NEURAL TRIGGER OF SPEAKING SKILLS IN AUTISTIC CHILDREN: AN INTERVENTION-BASED STUDY

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ABSTRACT

Autism is a pivotal language deficit among speakers all over the globe, and it is a restricting neural process that blocks the simultaneous exponential evolution of language usage; hence, it must be focused with some therapy stimuli. This study is an attempt to channel neural mechanisms underlying autistic children with controlled systemic interventions (CSI). Many previously conducted studies reported that speaking deficit in individuals at all levels reduces neural processing that blocks smooth speaking, and it is due to anatomical and neurophysiological underpinning factors. In this context of autism, anatomical factors are genetic, but neurophysiological can be reversed via controlled systemic intervention (CSI) that is used in this study. For providing neuropsychological reverse, many interventions have been constructed, but this study is only taking Repeat After Me (RAM) as an intervention using computer-assisted. For achieving neural triggers, this study adopts an experimental methodology. Autistic children were recruited via snowball sampling technique, and they are 48 (mean age=2-6 years, boys=28, girls=20). On their willingness to participate in the study, they were divided into two groups: control and experimental. The interventions were provided within six weeks, and the children were assessed via WSSPI-III before the interventions and after the interventions. The overall results of the study predict that in post-assessments, there is a significant satisfactory result. The study implies that 'RAM' should be adopted by parents in home settings and therapists in institutional settings to expedite neural processing that will help boost children's speaking skills with smooth fluency.

INTRODUCTION

Autism, a neurophysiological development disorder that affects communication and social interaction, has been studied across the globe in various language preferences (Keating et al., 2023; Buijsman et al., 2023; Bury et al., 2023). Children with autism often face challenges in developing their speaking skills, which can have a significant impact on their neural processing of the speaking motor system. The problem of the motor system is a neurophysiological issue, and to rectify this, specific interventions (Barnhart et al., 2023; Esposito et al., 2023; Bertoncello et al., 2021) and approaches (Nisar & Haris, 2023; Bozhilova et al., 2023; Veenstra et al., 2023) are adopted to develop children's various skills, but there is still a lack of comprehensive evaluation of autistic children typically residing in Pakistani Region and no such related research that examines the effectiveness of the interventions in developing the speaking skills of autistic children. Therefore, the present study aims to trigger autistic children's neural processing that tends to develop smooth speaking skills and to identify the most effective approach to develop speaking skills that implicate applied linguistics as an intervention to boost the neural process of speaking.

Autism, both at regional and global levels, is acknowledged as a crucial issue (Melo et al., 2023), so keeping in view, in this study, a specific focus is on the Mianwali Region. It seeks to address the critical need for developing speaking skills in autistic children, recognizing the skills' vital role in communication, social interaction, and academic success. By doing so, this research aims to contribute to the existing knowledge base, inform local practices, and influence policy decisions. By concentrating on a particular region and this essential need, the study intends to create a lasting impact on the lives of autistic children and their families in Mianwali and potentially extend its benefits beyond. By bridging the gap in research on interventions for boosting speaking skills in autistic children, this study aims to enhance communication, mitigate negative outcomes, and empower educators and caregivers to better support these children's communication needs, ultimately fostering their increased participation in social and academic spheres and promoting inclusion in their communities. Keeping in view the importance of this issue, the present study formulates certain research questions.

Research Questions

Q1. How can neural processing in autistic children smoothly be channelized through interventions for developing speaking skills?

Q2. What are the suitable interventions to develop speaking skills for autistic children (age=2-6)?

