Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v30i18.3432

COMPARISON OF SEMANTIC FEATURE ANALYSIS (SFA) AND MELODIC INTONATION THERAPY (MIT) IN PATIENTS WITH NON-FLUENT APHASIA

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Abstract

Introduction: Individuals with aphasia often experience difficulties in naming objects and words. While there have been reports of treatment benefits from approaches like Semantic Feature Analysis (SFA) and Melodic Intonation Therapy (MIT), a comprehensive understanding of their effectiveness is lacking. This study seeks to address this gap by investigating whether the therapeutic impact of SFA and MIT varies among individuals with Non-Fluent Aphasia. The primary objective of the research is to compare the outcomes of these therapy protocols to gain insights into their relative effectiveness.

Methods: The research was structured as a Between Group Research design, employing a non-randomized control sampling strategy to assess the effectiveness of Semantic Feature Analysis (SFA) and Melodic Intonation Therapy (MIT) in treating patients with Non-Fluent Aphasia. Utilizing a Within Subject Research Design, pre and post assessments were conducted. Data was gathered through purposive sampling from hospital settings, involving a sample size of 10 participants. Comprehensive assessment tools including the Boston Diagnostic Aphasia Examination, Progressive, and Aphasia Severity Scale were administered both before and after therapy sessions, spanning 6-8 weeks, conducted 2-3 days a week, each lasting 30-45 minutes.

Results: The Wilcoxon Signed Ranked Test showed good posttest findings, whereas the Mann-Whitney U Test produced favorable results, indicating a beneficial outcome. This study provides tried-and-true procedures to manage language impairments in people with aphasia, and it is anticipated to have a substantial positive impact on speech-language pathologists working in actual clinical settings.

Keywords: Semantic Feature Analysis & Melodic Intonation Therapy

1. Introduction

A major aspect of aphasia is impaired word retrieval, which has an effect on an individual's abilities for communicating and their overall quality of life (Boyle, 2010). Understanding the underlying causes and using focused rehabilitation techniques can help to lessen this impairment, enabling people with aphasia to communicate and engage with others more effectively (Kendall et al., 2019). Word retrieval is a multi-layered, intricately interrelated cognitive process. In those with aphasia, damage to particular brain regions prevents Word retrieval (Fridriksson, et al., 2018).

Aphasia is a linguistic impairment brought on by injury to the brain parts. Damage to the cortical centre for language may affect a person's ability to comprehend or formulate words. Head injury or stroke/cerebrovascular accident (CVA) can cause Aphasia. But aphasia is also known as a neurodegenerative disease, which means it can develop slowly (Chang et al., 2015). Aphasia can impair or affect the reading, Writing, understanding, and expression of language. It can coexist with other disorders too. Mostly middle age or older adults acquire aphasia. The ratio of children with aphasia is very low. Millions of people are affected by aphasia all around the world. According to a survey, 180k people get aphasia each year in America (Kuljic, 2003).

Spoken and comprehension are the basic function of language. Left side of the brain is responsible for these types of functions (Chang et al., 2015). Wernicke area processes the auditory and visual information (Kuljic, 2003). Different areas of brains are responsible for different functions related to language and language comprehension. Some of them are responsible for connecting the pathways others play different roles.

A semantic feature is simply described as a concept linked with a lexical item. It can also be any concept associated with the grammatical unit. These features also help to understand the meaning of words under certain semantic domains. Semantic feature analysis is being used as an approach for lexical retrieval. This was first introduced by Boyle and Coelho (1995) in a case of non-fluent aphasia. The purpose was to increase naming abilities in individuals *(*Victoria et al., 2014). Semantic Feature Analysis (SFA) is a therapeutic approach utilized in the management of patients with word retrieval issues, which are frequently present in conditions like aphasia. Patients identify and explain numerous characteristics, actions, and associations associated to the target words through guided exercises (Efstratiadou et al., 2018). By enhancing the activation of related ideas, this strategy makes word retrieval more effective (Gravier et al., 2018). SFA provides an effective method for overcoming word-finding difficulties. Wambaugh & Ferguson researched using semantic feature analysis as a treatment protocol for the retrieval of action names in patients with aphasia in 2017. They were evaluated in terms of productivity, information, and production of nouns and verbs. The treatment showed positive improvements in terms of naming. The results showed no changes in accuracy after post-treatment yet verbal productivity did improve (Wambaugh & Ferguson, 2017). Melodic Intonation Therapy (MIT) is a unique method created to help people with aphasia regains speech output. Melodic Intonation is a melodic and rhythmic speech therapy technique that is used for individuals with no-fluent aphasia (Norquist, 2021). Humming & singing are used for uttering words and phrases that are hard to remember for patients. Hand, finger, and toe-tapping are used to generate spontaneous speech (Albert et al., 1973).

