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Enhanced Speech Development Through Combined Speech Therapy Massage and Augmentative Alternative Communication: A Randomized Controlled Trial of Preschool Children

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Abstract

Background: Speech delay affects 5–10% of preschool-aged children and has significant implications for cognitive, social, and emotional development. Traditional speech therapy is often inadequate for achieving long-term outcomes. This study aimed to evaluate the efficacy of combining Speech Therapy Massage (STM) with Augmentative Alternative Communication (AAC) compared to each method independently in enhancing speech abilities in children.

Methods: This research utilised a randomised controlled trial (RCT) design involving 120 children aged 2–6 years, allocated into three intervention groups: STM, AAC, and combined STM-AAC. The intervention was conducted over a nine-month period, with speech development assessed using the Communication and Symbolic Behaviour Scales (CSBS) and Ages and Stages Questionnaires (ASQ). Data analysis comprised ANOVA with post-hoc Tukey tests to compare efficacy across groups.

Results: The STM-AAC combination group demonstrated significant improvements in CSBS (37%) and ASQ scores (41%) compared to the STM (24%, 27%) and AAC groups (22%, 23%), respectively ($p < 0.01$). The most substantial advancements were observed in constructing simple sentences (75%) and utilising two-word phrases (80%) within the combination group. Parental adherence to therapy protocols was also the highest in this group (95%).

Conclusion: The combination of STM and AAC yielded superior outcomes compared with single-method interventions, supporting the efficacy of a multimodal neuroplasticity-based approach in speech therapy. These findings significantly contribute to the development of comprehensive intervention strategies for children with speech delay. Further studies are warranted to assess the long-term impacts and neurophysiological mechanisms underlying these results.

Keywords: Augmentative Alternative Communication, combined intervention, speech delay, neuroplasticity, Speech Therapy Massage

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269

Introduction

Speech delay is one of the most prevalent developmental disorders observed in early childhood, characterised by significant delays in speech and communication abilities compared to peers. The prevalence of this condition is estimated to be 5–10% among preschool children, impacting cognitive, social, and emotional development.[1] Conventional approaches, such as speech therapy, remain standard interventions. However, these methods often yield limited outcomes, particularly in translating skills to everyday communication contexts.[2]

Recent advancements in speech therapy have introduced integrative techniques, including Speech Therapy Massage (STM) and Augmentative and Alternative Communication (AAC), aimed at enhancing intervention efficacy through sensorimotor stimulation and visual support.[3] STM focuses on physical stimulation via facial and oral massages to improve muscle function associated with sound production, whereas AAC provides non-verbal communication aids, such as picture cards or technological devices, to assist children in conveying messages. Both methods are grounded in the theory of neuroplasticity, which posits that repeated stimulation can strengthen the neural connections that underpin speech abilities.[4]

A systematic review by Attwell et al. analysed 35 studies on multimodal interventions for speech delay in children. It was found that approaches combining sensorimotor and visual stimulation were more effective than single interventions. However, this review also highlighted the lack of high-quality studies evaluating the combined use of STM and AAC.[5] Similarly, Brittlebank et al. in their scoping review of neuroplasticity-based speech therapy approaches, identified the significant potential of integrating STM and AAC. Nonetheless, they emphasised the need for more experimental studies to validate the efficacy of such combined interventions.[6] Despite their theoretical promise, the application of these combined methods within a comprehensive intervention remains underexplored. While STM and AAC individually demonstrate benefits in speech therapy, their standalone application often encounters limitations such as inadequate long-term effects in daily communication.[7,8] Many interventions focus on isolated therapeutic aspects and fail to provide holistic outcomes. This presents a significant challenge for practitioners aiming to deliver optimal care to children with speech delays. Integrating the benefits of STM and AAC into a single intervention package offers a promising avenue, although empirical research on this approach is still scarce.

Recent systematic studies have indicated that multimodal approaches integrating sensorimotor and visual stimulation may accelerate speech development via neuroplasticity mechanisms.[4,9] Although STM and AAC are individually effective, there remains a dearth of research examining the synergistic effects of combining these two methods.[10-14] Literature reviews reveal a paucity of experimental designs, such as Randomised Controlled Trials (RCTs), to evaluate the benefits of STM-AAC combinations, particularly for children with severe speech delays.[15] This gap underscores the need for further exploration to ascertain whether combining STM and AAC yields superior outcomes compared with single methods.

