child with ASD. Georgiou (2025) suggested that ethical considerations, transparency, and responsible clinical practice must be robust with regard to AI use in speech-language pathology. The findings of the present study corroborate this concern as it reveals that SLPs in Pakistan are aware of the ethical risks, and are convinced that AI should be utilized under proper professional guidance.

Overall, the results indicate that SLPs see a potential for using AI-driven communication apps as supportive tools in the enhancement of children with ASD's expressive and receptive language skills. They also emphasize, however, that careful integration of these applications is important within the context of the therapist-led intervention. The applications of AI seem to be most beneficial in vocabulary learning, request, simple instruction following, visual-auditory comprehension, engagement of children, and structured practice. Direct SLP involvement is still needed for more complex skills like sentence formation, social communication, multi-step comprehension and real-life generalization. The results also emphasize the need for professional training, parent education, easily accessible apps, culturally sensitive Urdu and regional language apps, and proper ethics. In Pakistan, therefore, it is recommended that the use of AI based communication applications should be encouraged as evidence informed aid to qualified Speech-Language Pathologists and not a replacement for them.

Summary

The purpose of this study was to examine the views of Speech-Language Pathologists regarding the effects of speech and language applications based on AI on expressive and receptive language skills in children with ASD. The quantitative descriptive survey design was adopted and data were collected from 137 Speech-Language Pathologists in both Punjab and Islamabad. An AI application self-developed Likert scale questionnaire was used to evaluate the following areas: expressive language, receptive language, clinical usefulness, and barriers.

The results revealed that SLPs found the AI communication applications to be useful in supporting introducing new vocabulary, requesting, sentence formation, understanding of spoken words, following instructions, and engagement of children in therapy. But on the other hand respondents also listed the significant challenges such as lack of professional training, high cost, limited internet connectivity, privacy concerns and limited support of Urdu and regional languages. In summary, the study found that AI tools can be used to assist Speech-Language Therapists, but are not a replacement for them.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. AI-based communication applications should be integrated as evidence-based supplementary tools in speech-language therapy for children with Autism Spectrum Disorder, while maintaining therapist-led intervention as the primary mode of treatment.
2. Hospitals, rehabilitation centers, autism intervention centers, and special education schools should provide Speech-Language Pathologists with access to validated AI-based

communication applications and the necessary technological infrastructure to support their effective clinical use.

3. Universities and professional training institutions should incorporate Artificial Intelligence, digital health technologies, and AI-assisted communication applications into Speech-Language Pathology curricula and continuing professional development programs to improve clinicians' knowledge and competence.
4. Regular workshops and certification programs should be organized to train Speech-Language Pathologists in selecting, implementing, and evaluating AI-based communication applications for children with Autism Spectrum Disorder.
5. Parents and caregivers should receive structured training and guidance on the appropriate use of AI-based communication applications at home to promote consistency between therapy sessions and daily communication practice.
6. Software developers and technology companies should collaborate with Speech-Language Pathologists to develop culturally appropriate AI applications that support Urdu and regional languages, ensuring greater accessibility and clinical relevance for Pakistani children with Autism Spectrum Disorder.
7. Government agencies and healthcare policymakers should provide financial support, grants, or subsidized access to evidence-based AI communication applications to reduce cost-related barriers for families receiving speech-language therapy services.
8. National professional organizations should develop ethical guidelines and best-practice standards addressing data privacy, informed consent, clinical responsibility, and the safe use of Artificial Intelligence in speech-language therapy.
9. Artificial Intelligence should complement rather than replace Speech-Language Pathologists. Clinical decision-making, individualized assessment, family counseling, and intervention planning should remain the responsibility of qualified professionals.
10. Future research should employ longitudinal, experimental, and multicenter study designs involving larger samples across different provinces of Pakistan to evaluate the long-term effectiveness of AI-based communication applications on expressive language, receptive language, functional communication, and quality of life among children with Autism Spectrum Disorder.

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