MIT makes use of the brain's capacity for musical processing to speed up language production (García et al., 2022). Patients are prompted to sing before moving on to speaking the targeted words or sentences by employing exaggerated intonation patterns. It shows the strong link between musical and linguistic processing in word retrieval and communication, and how MIT's novel technique might help people express them more successfully (García et al., 2022). Zhang et al., (2021) conducted a research on patients. The research compared melodic intonation implementation with traditional language therapy for aphasia individuals. The results of the study showed improvements in communication among patients with aphasia after using melodic intonation therapy (Zhang et al., 2021).

Table 1 *Descriptive Statistics of Demographic Variables (N=10)*

Characteristics	*M*	*SD*	*F*	%
Age	53.80	9.21		
Post Stroke onset	6.50	3.50		
Gender				
Male			3	30
Female			7	70
Education level				
Metric			4	40
Intermediate			3	30
Graduate			3	30
Type of Aphasia				
Broca Aphasia			7	70
Transcortical Motor Aphasia			3	30
Severity of Aphasia				
Mild			3	30
Moderate			7	70
Type of stroke				
Ischemic			4	40
Hemorrhagic			6	60
Socio-Economic status				
Lower Class			-	-
Lower Middle class			1	10
Middle class			5	50
Upper Middle Class			1	10
Upper Class			3	30

Note: SD=Standard Deviation, M=Mean, f=frequency, %= percentage

2. Materials and Method

2.1. Study design

Between Group Research design with non-randomized control sampling strategy was used to check the efficacy of Semantic Feature Analysis (SFA) & Melodic Intonation Therapy (MIT) for patients with Non-Fluent Aphasia. Within Subject Research Design was used for pre and post assessment. Non-Probability Purposive sampling strategy was used. As in the presented population, only the participants in hospitals were selected. The sample was drawn from the population on the rule of non-randomization. In the corresponding study this strategy was used to get participants from different hospitals. Purposive sampling was used in the research study. The sample was selected from different government hospitals in Lahore Punjab, Pakistan.

2.2. Participants

The study focused on a specific group of individuals, specifically patients diagnosed with Non-Fluent Aphasia, ranging in age from 45 to 65 years. A total of 10 patients were included in the sample. The selection criteria were meticulously defined: adults between the ages of 45 and 65 were chosen, particularly those who had experienced aphasia due to stroke. The study specifically targeted individuals who were in the post-stroke phase, having completed a twelve-month period since the onset of the stroke. Among these patients, only those with mild to moderate Aphasia were included, a determination made using the Progressive Aphasia Severity Scale (PASS). Both male and female patients were part of the sample, provided they exhibited preserved repetition abilities and were diagnosed with non-fluent Aphasia. Notably, patients who had not undergone Semantic Feature Analysis (SFA) and Melodic Intonation Therapy (MIT) previously were chosen for this study. However, individuals with concurrent speech-related disorders such as dysarthria, dysphagia, and

apraxia were excluded from the sample, ensuring a focused and specific participant group for the research.

2.3 Treatment Procedure

SFA is an effective therapy. In a research by Boyle and Coelho (1995), the participant showed remarkable improvement in the seventh session. Melodic Intonation Therapy is also effective for individuals having language difficulties. That's why same approaches used in this research study to know the improvements of functional naming in patients with aphasia by using semantic feature analysis and melodic intonation therapy. Therapy protocol was different for both therapy and it administered individually.