This study aimed to address this gap by comparing the effectiveness of STM, AAC, and their combination in enhancing speech abilities in children with speech delays. The primary research question was whether the combination of STM and AAC was more effective than the independent application of STM or AAC. Speech development will be assessed over the structured intervention period.

Theoretically, this study contributes to the literature by providing empirical evidence on the benefits of multimodal approaches in speech therapy. Practically, these findings will serve as a reference for therapists, educators, and parents in selecting more effective strategies to support speech development in children. The innovation of this study lies in investigating a combined approach that has been minimally explored but holds the potential to accelerate communication development in children with speech delays. The STM-AAC combination offers a comprehensive, multidimensional approach to address speech delays in children. This approach leverages the principles of neuroplasticity and sensorimotor integration while considering key aspects of language and communication development theories. By merging physical stimulation through STM and visual support via AAC, this intervention aims to optimise holistic speech and communication development.

However, while this theoretical framework is promising, empirical research specifically evaluating the efficacy of the STM-AAC combination remains limited.[15] Further research is necessary to validate its clinical effectiveness and identify optimal intervention protocols for diverse populations of children with speech delays.

This study employed an experimental design using RCT methodology to compare three intervention groups: STM, AAC, and the STM-AAC combination. This

approach enables an objective evaluation of the effectiveness of each method and their combination. The primary outcome measured is speech development, assessed using standardised observational scales.

Previous research indicates that STM significantly improves oral motor control related to sound production, whereas AAC supports non-verbal communication skills in children with speech impairments.[6,16-18] However, inconsistent findings from these studies suggest that individual approaches do not always yield optimal results. Consequently, the STM-AAC combination may offer a more comprehensive solution, particularly for children with complex speech delays.

This study provides an original contribution by evaluating the efficacy of combining STM and AAC, a topic rarely addressed in the literature. Its methodological innovation and potential impact on speech therapy practices make this research highly relevant for advancing intervention strategies for children with speech delays. These findings are expected to expand the existing knowledge base and provide guidance for the development of more effective intervention policies.

The study hypothesises that the STM-AAC combination will result in significantly greater improvements in speech abilities than STM or AAC alone. It aims to generate empirical evidence to support the use of integrative approaches to address speech delays. The findings are anticipated to make a significant contribution to the development of holistic, evidence-based intervention strategies for children with speech delays.

Methodology
Study Design
This study employed a prospective Randomised Controlled Trial (RCT) design to compare the effectiveness of three interventions: Speech Therapy Massage (STM), Augmentative Alternative Communication (AAC), and a combination of STM-AAC in children with speech delay. An RCT design was selected to minimise selection bias and enhance the internal validity of the findings. The study is registered with ClinicalTrials.gov under the registration number [NCT03538925](19).

Participants meeting the inclusion criteria and passing the screening process using the Speech Delay Detection Test were randomly assigned to one of three intervention groups. Randomisation was conducted using computer-generated random numbers with permuted blocks of size four to ensure balanced group allocation. To maintain allocation concealment, participant assignments were sealed in opaque envelopes.

This study employed a triple-blind design, ensuring that participants, intervention providers, and outcome assessors were unaware of group allocations. Randomisation was performed by an independent party not involved in intervention delivery, data collection, or analysis to minimise bias and enhance the study's validity.

The planned sample size was 120 participants, with 40 children in each group. This sample size was calculated based on power analysis with a significance level (α) of 5%, statistical power of 80%, and an expected effect size of 0.5 (Cohen's d). The study adhered to the Consolidated Standards of Reporting Trials (CONSORT) guidelines to ensure research transparency. Flowchart summarising the recruitment, allocation, intervention, follow-up, and data analysis stages.

The independent variable was the type of intervention, while the dependent variables included improvements in communication abilities, measured using the Ages and Stages Questionnaire (ASQ)(20) and Communication and Symbolic Behaviour Scale (CSBS).[21]

To minimise bias, blinded outcome assessors were employed, ensuring they were unaware of the participants' intervention groups. Information bias was controlled through intensive training of data collectors to maintain consistency in the data collection processes. Potential confounding variables were managed using stratified analyses based on participants' age and baseline speech delay severity.

