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An Intervention Study of Augmentative Sign Language on the Ability to Describe Situations in Autistic Children with Speech Impairments

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Abstract: Social impairment is one of the core symptoms of autism spectrum disorders, while the common issue among those affected is a significant delay in both receptive and expressive language development. This study aimed to investigate the effectiveness of augmentative sign language (ASL) for children with autism spectrum disorder (ASD) in improving their ability to describe situations. In accordance with the purpose of the study, the A-B-M experimental design of the single-study experimental method was used to conduct an instructional intervention with a 7-year-old child with autism who has a speech and language disorder. The independent variable was the supported sign language intervention programme, and the dependent variable was the ability of sign language to assist spoken description of situations including nouns, verbs, adjectives, quantifiers and prepositions. The results showed that augmentative sign language had an immediate and maintenance effect on the ability to describe a situation in children with autism who had language impairments.

Keywords: Children with autism, Language Barrier, Auxiliary Sign Language, Description of situational skills

1. Introduction

Autism Spectrum Disorder (ASD) is diagnosed based on two criteria, social communication and interpersonal interaction disorders, and repetitive behaviours and narrow interests, while delayed language development is one of the main reasons or features for the initial diagnosis [1-2]. The development of social communication functions is influenced by early motor skills related to language acquisition, and children with autism consistently show impairments in basic and complex motor skills that are closely associated with delayed or regressive speech development and social challenges [3]. According to the most recent evaluation of the study, PECS is considered a promising communication intervention for children with autism [4]. This is because images are easier to understand and do not require prerequisite skills such as eye contact and oral-motor skills, whereas Manual signs often require eye contact and mimicry, both of which are difficult for children with autism to acquire [1,5]. Furthermore, Although the visual-gestural model of sign language differs from the vocal-auditory model of language in several key aspects, deaf or severely autistic children with autism do exhibit sign language imitation and response, which provides new clues for analysing the purpose and functional understanding of the response in children with autism [6-7]. Therefore, this study attempts to use sign language to assist children with autism in

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describing a situation. The theoretical significance of this study lies in providing a referential theoretical framework for sign language intervention strategies concerning children with autism. While enhancing the ability of children with autism to describe situations and language development, it helps them integrate smoothly into mainstream educational institutions and the wider social structures, thereby increasing their sense of belonging and overall well-being.

2. Literature review

Children with severe autism can acquire communication skills through sign language and a combination of spoken and signed modalities [7]. Sign language and spoken language share similar phonology, morphology, and syntax, despite significant grammatical differences [8]. Currently, the AAC technical intervention for autistic children has shifted from sign language to a combination of pictures, symbols, and speech output from specialized devices [1]. Despite the limitations of sign language, it enhances the language quality of the participating groups. Therefore, attention should still be paid to sign language intervention for autistic patients to promote the diversification of intervention strategies [1]. Sign language is an effective means of enhancing communication for many people with non-verbal developmental disabilities. Visual cues are formed through the styling of symbols in sign language, and their figurative nature helps to transfer them to life situations, thus facilitating language learning [5]. Sign language is a language similar in structure to spoken language, having many of the attributes of spoken language, and sign language is closer to the use of spoken language than gestures [8]. Both sign language and spoken language involve phonological and syntactic processing areas in Broca's area, and Broca's area and its neighbouring cortex (Brodmann's area 45/47) are activated when there is an increased load of integrating gesture and speech in the language environment [9]. Broca's area, which is typically associated with internal language processing, also integrated for movement observation and speech. This demonstrates that language and movement processing share a high-level neurological integration system [9]. Research has confirmed that in most speech-gesture pairs, the strokes are consistent with the corresponding speech fragment, which may be a single word or phrase [10].

3. Research design and implementation

3.1. Study subjects

The subject of this study was a 7-year-old child who was diagnosed with ASD with speech disorder by professional assessment of a hospital physician and met the DSM-5 classification criteria in the Support Needs Category (Mild Disorder). The researcher interviewed the rehabilitation teachers and kindergarten teachers of the special institution about the subject's intervention, and after collecting their opinions or feedbacks, a summary table of the study subject's competencies was compiled. Subject has good mimicry skills, including large movements and a few fine movements. Engagement in learning is largely dependent on the presentation of the learning material. The visual material can maintain for a longer period of time (about 45mins-1h). Otherwise, problematic behaviours such as loud talking, crying, etc. will occur frequently. In terms of social skills, the subject had speech impairment. Frequently used nouns (e.g., cake, etc.) and actions (e.g., pushing others, etc.) in isolation to express meaning. Inability to express needs or answer questions use complete sentences. When asked to describe "who/what + what" or "who/what + where + what" in real scenes, picture books or pictures, the subject could only answer using nouns or verbs alone, such as "what/who" and "what". Adjectives, prepositions, and quantifiers are never involved, and only when asked individually are responses given truthfully, but with a low rate of accuracy. Nouns and verbs were the best mastered, followed by adjectives and quantifiers, and prepositions were the worst mastered.

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3.2. Related work

This study adopted the A-B-M design of the single-subject research method. A denotes the baseline period, B denotes the intervention period, and M denotes the maintenance phase after the intervention withdrawal. In the baseline period, there was no teaching and the intervener tested the subject on both short and long sentence expressions. The data collection in the baseline period consisted of six data points and was conducted in three sessions (three days) of 20 minutes each. The intervention period is the intervention in sign language teaching, in which the learning of sign language movements is based on discrete trial teaching (DTT), the training of sign language-assisted oral expression is based on verbal behavior (VB) teaching, where the teaching is controlled by the intra-verbal of the linguistic stimuli. The training was based on the graded training system teaching strategy, which subdivided the teaching skills into acceptable ranges for the subject and followed the principle of “decreasing prompts” to enable the subject to realize learning autonomy [11]. The test was divided into the mastery of sign language action (at least 3 consecutive points pass rate of 80% or more), and the contextual description post-test (at least 3 consecutive points pass rate of 80% or more) [12]. The intervention training tool features standardized sign language from "Chinese Sign Language Teaching," focusing on prepositions, verbs, adjectives, and quantifiers. To prevent the 'practice effect' that could bias results, situational pictures from children's books were used as assessment tools during the intervention while story situation pictures developed by the researchers were used during the baseline and maintenance phases. In addition, the subject was taught sign language with the palms and fingers oriented in the opposite direction of the correct direction so that he/she could learn the correct sign language [6]. The maintenance period is a test administered one week after the end of the intervention period to observe and collect test data for pre- and post-intervention comparisons. The subject's ability to describe a situation through auxiliary aids was measured, with a minimum of 3 points collected during the maintenance period and no passing or failing criteria.

3.3. Variables

The independent variable in this study were the auxiliary sign language intervention programme. Dependent variable is the effectiveness of sign language in assisting spoken language in its ability to describe a situation. One point is awarded for each correct word, and no points are given for unrelated, grammatical, or incorrect words, and the data are used to measure the correctness of the subject's independent responses. The control variables were divided into four components, the instructor, the assessment method, the location of the intervention experiment and the assessment, and the data recorders.

4. Result

4.1. Inter-observer reliability

The formula for calculating the percentage of inter-observer reliability is: inter-observer reliability=number of times of consistency/(number of times of consistency+number of times of inconsistency)×100%, and the reliability index should preferably be between 80% and 100% [12]. In this study, it was calculated that both Recorder A and Recorder B had a test-observation concordance of more than 85% regarding the study participants. Whether the participants were able to describe the picture situation through sign language during the test, the observational agreement between the two recorders reached 100% at baseline, 95.5% at intervention, and 98.5% at maintenance. As the inter-observer agreement at all stages was above 85%, it indicated a certain degree of confidence in the observation.

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4.2. C-statistical analyses

4.2.1. Immediate effectiveness

As depicted in Figure 1 and Table 1, during the baseline period, the full range of the level is 2-2, the change in the level during the period is 0, and the average level is 2. This indicates a stable and isochronous trend, with both level and trend stability at 100%. Given the stable and unimproving trend observed in the baseline period, the intervention period was initiated. Since all data points in the baseline period are the identical, it is not appropriate to calculate the C-value [12].

Upon entering the intervention period, the full distance of the level is 4-5, with a change in level within the phase of 1, and the average level of 4.5. This also represents a stable trend, with both level and trend stability at 100%. According to the results of the C-statistics, the C-value for the intervention period was -0.125 and the Z-value was 0.23, which did not meet the 0.05 criterion of significance, indicating no significant difference and a stable, non-significant change in the trend.

When comparing the baseline period to the intervention period, the change in level between phases was 3, the change in average level was 2.5, and there was a change in the trend direction of the outcome. The trend stability changed from stable to stable, with 0 percent overlap. Although there was no change in the interphase trend and outcome between the baseline and intervention periods, the average level in the intervention period was higher than that in the baseline period. According to the results of the within-stage C-statistics, the C-value is 0.71 and the Z-value is 3.55, reaching a significant level of 0.01, which is a significant difference. Therefore, there is a significant positive intervention effect and a trend towards significant change.

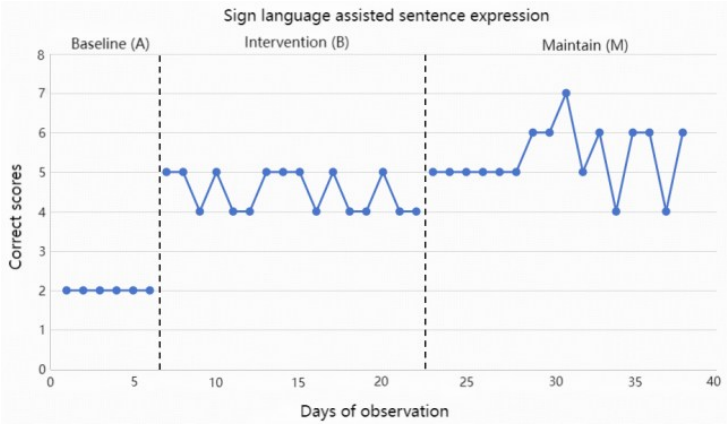

Figure 1: Curve of percentage of correct scores in describing situations in auxiliary aids

Table 1: Effectiveness analysis of augmentative sign language communication

Dimensions of Analysis	Results of analysis		
	Intra-stage Changes		
Stage Name	Baseline period	Intervene period	Maintain Period
Stage Length	6	16	16
Level Range	2-2	4-5	4-7
Level Changes	0	1	3
Average Level	2	4.5	5.4
Level Stability	100%	100%	81.25%
Trend and Data Path within Trends	-(=)	-(=)	/(+)
Trend Stability	100%	100%	81.25%
C Value	NA	-0.125	-0.18
Z Value	NA	0.23	0.23
	Inter-phase Changes		
Comparative Stages	Intervention /Baseline period		Maintain /Intervention period
Level Changes	3		1

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Table 1: (continued)

Average Level Changes	2.5	0.9
Trend Changes and Results	—(=)—(=)No change	—(=)/(+)Positive
Trend Stability Changes	stable to stable	stable to stable
Overlap Rate	0%	56.25%
C Value	0.71	0.175
Z Value	3.55**	0.17

4.2.2. Maintenance effectiveness

As depicted in Figure 1 and Table 1, during the maintenance period the full range of levels is 4-7, with a change of 3 and an average level is 5.4, which shows a stable trend with both level stability and trend stability at 81.25%. According to the results of the C-statistics, the C-value of the maintenance period is -0.18 and the Z-value is 0.23, which does not reach the significant criterion of 0.05, indicating no significant difference and a stable trend without significant change. Transitioning from the intervention period to the maintenance period, the change in level between stages is 1, the change in average level is 0.9, the trend direction changed positively, the trend stability remained stable, and the overlap rate was 100%. According to the results of the in-stage C-statistics, the C-value was 0.175 and the Z-value was 0.17, which did not reach the significant level of 0.05. This indicates no significant difference and suggests that the intervention effects were effectively maintained.

5. Discussion

5.1. Enhancing autistic children's descriptive and social skills in a situation

Before the teaching intervention, participants could only describe a situation using nouns or verbs alone. After the sign language teaching intervention, participant used sign language to assist the use and expression of oral language. First, the participant was able to prompt oral expression through "finger reading", which did not require the use of sign language at this stage, including the use of nouns and some adjectives (mainly related to color). Furthermore, participant also used sign language to assist in prompting or correcting oral expression, including verbs (parts), adjectives (parts), directional prepositions, and quantifiers (if involved). Since the subject's description of certain fragments or characters was not comprehensive, the subject had to rely on self to "make marks" to confirm whether the comprehensive description had been completed. In addition, through a series of teaching interventions, participant was able to improve the ability to express themselves independently in a broad context, no longer limited to the use of nouns or verbs alone, such as actively expressing needs or refusing by using sign language to assist their oral language.

5.2. Enhancing the learning efficiency of autistic children

Due to the presence of a more pronounced language barrier, subject was less effective in purely linguistic learning processes. Prior to the teaching intervention, he/she frequently exhibited problematic behaviours, such as resisting learning by talking out loud about things that are not relevant to learning. Although attempts were made to use positive behavioural support to improve the student's problematic behaviours and negative emotions, learning remained less effective. With the intervention of sign language teaching, the participant was able to understand and use the abstract language in a more visual way by imitating the positional prepositions, verbs, adjectives and quantifiers of the target objects in the context, which in turn improved the learning efficiency.

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6. Conclusion

In this study, A-B-M was used as an auxiliary sign language strategy to improve the situation description ability of autistic children. The stability of children's data points using long and short sentences (including nouns, verbs, adjectives, quantifiers, and directional prepositions) in specific situations was observed repeatedly at baseline, followed by an experimental treatment that assisted sign language strategies, and finally, the children's maintenance performance was assessed at the end of the week. However, there are some shortcomings in this paper. First of all, the teaching intervention time of this study should be set for a long time to enhance the familiarity of the subjects. In addition, this study only focuses on the description of parallel relations in the context, and it is suggested that future studies can be further extended to the description of logical relationships such as adversative or transitive relations.

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