LITERATURE REVIEW

Autism Spectrum Disorder

Autism Spectrum Disorder (hereafter ASD) is considered a type of syndrome or just autism, a set of developmental disorders and "abnormalities" that can have a substantial impact on a child's ability to interact socially, communicate effectively, and behave appropriately throughout their whole life (Fernandez & Scherer, 2017). Deficits cause prominent disabilities in autistic children, such as their educational life as learning, social life as interaction, daily life functioning such as behaviors, and their professional life as well (Zhang et al., 2023). Autism is a neurodevelopmental condition with biological roots that is defined by "abnormalities" in two key areas: social interaction and communication, as well as limited repetitive patterns of behavior, interests, and activities. Autism has an impact on how individuals connect and communicate. It has an impact on how people interpret the world. Autism is a developmental disorder that often lasts a lifetime. Communication, social engagement, and repetitive/restricted activities are challenges for people with autism (Faras et al., 2010). Autism is characterized by difficulty with verbal and/or nonverbal communication, social interaction, or restricted behaviors. Autism is classified as a pervasive developmental disorder. The terminology used about persons diagnosed with autism spectrum disorder (ASD) has received increasing attention (Bury et al., 2020). Hollander et al. (2022) give a heuristic representation of a child with autism: a prominent example is a 3-year-old child who does not communicate and does not reply when his or her name is called upon. Although autism may cover a larger spectrum of functionality than was previously assumed, and although children may present in several ways, they provide a heuristic picture of a child with autism. These children seem to be living in their world when they are left alone, and when they are at daycare, they tend to isolate themselves from the other children. They do not play with toys; rather, they may lay on the ground and repeatedly arrange blocks or run a toy car while doing so. They are sensitive to loud noises, as evidenced by the fact that they shield their ears if large vehicles are around. They make circular motions with their hands and bodies.

Related Studies

Many previously conducted studies on developing speaking skills have been reported in autism (Wan et al., 2010; Le Bel et al., 2009; Anwar, 2011; Park, 2014; So et al., 2018; Febriantini, 2021; So et al., 2023) in various languages such as Chinese, English, and also in bilingual speakers. The studies vary from various points of view regarding the variables, framework, methodology, and language-based intervention. According to So et al. (2023), the narrative skill of pre-school children can be developed through robotic-

based drama. A total of 26 participants, pre-school children with autism deficit, have been recruited and evaluated with pre and post-tests. A drama-based intervention has been used in this study. The study reports that the narrative skills can be boosted with verbal and non-verbal communication of autistic children. Febriantini (2021) focused on autism and examined verbal and non-verbal communication in this study. So et al. (2018) worked on Chinese-speaking pre-school children, typically called autistic children. Park (2014) dedicated the study to bilingual children with autism disorder. Anwar (2011) conducted a study on autism by specifying fluency development is channelized through computer-based stimuli. Wan et al. (2010), on the same line, conducted a study on autism, but the stimuli used in the music interventions. After reviewing all the latest innovative studies on autism, it is imperative that there are a lot of factors that mediate autism. Autism is an anatomical issue, as well as delayed speech. Delayed speech means that the operating system exists with a full-fledged mechanism; it only needs external relevant stimulus to process the neural mechanism, and this process boosts speaking fluency. Two studies have been dedicated to Working on natural speech within the naturalistic setting by Ali et al. (2021) and Jabbar et al. (2021) in the Pakistani context. According to Ali et al. (2021), natural speech in bilinguals is fully grammatical and has no need for any external restrictions (interventions). Ali et al. (2021) worked on bilingual competence. They tried to draw a bilingual model of the human capacity of bilingualism according to the matrix language frame model. Still, this study focuses only on autistic children without any language specificity, either monolingual or bilingual. The results of Ali et al. (2021) challenged the theoretical model of matrix language. Subsequently, Jabbar et al. (2021) worked on a morphosyntactic study of only lexical verbs and pointed out that there are sub-divisions of features within lexical verbs: +F-features and –F-features. Jabbar et al. (2021) suggested some verbs from various languages, Urdu, Punjabi, and English that are different in nature. In the Pakistani context, this research domain has not been focused on, and the previous studies have been missed. This study will be a handful dedicated to autism, opting for modern research techniques that have never been adopted in previous studies conducted in Pakistan with various domains of applied linguistics.

METHODOLOGY

Participants

In the current study, the total number of participants is 48 children, with ages from 2 to 6 years old, and they were autistic diagnosed as their medical reports confirmed. They were attending an autistic center on a regular basis. All autistic children use Urdu as their first language. A group of 48 autistic children took part in this research study. The demographic details of the participants are given in Table 1.

Table 1. Participants' details.

Sr. No	Participants	N	Age	N%	Age%	SD
1	Boys	28	2-6	58.3	4.2	0.92
2	Girls	20	2-6	41.6	3.9	1.02

Procedure

The children included in this study are recruited via systemic processes and steps. Primarily, the ASD group was composed of a total of 77 children, and they belonged to various autistic centers and families that voluntarily agreed to participate, but 29 children were excluded from the study for different reasons and their unwillingness to participate in the study, not having oral language, or not receiving their parents' informed consent. The participants were categorized into two groups: experimental vs. control. This categorization has been allocated to the participants and their parents' willingness. Both the groups have the same number (n=24) and gender (b=14, g=10). The details of the groups are given in the Table 2.

Table 2. Group details.

Sr. No	Group Type	N	Age	N%	Age%	SD
1	Experimental	24	2-6	50%	4.9	1.13
2	Control	24	2-6	50%	4.6	0.78

Research Ethics

For conducting this study, all the ethical codes have been pursued, and the study was approved by Obaid Noor Institute of Medical Sciences, Mianwali. All participated autistic children were recruited based on their willingness to participate in this research study. All the examples and numerical data collected from the participants are being used following all the ethical codes for this study. Parents and children did not show any unwillingness while conducting this research study.

RESULTS AND DISCUSSION

In this section, the results have been presented in Table 3. The pre-and post-test results in the above table show that two groups participated in the study: control and experimental. The control group is provided the normal routine method with no specific stimuli. Still, for the control group, a control intervention has been provided in the form of repeat after me in a computer-based tool, Microsoft Edge. The stimulus was provided to the experimental groups, and after that, the responses were collected through a scale, i.e., the Information Subtest of the WSSPI-III (Wechsler, 2009). According to this subtest of the WSSPI-III Verbal Scale, the child's ability to acquire, conserve, and process knowledge about general events has been assessed, and it is related to crystalized intelligence, neural processing, long-term memory, and the ability to recall information taken from our surroundings. This study is composed of 12 items: a verbal stimulus that is provided via Microsoft Edge tool in the form of audio, and the participants are instructed to repeat after me after listening, such as: "What is your name?" or "What day comes after Saturday?". After repeating verbally, the child receives 0 or 1 point depending on his/her answer.

Table 3. Descriptive statistics.

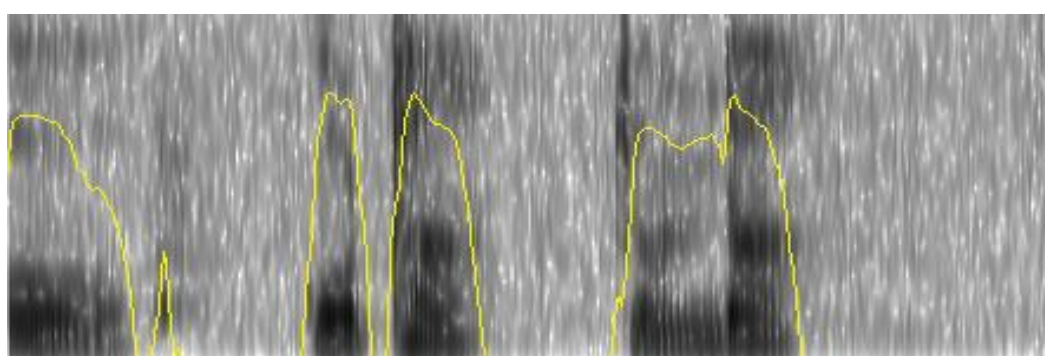	Descriptive statistics	Pre Test				Post Test			
Group	N	X	SD	Min	Max	X	SD	Min	Max
Experimental	24	103.17	9.35	85	119	112.76	8.25	98	124
Control	24	103.16	7.40	91	117	106.58	5.88	95	117

Figure 1. Spectrogram of Autistic Speech.