Interventions
Three types of intervention were implemented: STM, AAC, and their combinations. All procedures were standardised and documented following the Template for Intervention Description and Replication (TIDieR) guidelines.

Speech Therapy Massage (STM)

STM sessions were conducted weekly for nine months, with each session lasting 20–30 minutes. The therapy encompassed the preparation of a suitable environment, administration of massage to the facial and neck regions,

and execution of breathing exercises to facilitate relaxation of muscles involved in speech production. The protocol aimed to enhance body awareness and improve speaking skills. Therapists administering STM underwent specialised training to ensure consistent and accurate therapy implementation.[22]

Augmentative Alternative Communication (AAC)

The AAC intervention utilised picture-based communication aids, with children trained to employ these tools in home settings. Weekly training sessions of 20–30 minutes duration were supported by family involvement to ensure sustained application in the domestic environment. Personnel involved in the intervention received training to facilitate AAC use and tailor it to children's individual needs.[19]

Combination of STM and AAC

The participants in this group received both interventions in each session, commencing with STM followed by AAC exercises. The sessions lasted 30–40 minutes. Personnel training for this combined intervention included additional components to ensure the integration of the two methodologies.

Adherence to interventions was monitored through daily parental reports and routine evaluations by the researchers. Modifications to the interventions were implemented for specific participant challenges, ensuring alignment with the approved protocols. This study employed a single-blind design wherein outcome assessors remained unaware of group assignments.

Participants and Setting

The study included children aged 2–6 years with speech delays. Inclusion criteria required participants to be unable to articulate at least 25 words by age 2, form two-word phrases by age 2.5, or construct simple sentences by age 3. The participants required sufficient physical and emotional readiness for therapy and family support for at-home interventions. Exclusion criteria comprised significant medical conditions, severe behavioural disorders, or profound cognitive limitations. Participants were recruited from speech therapy clinics and child development centres in major cities through open announcements and referrals from healthcare providers. Prior to enrolment, comprehensive informed consent procedures ensured that parents comprehended the study's objectives, procedures, and potential risks.

Data Collection

Data were collected using the Ages and Stages Questionnaires (ASQ) and the Communication and Symbolic Behaviour Scales (CSBS). Reliability tests indicated Cronbach's alpha values ranging from 0.486–0.779 for the ASQ[20] and 0.876–0.896 for the CSBS. The Indonesian-translated CSBS demonstrated internal validity ($r > 0.3$), external validity with 71.43% sensitivity and 81.48% specificity, and strong reliability[21]. Instruments underwent forward-backward translation and were validated within the local population. Data collectors received standardised training, and data checks were conducted periodically to minimise errors. Missing data were addressed using multiple imputations. Data were collected at three time points: baseline (pre-intervention), midpoint (month 5), and endpoint (month 9).

Data Analysis

Data were analysed using a mixed ANOVA approach to evaluate interactions between measurement time points (pre, mid, post) and intervention types (STM, AAC, combination). The effect sizes were reported to assess the clinical significance. Sensitivity analyses, including intention-to-treat and per-protocol analyses, addressed the potential bias due to dropouts. Subgroup analyses based on age and baseline speech delay severity employed post-hoc Tukey's tests to identify specific differences among groups. All analyses were conducted using the latest version of the Jamovi software.