The sessions of Treatment & Control group were schedule respectively. 5-7 pictures were used in every session by practicing the same activity that has been mentioned above, for 30-35 minutes. Pictures were selected on the bases of client's need. Total 15-20 pictures were the target of total 20 therapy sessions. The sessions were recorded for record keeping after taking consent from the caregivers of the participants. (2-3 sessions per client, in a week were conducted for six–eight weeks). Sessions were conducted for control group by considering the same pattern of 5-7 words of functional vocabulary for 6-8 weeks with 3-5 trails each but the therapy steps were completely different from Treatment group.

Session Details (Semantic Feature Analysis)

Session No	Goals	Activities
1st	To be able to Name 5-7 pictures on functional vocabulary with multiple trails on the basis of patients' needs with 80% accuracy.	Pictures were presented one by one for 20 seconds to the patient. Semantic cues were used as advised in the therapy. Cues about group, Use, Action, Properties, Location, and Association of the object were used. The responses were recorded.

Session Details (Melodic Intonation Therapy)

S No	Goals	Activities
1st	To be able to repeat 5-7 words on functional vocabulary after the therapist with multiple trails on the basis of patients' needs with 80% accuracy.	The patient was first asked to perform 5 Steps of Melodic Intonation Therapy for each word, these were the steps: Humming, Unison Intoning, Unison Intoning with Fading, Immediate Repetition, Response to Question:

2.4 Assessment Material and Procedure

In this section, the assessment materials and procedures employed for Semantic Feature Analysis (SFA) and Melodic Intonation Therapy (MIT) are described. These critical components serve as the foundation for our study, providing a structured framework for evaluating the efficacy of these therapeutic approaches. The careful selection and execution of assessment tools and procedures are pivotal in gaining valuable insights into the impact of SFA and MIT on individuals with language deficits. These measures were used:

2.4.1 Progressive Aphasia Severity Scale (Sapolsky et al., 2010)

An informal Checklist was used for determining the severity of Aphasia.

The age range was 48-78. PASS primary domains has 10 discrete, and 3 supplemental domains. The scoring of the clinical measure ranged from 0-3 on a 5-point scale. 0, 0.5, 1, 2, and 3 were used for individual ratings.

2.4.2 Boston Diagnostic Aphasia Examination (Goodglass et al., 2020)

It was formulated for diagnostic purpose of aphasia. It examines different domains of language like: expository speech, auditory comprehension, writing and reading modalities (Goodglass & Kaplan, 1972). BDAE consists of Short and Extended version. The short version of BDAE was used for diagnosis. Yes-or-no categories were used to record replies, which were ultimately classified as 0–1 responses.

2.4.2.1 Boston Naming Test (Goodglass et al., 2020). Boston Naming Test is the Subset of BDAE. Boston naming Test-2ed was used for the assessment. The number of accurate spontaneous (SR) and cued responses (SC) on the BNT determined the final score. The discontinuance rule was six consecutive failures, and the basic rule was eight consecutive photographs properly characterized without any additional assistance.

2.4.3 Scoring

Standardized test batteries were used to evaluate each individual both before and after treatment. The 4-point rating scale was used where 0 denotes the absence of a response, perseveratory error, empty speech, and semantic error, 1 indicates the retrieval of a word based on a phonemic cue, 2 denoted the retrieval of a word based on a semantic cue and an incomprehensible response, and 3 denotes the retrieval of a word with no cues, a small articulator error, and morphological mistake.

2.4.6 Statistical Analysis

In the data analysis process, SPSS version 23.00 was employed as the analytical tool. The Mann-Whitney U test was applied to discern variations between two distinct groups, providing valuable insights into their differences. Additionally, the Wilcoxon signed rank test was utilized to evaluate the pre and post-therapy results, offering a comprehensive perspective on the effectiveness of the therapeutic interventions. These statistical methods were pivotal in drawing meaningful conclusions from the research findings.

3. Results

The SPSS version 23.00 was used to analyze the data. Mann Whitney u test was used to know the difference between two groups. Wilcoxon signed rank test was used for pre-post therapy results.
Different test batteries were used for the diagnosis and then language assessment of patients with aphasia. Boston Diagnostic Aphasia Examination, Boston Naming Test, Progressive Aplasia Severity Index, and Stroke Aphasia Quality of Life Scale-39 were used for assessment purpose.

Table 2 *Descriptive Statistics and Psychometric Properties of Boston Diagnostic Aphasia Examination (N=10)*

Variables	*M*	*SD*	*a*	Range
Conversational & Expository Speech				
Simple Social Response	5.90	.74	-.90	5-7
Auditory Comprehension				
Basic Word Discrimination	9.70	1.55	-.17	7-11.50
Commands	3.50	.97	-.99	2-5
Complex Ideational Material	2.60	.84	-1.50	1-4
Recitation, Melody, and Rhythm	1.80	1.03	.34	0-3
Repetition of Words	2.75	.75	-1.04	2-4
Repetition of Sentences	.45	.68	.47	0-2
Reading				
Basic Symbol Recognition	2.50	1.08	.15	1-4
Number Matching	2.50	.97	-.06	1-4
Word Identification	2.60	.97	-.09	1-4
Oral Reading of Sentences with comprehension	3.20	1.32	.34	1-5
Writing-Mechanics of Writing				
Well-Formedness of Letters	6.80	1.13	-1.57	5-8
Correctness of Letter Choice	7.20	1.32	-.57	5-9
Motor Facility	2.80	1.62	.36	0-6

Note: K= Number of items; M= Mean; SD= Standard Deviation; α= Alpha; s = Skewnes; k= Kurtosis

The mean and standard deviation of the Boston Diagnostic Aphasia Examination are shown in Table 2. Kurtosis should be between -10 and +10, and skewness should be between -3 and +3 (Brown, 2006). The internal consistency index (alpha coefficient) is also displayed. The results showed that some of the sub-parts of BDAE are correlated other are not above .70 because this measure was used for diagnostic purposes that's why the results are not correlated, it has diversity.

Table 3 *Descriptive Statistics and Psychometric Properties of Progressive Aphasia Severity Index, Boston Naming Test, and Stroke Aphasia Quality of Life Scale-39 (N=10)*

Variables	*M*	*SD*	*a*	Range
PASS	4.00	.94	.64	2-5
BNT	19.60	3.20	.75	15-25
PS	44.67	3.52	.04	40-50
CS	9.27	.74	.20	8-10
PS	37.15	3.37	.25	32-43

Note: K= Number of items; M= Mean; SD= Standard Deviation; α= Alpha; s = Skewnes; k= Kurtosis; PASS= Progressive Aphasia Severity Scale; BNT= Boston Naming Test; PS= Physical Scores; CS= Communication Scores; PS= Psychosocial Scores

Table 3 shows mean and standard deviation of Progressive Aphasia Severity Scale, Boston Naming Test, Stroke Aphasia Quality of Life Scale-39 (Physical, Communication, and Psychosocial Domains). Additionally, the value of skewness and kurtosis is shown. Kurtosis should be between -10 and +10, while skewness should be between -3 and +3. For each scale employed in this study, the internal consistency index (alpha coefficient) is also shown. Progressive Aphasia Severity Scale indicated an alpha value of a= .64. The results showed that BNT is internally highly consistent, as an alpha coefficient is above .70. Physical, Communication, and Psychosocial Domains of Stroke Aphasia Quality of Life Scale-39 are not internally highly consistent because the data is acquired from stroke survivors and each participant is different from each other.

Table 6 *Wilcoxon Signed Ranked Test for Mean Comparison of Pre and Post Test of Boston Naming Test for Patients Treatment Group (Semantic Feature Analysis) and Control Group (Melodic Intonation Therapy) (N=05)*

	Pre Scores		Post Scores			
Variable	*M*	*Mdn*	*M*	*Mdn*	*Z*	*P*
BNT SFA	47.20	18.22	56.20	57.00	-2.02	.04
BNT MIT	17.80	22.00	21.40	47.00	-2.03	.04

*Note: M=Mean; SD=Standard Deviation; BNT= