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Application of the Core Concepts of Whole-Brain Language Combined with Desktop Teaching Methods in the Language Development of Children with Autism Spectrum Disorder

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Abstract: *This study aims to explore the application effects of integrating the core concepts of whole-brain language with tabletop teaching methods on language development in children with autism spectrum disorder (ASD). The study selected 100 children with ASD who were treated at our hospital between October 2022 and October 2023. These children were randomly divided into a control group and an observation group, with 50 cases in each group. The control group received tabletop direct teaching methods that align with the developmental sequence of children, while the observation group was additionally provided with specialized techniques based on the core concepts of whole-brain language. By comparing the Gesell scale and ABC scale assessment scores of the two groups before the intervention and after six months of intervention, the results showed that after six months of training, the Gesell scale scores of the observation group were significantly higher than those of the control group (P<0.05), while the ABC scale scores were significantly lower than those of the control group (P<0.05). Therefore, it is concluded that integrating the core concepts of whole-brain language with tabletop teaching methods in the language development treatment of children with ASD can effectively alleviate symptoms, promote functional development, and improve behavioral problems.*

Keywords: *Whole-brain language, Autism, Language disorder*

1. Introduction

Autism Spectrum Disorder (ASD), also known as autism, is a neurodevelopmental disorder that originates in early childhood. It is characterized by difficulties in social interaction and communication, repetitive behaviors, and a restricted range of interests and activities. Research shows that children and adolescents aged 3 to 16 are the primary demographic affected by this disorder. According to data released by the U.S. Centers for Disease Control and Prevention (CDC) in 2021, the prevalence of ASD among American children is 1 in 44, and this ratio continues to rise annually[1]. In 2022, data from China's National Health Commission indicated that the prevalence of ASD among Chinese children is approximately 7%, with a significantly higher diagnosis rate in males compared to females[2].Related studies suggest that functional developmental deficits in children with ASD may lead to abnormal perceptions of their environment, which can trigger atypical emotions and behaviors and significantly impact the development of their language abilities. Although the exact cause of ASD remains unclear and its prognosis is generally poor, the plasticity of the brain during childhood offers a window for improvement. With appropriate interventions, there is potential to enhance language function and, consequently, alleviate social and communication deficits in children with ASD.The core concepts of whole-brain language represent a comprehensive approach to language instruction, aimed at stimulating multiple sensory areas of the brain to facilitate language learning. This approach emphasizes the coordinated use of visual, auditory, and tactile senses to enhance language acquisition. Meanwhile, the table-top teaching method is a structured intervention strategy that uses clear visual cues and task breakdowns to help children with autism learn in an organized environment[3].Therefore, this study aims to explore the application effects of combining the core concepts of whole-brain language with table-top teaching methods on the language development of children with ASD. Through systematic experimental design and scientific evaluation methods, this research seeks to provide new theoretical foundations and practical guidance for language interventions in children with autism.

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2. Materials and Methods

2.1 General Information

A total of 100 children with autism who were treated in the Speech and Language Therapy Department of our hospital from October 2022 to October 2023 were selected as study subjects. They were randomly divided into a control group (n=50) and a study group (n=50) using a computer-generated random number table, as shown in Table 1.Control group: 26 boys and 24 girls, aged 3 to 7 years, with an average age of (4.28±1.21) years, and a disease course ranging from 0.6 to 1 year.Study group: 30 boys and 20 girls, aged 4 to 7 years, with an average age of (4.24±1.35) years, and a similar disease course ranging from 0.6 to 1 year.Data analysis showed no statistically significant differences in the general information between the two groups (P>0.05), as shown in Table 2.This study was approved by the hospital's ethics committee. All the children's guardians provided informed consent, agreed to the treatment arrangements, and signed the informed consent forms.

Table 1: Summary of Random Grouping

Group	Number of Cases	Percentage (%)	Valid Percentage (%)
ControlGroup	50	50.0	50.0
Study Group	50	50.0	50.0
Total	100	100.0	100.0

Table 2: Analysis of General Information of Children in Both Groups

Group (Mean ± Standard Deviation)	n	Gender		Age (years)	Disease Duration (months)
		Male	Female		
ControlGroup	50	30	20	4.24±1.35	8.40±2.89
Study Group	50	26	24	4.28±1.21	8.48±3.03
t				0.16	0.14
P				0.88	0.89

2.2 Inclusion Criteria

(1)Meeting DSM-V diagnostic criteria[4].(2)Children with no verbal expression or low language initiative.(3)Children exhibiting significant behavioral issues.(4)Children with social interaction difficulties.

2.3 Exclusion Criteria

(1)Excludes children raised by non-immediate family members.(2)Excludes children with intellectual disabilities, cerebral palsy, hearing impairments, stuttering, or Down syndrome (Trisomy 21).(3)Excludes children with other neurological disorders.

2.4 Withdrawal Criteria

(1)Children who received less than one month of intervention.(2)Parents who independently adjusted the treatment plan.(3)Children who voluntarily withdrew due to personal reasons.

2.5 Methods

Control Group: Children in the control group were treated using table-top direct teaching methods that align with the developmental sequence of children. The intervention lasted 6 months, with sessions conducted 5 times a week, each lasting 30 minutes.(1)Object Manipulation: Teachers selected teaching aids (e.g., dolls, rainbow towers, toy telephones, fruit-cutting toys, jigsaw puzzles, toy cars) and performed 1-2 functional operations. Specific operations included demonstrations or DTT (Discrete Trial Training) session-based methods, with each toy manipulation lasting 5-10 minutes.(2)Object Matching: Children matched previously learned objects/cards presented visually on the table, at least three at a time. Specific operations included instructions like "find the same one" or "put the same ones together," with each instruction lasting 5-10 minutes.(3)Object Selection: Objects/cards (at least three)

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were presented on the table. Specific operations included instructions like "find...," "give me...," or "point to...," with each instruction lasting 5-10 minutes.(4)Object Naming: Toys or common cards were presented one by one. Specific operations included asking the child, "What is this?" with each instruction lasting 5-10 minutes.(5)Group Lessons: When children could follow classroom rules and obey instructions, peers with similar abilities were paired with them in group lessons. Specific operations included simple game rules like "let's do it together," "compare…," and "first..." to improve their comprehension, gameplay skills, and social conversation abilities.The direct teaching method was used during interventions to enhance skills related to cognition, comprehension, expression, gameplay, and social interactions in a way that aligns with the child's developmental stage. After each session, feedback was provided to the parents regarding the child's classroom behavior (including cooperation, active participation, language initiative, and comprehension abilities), along with a home guidance plan to extend classroom tasks into the home environment.

Study Group: The study group received the same intervention as the control group, with additional specialized techniques from the "whole-brain language" core concept:(1)Pivotal Response Training (PRT) [5]: Child-centered training where the child chooses the teaching aids or activities, conducted in a natural environment. Specific operations included placing the child's favorite items in a visible location, with the therapist asking, "What do you want?" or "Which one do you want to play with?" After the child selected an activity, the therapist participated, offering parallel descriptions, parallel play, creating opportunities, rewarding effort, and using differential reinforcement.(2)Social Pragmatic Training: Different scenarios were set up, alternating between table-top and floor activities. Specific operations included designing the environment, setting rules with the therapist or child, and activities such as "stay quiet" or "speak softly." After the activity, participants asked questions, discussed, and described their experiences. If the child was unable to engage, the therapist initiated a topic.(3)Auditory-Verbal Therapy (AVT) [6]: Hearing-related teaching aids were selected for use in a pre-set environment. Specific operations included playing various sounds and observing the child's reactions, playing animal sounds, and asking, "What sound is that?" or "Who is making that noise?" The therapist also used exercises such as "1-2-3-4-5, please repeat" and displayed related groups of six pictures. For example, the therapist might say, "Auntie went to the breakfast shop to buy buns," and the child would identify the picture related to the key information.(4)Augmentative and Alternative Communication (AAC) Tools [7]: Teaching using pictures/communication boards as a medium. Specific operations included labeling objects, placing corresponding pictures or symbols on containers storing the items (e.g., placing a picture of blocks on a box of blocks); arranging words on a communication board by part of speech or meaning for easy communication; creating task lists to be completed with visual prompts; and using a calendar to display daily activities with corresponding times and pictures.(5)Logical Thinking: Thinking teaching aids appropriate to the child's cognitive age were selected to build thinking frameworks and fill in content. Specific operations included practicing temporal sequences (e.g., morning and evening, months, schedules) to differentiate events and their timing; structural sequences using pronouns, nouns, verbs, adjectives, prepositions, and conjunctions in sentence structures for conversations and descriptions; and sequences of importance, using terms like "first," "then," and "finally" to describe or explain observed scenes.

The methods were applied in 30-minute sessions, 5 times a week, over a total intervention period of 6 months. The study group's plan focused on addressing the core issues of each child, aiming to rapidly improve skills related to cognition, comprehension, expression, and social interaction. The intervention was adjusted dynamically based on the child's specific performance, tailoring the approach to meet the child's immediate needs.

2.6 Clinical Observation Indicators

Both groups of children underwent a six-month treatment intervention. The Gesell Developmental Schedules [8] were used to assess the development of the children in both groups before and after the intervention. This assessment includes areas such as gross motor skills, cognitive abilities, language communication, and social-emotional development. The scores are standardized, comparing the child's performance with that of their age-matched peers to determine their developmental level in each area.

The Autism Behavior Checklist (ABC) [9] was used to evaluate behavior. According to the ABC, a total score of less than 53 points indicates a negative screening, a score between 53 and 67 points indicates a positive screening, and a score of 68 points or higher can assist in diagnosing autism. The higher the score on this scale, the more severe the autism-related behavioral symptoms.

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2.7 Statistical Methods

The results of this study were statistically analyzed using SPSS 25 software. Measurement data were expressed as mean ± standard deviation ($\bar{x}\pm s$) and compared using t-tests. Categorical data were expressed as proportions (%) and analyzed using chi-square tests. A P-value of less than 0.05 was considered statistically significant.

3. Results

3.1 Analysis of Personal Adaptability Scores in Both Groups

After testing, the personal adaptability scores of both groups before and after treatment conformed to a normal distribution. An independent samples t-test was used for analysis. The mean scores of personal adaptability between the two groups before treatment showed no statistically significant difference ($P > 0.05$). However, after treatment, the difference in mean scores of personal adaptability was significant and statistically meaningful ($P < 0.05$).A pairwise comparison revealed that there was no statistically significant difference in personal adaptability scores between the control group and the study group before treatment ($P > 0.05$). However, after treatment, the personal adaptability scores were significantly different between the two groups, with statistical significance ($P < 0.05$). This indicates that the personal adaptability of children in both groups improved after treatment, with the study group showing the most significant improvement, outperforming the control group.See Table 3.

Table 3: Comparison of Personal Adaptability Scores Between the Two Groups [$\bar{x}\pm s$,points]

Group (Mean ± Standard Deviation)	n	Pre-treatment Score	Post-treatment Score
Control Group	50	47.40±16.72	56.40±16.57
Study Group	50	41.56±17.59	64.47±16.52
t		1.7	-2.44
P		0.09	0.02

3.2 Analysis of Personal Social Ability Scores in Both Groups

The personal social ability scores of both groups were assessed before and after treatment, and the data followed a normal distribution. An independent samples t-test revealed that there were no significant differences in the mean scores before treatment between the control group and the study group ($P > 0.05$). However, after treatment, the differences in mean scores between the two groups were significant ($P < 0.05$). Pairwise comparisons showed that there were no significant differences in scores before treatment ($P > 0.05$), but significant differences emerged after treatment ($P < 0.05$). This indicates that both groups showed improvement in personal social ability following treatment, with the study group demonstrating a greater improvement compared to the control group.See Table 4.

Table 4: Comparison of Personal Social Ability Scores between the Two Groups [Mean ± Standard Deviation, points]

Group (Mean ± Standard Deviation)	n	Pre-treatment Score	Post-treatment Score
Control Group	50	36.30±14.16	46.24±14.41
Study Group	50	32.72±13.72	53.28±13.59
t		1.28	-2.51
P		0.2	0.01

3.3 Analysis of Personal Language Ability Scores in Both Groups

The personal language ability scores of both groups were assessed before and after treatment, and the data followed a normal distribution. An independent samples t-test showed no significant difference in the mean pre-treatment language ability scores between the control group and the study group ($P > 0.05$). However, after treatment, the mean scores for personal language ability differed significantly between the two groups ($P < 0.05$). Pairwise comparisons revealed no significant differences in scores before treatment ($P > 0.05$), but significant differences were observed after treatment ($P < 0.05$). This indicates that both groups improved in personal language ability following treatment, with the study

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group showing the most significant improvement compared to the control group.See Table 5.

Table 5: Comparison of Personal Language Ability Scores between the Two Groups [Mean ± Standard Deviation, points]

Group (Mean ± Standard Deviation)	n	Pre-treatment Score	Post-treatment Score
Control Group	50	30.52±13.69	39.84±14.38
Study Group	50	29.58±14.95	52.00±15.22
t		0.33	-4.11
P		0.74	0.00

3.4 Analysis of ABC Scale Scores in Both Groups

The ABC scale scores of both groups were assessed before and after treatment, and the data followed a normal distribution. An independent samples t-test showed no significant difference in the mean pre-treatment ABC scale scores between the control group and the study group ($P > 0.05$). However, after treatment, the mean ABC scale scores differed significantly between the two groups ($P < 0.05$). Pairwise comparisons revealed no significant differences in scores before treatment ($P > 0.05$), but significant differences were observed after treatment ($P < 0.05$). This indicates that both groups showed improvement in ABC scale scores following treatment, with the study group achieving the most significant improvement compared to the control group.See Table 6.

Table 6: Comparison of ABC Scale Scores between the Two Groups [Mean ± Standard Deviation, points]

Group (Mean ± Standard Deviation)	n	Pre-treatment Score	Post-treatment Score
Control Group	50	73.54±8.56	67.78±8.73
Study Group	50	72.22±8.28	51.34±8.62
t		0.78	9.47
P		0.44	0.00

4. Discussion

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by dysfunctions in the sensory and neural systems of the brain. Clinically, it presents with impairments in perception, social interaction, learning ability, language, and motor skills, leading to challenges in learning, daily communication, and empathy. These difficulties severely impact the growth and development of affected children[10]. Currently, there is no specific medication available to effectively treat ASD. The "Whole-Brain Language" approach, combined with its foundational design principles, offers a rehabilitation concept aimed at improving the clinical symptoms related to language disorders in children with ASD. This approach addresses social and language impairments from the perspectives of cognitive neuroscience and specialized technical training.Given that ASD affects multiple systems and areas, the effectiveness of a single training method is limited and cannot significantly improve the overall prognosis of the child. The Whole-Brain Language training model involves engaging multiple sensory modalities, including visual, tactile, auditory, vestibular, and proprioceptive senses, to provide comprehensive sensory training for the child. In this study, conventional technical training was combined with specialized techniques from the Whole-Brain Language model to treat the language and social impairments in children with ASD. The goal was to reduce functional impairments and improve language, social abilities, and clinical symptoms. The intervention was conducted using a team-based approach, with systematic assessments used to design both short- and long-term teaching objectives. These objectives were further refined into specific teaching steps, and re-evaluations were conducted after each treatment period to establish new goals. The treatment plan was dynamically adjusted based on the child's actual progress during the intervention[11].

The innovation of the Whole-Brain Language treatment model lies in its inclusion of parents as active participants in the treatment team for language dysfunction in children with ASD. Through interactive sessions, therapist-parent collaboration, and classroom learning, parents are equipped with certain intervention skills and are regularly assessed through video feedback. In our department, weekly parent workshops were held alongside the multi-child interventions, providing parents with

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knowledge about ASD and relevant intervention methods. This not only helped parents acquire intervention skills but also reduced their anxiety, similar to the outcomes seen in studies conducted abroad where parents are involved in the intervention process. This approach also alleviates the strain on public resources, allowing more children with ASD to benefit from timely intervention.

In conclusion, the development of language expression requires long-term language comprehension, imitation, and the accumulation of social experiences. The Whole-Brain Language treatment model is not intended to completely replace traditional intervention methods; rather, the combination of the two may yield better outcomes. However, due to the limitations of the sample size and the potential biases inherent in short-term studies, further research in this area is necessary to obtain more accurate and reliable results.

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