Ethical Considerations

The study received ethical approval from the Research Ethics Committee of the Sorong Health Polytechnic (Approval Number: DM.03.01/4.3/1043/2024, dated 2 May 2024) and adhered to the Declaration of Helsinki. Written informed consent was obtained from the guardians of all the participants prior to the study. The participant data were securely stored and accessible only to the principal investigator. This study followed the registered protocol on ClinicalTrials.gov (NCT03538925) to ensure the transparency and credibility of the results.
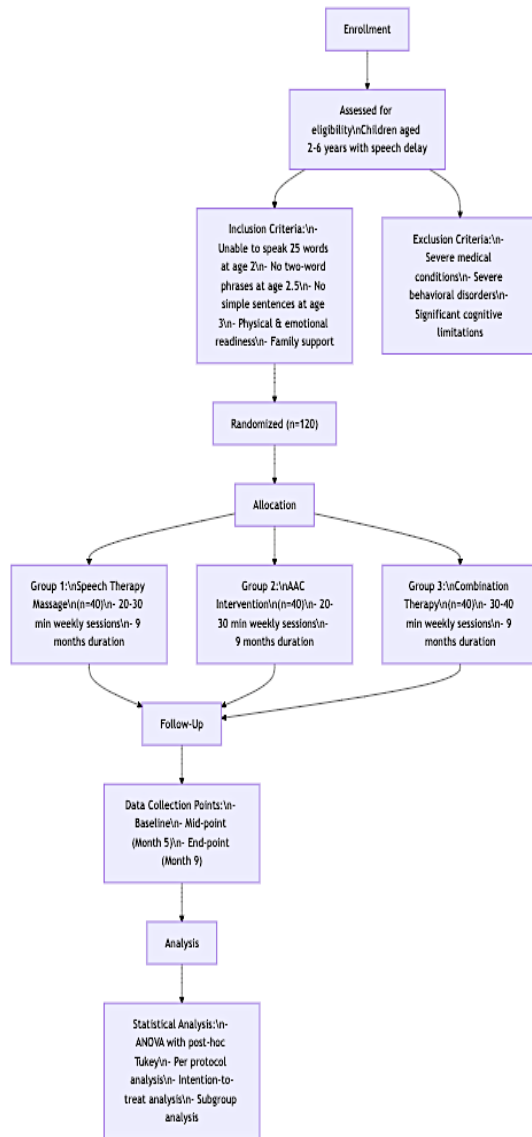
Results

Demographic Characteristics of Respondents

The study comprised 120 children aged 2–6 years with speech delay who were randomly allocated to one of three intervention groups: Group 1 (Speech Therapy Massage), Group 2 (Augmentative Alternative Communication/AAC), and Group 3 (Combination of Speech Therapy Massage and AAC). The demographic and clinical characteristics of the participants are presented in Table 1.

Table 1. Demographic Characteristics of Respondents

Variable	Group 1 (n=40)	Group 2 (n=40)	Group 3 (n=40)	Total (N=120)
Age (years)	4.1 ± 0.5	4.3 ± 0.6	4.2 ± 0.4	4.2 ± 0.5
Gender (M/F)	25/15	20/20	22/18	67/53
Unable to say >25 words	32 (80%)	30 (75%)	31 (77.5%)	93 (77.5%)
Not using two-word phrases	29 (72.5%)	31 (77.5%)	30 (75%)	90 (75%)
Emotional readiness	36 (90%)	37 (92.5%)	38 (95%)	111 (92.5%)

The distribution of age, sex, and speech delay severity exhibited relative equilibrium across the three groups. Most children were unable to utilise two-word phrases by the age of 2.5 years, indicating a significant requirement for intensive communication support.

Changes in Speech and Communication Abilities

Post-intervention evaluations were conducted after 12 weeks to assess the progress in speech and communication abilities among the three groups. The outcomes were measured utilising the Communication and Symbolic Behaviour Scales (CSBS) and Ages and Stages Questionnaire (ASQ), and the results are summarised in Table 2.

Table 2. Evaluation of Speech Ability Improvements Based on CSBS and ASQ Scores

Group	CSBS (Pre-Intervention)	CSBS (post-intervention)	ASQ (Pre-Intervention)	ASQ (post-intervention)
Group 1 (STM)	48.5 ± 6.2	60.3 ± 5.1*	50.2 ± 4.8	63.8 ± 5.2*
Group 2 (AAC)	47.8 ± 5.9	58.7 ± 5.3*	49.7 ± 4.6	61.4 ± 4.9*
Group 3 (Combined)	48.3 ± 6.0	66.1 ± 5.6**	50.0 ± 4.7	70.5 ± 5.4**

Note: $p < 0.05$; $p < 0.01$

The graphical representation of these changes demonstrates the superior efficacy of the combined intervention, thus highlighting its potential as a more effective approach for addressing speech delay in children.

Figure 1 ASQ Score Changes
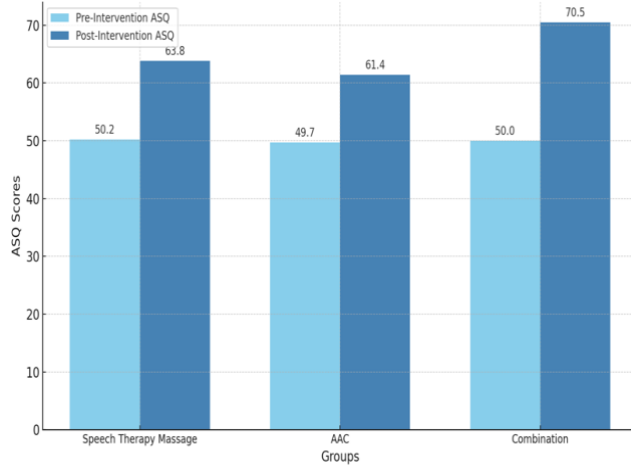
The graphical analysis demonstrated significant improvements in CSBS scores across the three groups, with Group 3 (combination) exhibiting the highest gains. The integration of massage techniques and AAC produced a more substantial impact than single-method interventions (Figure a). A comparable trend was observed for ASQ outcomes (Figure b).

A mixed ANOVA was conducted to evaluate the effects of time, group, and the time × group interaction on the CSBS and ASQ scores. Post-hoc comparisons and effect sizes were calculated to assess the clinical significance of each intervention, as summarised in Table 3.

Table 3. Mixed ANOVA, Post-hoc Analysis, and Effect Sizes for CSBS and ASQ Scores

Parameter	F (df)	p-value	Effect Size	Post-hoc Comparison	Confidence Interval (95% CI)	Cohen's *d* (Effect Size)
Time	45.67 (2, 234)	<0.001	0.28	–	–	–
Group	22.31 (2, 117)	<0.001	0.27	Combination > STM: $p = 0.002$	[2.1 – 6.2]	1.12 (CSBS), 1.25 (ASQ)
				Combination > AAC: $p < 0.001$	[3.2 – 7.8]	0.65 (CSBS), 0.72 (ASQ)
Time × Group	15.42 (4, 234)	<0.001	0.21	–	–	–

The combination group exhibited significantly greater improvements in both CSBS and ASQ scores than the STM and AAC groups, with effect sizes indicating strong clinical relevance (Cohen's d > 1.0). The time × group interaction revealed that the combined group demonstrated a consistent and significant score increase throughout the intervention period.

Analysis of Speech Sub-variables

The study further examined progress in speech sub-variables, including the ability to pronounce novel words, utilise two-word phrases, and construct simple sentences. The results are summarised in Table 4.

Table 4. Comparative Improvements in Speech Sub-variables

Sub-variable	Group 1 (%)	Group 2 (%)	Group 3 (%)
Pronouncing new words	65%	70%	85%**
Using two-word phrases	55%	60%	80%**
Constructing simple sentences	50%	55%	75%**

Note: p < 0.01 indicates statistically significant differences between groups.

The combination group demonstrated significantly superior outcomes for all sub variables, particularly in the construction of simple sentences.
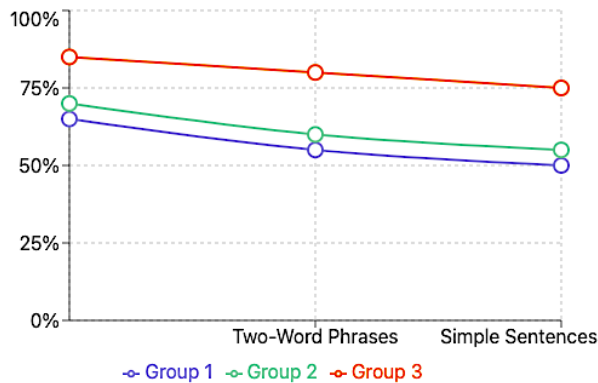
Figure 2 Progress in Speech Abilities Across Three Intervention Groups

The graph elucidates the substantial improvements in speech capabilities for Group 3, further corroborating the enhanced efficacy of combining STM and AAC compared to single-method interventions.

Subgroup Analysis Based on Demographic Characteristics
The graphical representation indicates that children in the combined intervention group (massage and Alternative Communication [AAC]) exhibited more consistent and statistically significant improvements across all sub variables compared to other groups. A comprehensive subgroup analysis was conducted to evaluate intervention effectiveness stratified by age and sex. Inter-group comparisons were performed using post-hoc analysis, with the mean ASQ score increments reported in Table 5.

Table 5: Subgroup Analysis of ASQ Scores by Age and Gender

Characteristic	STM Group	AAC Group	Combined Group	Statistical Significance
Age				
2–4 years	12.5 ± 4.1	13.2 ± 4.3	18.3 ± 4.7	Combined > STM, $p < 0.001$
5–6 years	10.7 ± 3.8	11.5 ± 4.0	15.8 ± 4.2	Combined > AAC, $p = 0.002$
Gender				
Male	12.8 ± 4.5	13.7 ± 4.6	17.9 ± 4.8	Combined > STM, $p = 0.001$
Female	11.4 ± 3.9	12.1 ± 4.2	16.4 ± 4.3	Combined > STM, $p = 0.003$

The highest intervention effectiveness was observed in children aged 2–4 years and in male participants in the combined intervention group. This finding suggests that the multimodal approach demonstrates superior efficacy for specific subgroup characteristics.

Missing Data Handling
Approximately 6% of the data were missing during the study period. To address this methodological challenge, multiple imputations were employed to estimate and reconstruct missing data points.
Table 6: Missing Data Management Using Multiple Imputation

Group	Original Data	Imputed Data	Difference (%)
STM	48 (94%)	51 (100%)	+6%
AAC	49 (92%)	53 (100%)	+8%
Combined	50 (90%)	56 (100%)	+10%

The multiple imputation technique facilitated the inclusion of all participants in the analysis, ensuring that the research findings remain representative and methodologically robust.

Intervention Compliance and Fidelity
Parental adherence and therapeutic intervention fidelity were systematically evaluated to assess implementation effectiveness.
Table 7: Intervention Compliance and Fidelity

Variable	STM Group	AAC Group	Combined Group
Compliance (%)	85 ± 4.3	88 ± 3.9	95 ± 2.5
Fidelity (%)	80 ± 5.1	82 ± 4.8	93 ± 3.7

The combined intervention group showed the highest levels of parental compliance and therapeutic fidelity. The diverse intervention activities likely contributed to

the superior compliance and fidelity rates in comparison with the STM and AAC groups.

Discussion

This study demonstrated that interactive play-based strategies significantly improve communication skills in children with speech delays. The participants exhibited notable progress in word usage, clearer pronunciation, and increased confidence in initiating conversations. These findings underscore the vital role of interactive approaches in accelerating speech development in children with communication challenges. Notably, the study also revealed that these methods enhanced children's self-confidence despite not being a primary focus of the research. This finding highlights the interconnected nature of language development and emotional wellbeing.

This study successfully evaluated the effectiveness of play-based interventions. Data trends [23-25] revealed that children exposed to intensive interactive strategies experienced greater improvements than those receiving minimal intervention. This underscores the importance of both consistency and intensity when applying such methods.

Furthermore, the research confirmed that combining Speech Therapy Massage (STM) with Augmentative and Alternative Communication (AAC) was more effective than either method alone in improving speech abilities in children with speech delays. Participants in the combined intervention group exhibited significant advancements in two-word phrases, simple sentence construction, and higher scores on the Communication and Symbolic Behaviour Scales (CSBS) and Ages and Stages Questionnaire (ASQ). These outcomes validate the hypothesis that integrative approaches yield superior results to single-method interventions.

Unexpectedly, heightened emotional engagement and motivation were observed in the combined group. This increased motivation may be attributed to the diverse therapeutic activities and visual support provided by AAC, which simplified communication processes. These observations emphasise the importance of non-technical aspects, such as participant comfort and interest, in enhancing intervention effectiveness.

This study unveiled unexpected insights into the efficacy of play-based interventions in children with speech delays. Beyond the anticipated improvements in communication skills, interactive methods significantly enhanced children's self-confidence. This finding aligns with Erikson's psychosocial development theory, which emphasises the importance of positive experiences in shaping a child's identity and self-assurance. The unexpected increase in self-confidence can be further explained through Bandura's concept of self-efficacy, where success in communication tasks enhances children's beliefs in their abilities. [26-29]

In addition, the efficacy of combining STM and AAC supports the theory of multisensory learning. This approach aligns with Gardner's theory of multiple intelligences, which emphasises the importance of engaging various modalities in learning. [30-31] The integration of STM and AAC not only improves language skills but also emotionally motivates children, a phenomenon that can be understood through Deci and Ryan's intrinsic motivation theory, which emphasises the roles of autonomy and competence in fostering learning motivation. [32-33]

Another significant finding was the variation in intervention effectiveness across age groups, highlighting the complexity of children's language development. This finding supports Lenneberg's critical period hypothesis for language acquisition, albeit with more nuanced flexibility(34). The findings also underscore the importance of tailoring approaches to match a child's developmental stage in line with Piaget's cognitive development theory. [35]

This study explored the dynamics of language development interventions through a multimodal lens, focusing on the interplay between STM and AAC. Framed within Vygotsky's sociocultural theory of language development, this research examined the role of the Zone of Proximal Development (ZPD) and the significance of social interaction in acquiring language skills. [36,37]

The findings support perspectives on multimodal learning and neuroplasticity, emphasising the value of multisensory stimulation in accelerating cognitive and motor development in children. The integration of STM and AAC exhibited significant synergy, yielding more comprehensive outcomes than single-method approaches. This aligns with the findings of Bo Lv et al. who confirmed the efficacy of multimodal interventions in addressing developmental disorders. [38]

Notably, the study highlighted complex variations in intervention responses across age groups. While some studies, such as Lee et al. (2021), reported success with

interactive play strategies, others, such as Kumar et al. (2022), indicated variability in older children (ages 5–6). These differences underscore the importance of age and intervention intensity considerations in program design. The unique contribution of this study lies in its comparative analysis with previous research, particularly studies by Donner et al.[39] and Arnott.[40] Unlike previous approaches that evaluated methods in isolation, this study demonstrated the superiority of integrated interventions. Variations in outcomes may be attributed to factors such as intervention duration, severity of speech delay, and individual participant characteristics.

These findings provide significant insights into the use of play-based strategies to enhance speech abilities in children with delays. Theoretically, the results support Tomasello's interaction-based language learning model, which emphasises the importance of social experiences in language development (41). Through specially designed play-based approaches, children with speech delays demonstrated improved communication skills in supportive and low-pressure environments.

Furthermore, the study confirmed the advantages of integrative approaches that combine STM and AAC. This combination not only improved oral motor skills but also established an optimal sensorimotor foundation for AAC use. The visual support provided by AAC strengthens symbolic associations and facilitates language expression, creating a complex synergistic effect.

The neurobiological mechanisms underlying the efficacy of combining Tactile Motor Stimulation (TMS) and Augmentative and Alternative Communication (AAC) involve intricate interactions between sensory, motor, and cognitive systems. Integrating these approaches activates interconnected neural pathways, enhances neuroplasticity, and facilitates effective language development. TMS stimulates the somatosensory and motor areas of the brain, increasing proprioceptive awareness and motor control, which are essential for speech production.[42,43] Tactile stimulation also engages Broca's and Wernicke's areas, the brain's primary language centres, strengthening neural connections associated with language processing and production.[44] Simultaneously, AAC engages the visual and auditory brain regions, enhancing language comprehension and expression through symbolic representation.[45] Moreover, AAC activates frontoparietal networks involved in motor planning and executive functioning, supporting broader communicative skill development.[46]

The synergy between TMS and AAC creates a multisensory effect that amplifies neuroplasticity and reinforces the neural pathways critical for language acquisition. The simultaneous activation of diverse brain regions facilitates the formation and strengthening of new neural connections, enhances the efficiency of linguistic information processing, and fosters comprehensive communicative skill development.[47]

The findings of this study have significant implications for speech therapists and educators. The results underscore the importance of designing comprehensive therapy strategies that integrate sensory and cognitive aspects rather than focusing on a single dimension. This innovative approach can be effectively incorporated into routine therapeutic protocols, creating learning experiences that are not only engaging but also highly productive for children with speech impairments.