In spectrogram as shown in Figure 1, the continuous speech layer has been mentioned in the yellow wave. It was conducted using Praat (Boersma, 2011) to view the speech fluency improvement. The layer of spectrogram-1 demonstrates that there is less delay after the intervention, and in connected speech, the minimum delayed timing is 0.782555947 msc. That is comparatively less than prior to intervention

0.798691118 msc. This shows that the neural system is working smoothly if externally controlled interventions are provided.

Discussion

The findings provide preliminary insights into the potential benefits of the intervention in improving the speaking skills of autistic children. The participants in this study are observed simultaneously with the same specifically designed questionnaire for all autistic children. In this whole process, their parents played a vital role by providing the precipitants through the specified intervention. According to Wan et al. (2010), autism can be reversed by using music stimuli, but in this study, the results are taken from multiple techniques that are typically used in language engineering, so the results of this authentic and theoretically compatible with theory, and learning a language, stimuli must be provided within the domain of theory. Later on, Anwar (2011) and Park (2014) predicted that autism might be developed in bilingualism; it may affect verbal and non-verbal communication, and our study is diverse in nature with respect to these two studies as language is part of monolingual and bilingual speakers. Hence, this study is further steps from these two studies, and lastly, So et al. (2018, 2023) is the big name in autism to develop children's various skills through robotic dramas. Still, in this study, pure language interventions are employed to trigger the neural system of autistic children; in this way, their speaking fluency may be improved as this study reports the delay timing that indicates improvement in the neural system. The neural system is interconnected with the auditory and perceptual systems through the ear and oral. To provide controlled gestures to autistic children these input systems, the neural mechanism processes efficiently in this way, the whole can smoothly be channelized.

CONCLUSIONS

In the concluding remarks, the results of this study reveal that autistic children of the control group and experimental group present differences in speaking skills processing. Both groups show a preference for the experiential route as the main speaking categorization route. Language development in normal and typical children, especially in Pakistan, is a crucial issue, and there are a lot of speaking fluency problems in individuals at all levels. To rectify this issue with reference to specify our data to only one city, Mianwali. The results indicate that controlled systemic interventions (CSI) are the best therapies for providing gestures to autistic children. This study implies that the external system of human anatomy is interconnected with the internal system through auditory and perceptual systems. The external system should be provided CSI; in this way, the internal neural system will work smoothly, enhancing speaking fluency in autistic children. This study is innovative with respect to methodology as it uses all those tools that have now been adopted in language engineering, artificial intelligence, and machine learning. Future researchers may use this study as a theoretical framework for normal children's speaking skills.

The study implies that autism, in the globe, and especially in Pakistan, is a crucial issue among speakers of any language: English, Urdu, Punjabi, and every bilingual speaker who potentially speaks more than one language. According to the linguistics point of view, there are many practical implications of this study: (a) it implies that learning a first language and even a second/foreign language prerequisite the environmental stimuli that are naturally provided by the parents and surroundings. If these stimuli are controlled according to the nature of the learners' issues and neurophysiological problems, they can smoothly be developed. (b) Second, the second/foreign language learners, at a rate, face the issues of accuracy and fluency. Accuracy is more primary than fluency. For accuracy, the mechanism should be active, and muscles must be active that regulate language processing efficiently. If language tutors/teachers/trainers wholeheartedly want to improve in accuracy, this study provides an effective mechanism that has been tested and evaluated by learners with advanced tools. (c) Owing to multilingualism and translanguaging, human cognitive faculty is being incorporated as hybrid cognition as the multiple inputs within the single system are being provided; therefore, the issues of autism are unprecedentedly rising around the globe, especially in Pakistan. This study implicates the full-fledged mechanism that can be adopted by the parents

in a home setting and language therapist in the institutional setting to deal with all the related issues of autism.

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