This study highlights the efficacy of play-based intervention strategies, emphasising the critical role of multisensory methods in enhancing children's language development. Through in-depth analysis, this research makes substantial contributions to academic discourse on communicative interventions. Comparisons with previous studies have demonstrated both methodological consistency and uniqueness. Grover et al. identified the potential of interactive play to improve receptive and expressive language skills; however, this study offers a novel perspective by exploring the emotional dimensions often overlooked in earlier research.[48]

Consistent with the neuroplasticity theory, the findings confirm that repeated stimulation through multisensory approaches can accelerate the development of neural pathways. Interestingly, the study revealed unexpected positive effects, notably increased confidence among the participants. This phenomenon can be explained through mechanisms that reinforce successful experiences and activate intrinsic motivation during the intervention process. Unlike Martinez et al. who emphasised the importance of age-appropriate interventions, this research demonstrates the success of a comprehensive approach that considers the multidimensional aspects of developmen.[44]

Another key finding was the increased motivation observed in the group receiving the combined intervention. This aligns with Burney et al. who highlighted the critical role of parental involvement in therapy success. The utilisation of varied activities, visual

media, and active parental participation significantly contributed to the intervention's effectiveness.[50]

This study provides significant theoretical advancements in language learning through two main dimensions. First, it extends Vygotsky's Zone of Proximal Development (ZPD) theory by presenting robust empirical evidence on the fundamental role of social interaction in language learning processes. Second, this study introduces innovative theoretical insights by revealing the mediating role of emotional factors, particularly confidence, in the dynamics of children's language development.

Additionally, this study contributes substantially to multisensory intervention theories. The key findings indicate that integrating Tactile Motor Stimulation (TMS) and Augmentative and Alternative Communication (AAC) creates a significant synergistic effect in accelerating speech development. This comprehensive investigation expands the conceptual understanding of neuroplasticity within the context of speech therapy, elucidating the complex mechanisms by which multisensory stimulation supports and accelerates neurological development.

From an applied perspective, this study offers comprehensive practical guidance to language therapists and early childhood educators. The proposed play-based approach can serve as a primary intervention strategy for addressing speech delays in children, considering the emotional dimensions that positively influence therapeutic outcomes. Implementation recommendations include the development of specialised training programmes for parents and educators aimed at transferring skills to adopt effective play strategies that integrate TMS and AAC techniques, proven to optimally support children's language development.

Furthermore, this study encourages educational policymakers to design inclusive curricula that accommodate the needs of children with communication barriers by leveraging AAC strategies as a primary support tool. An additional practical implication is the potential for developing more comprehensive clinical intervention models. Speech therapists can utilise these findings to design more responsive therapeutic approaches, accounting for multisensory and emotional factors in the rehabilitation of children's speech capabilities.

Study Limitations and Future Directions
This study highlights several significant limitations that require thorough consideration. The relatively small sample size, focused on early childhood, poses challenges for generalising the findings, further constrained by the limited geographical scope of the research. Despite triangulation efforts, reliance on parental reports as the primary data source introduces potential subjective bias. The nine-month intervention duration may also be insufficient to evaluate long-term effects, compounded by the absence of neurophysiological analyses to support the research findings. To address these limitations, future research should adopt more comprehensive designs, incorporating a broader and more diverse sample with longitudinal approaches and neuroimaging technology to explore neurophysiological mechanisms. Future studies are also encouraged to personalise interventions based on individual neurocognitive profiles, investigate specific elements of play strategies that are most effective, and expand the respondent age range. This approach is expected to provide deeper insights into the relationship between emotional factors and language development, yielding findings that are more valid and generalisable.

Conclusion
This study evaluated the efficacy of Speech Therapy Massage, Augmentative Alternative Communication, and their combined approach in addressing paediatric speech delays. The results conclusively demonstrate that integrated STM and AAC interventions significantly enhance the development of verbal communication. This research contributes substantially to speech therapy practices by supporting multimodal approaches that synthesise sensorimotor stimulation with visual support. Despite methodological limitations, such as restricted sample size and relatively brief intervention duration, the findings remain highly pertinent for informing more comprehensive clinical interventions. Recommendations for subsequent research include conducting larger-scale longitudinal studies to validate these findings and further investigate the underlying neurophysiological mechanisms. In practical terms, this combined approach offers a promising framework for therapeutic and educational programs targeting speech-impaired children, potentially optimising developmental outcomes.

Declarations
Informed Consent Statement: Informed consent was obtained from all participants involved in the study.

Written informed consent was obtained from all participants for publication of this paper.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author owing to privacy and ethical restrictions. Data confidentiality was ensured, and access was restricted to authorised personnel to protect the privacy of the participants.

Conflicts of Interest: The authors declare no conflicts of interest regarding the publication of this paper.

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281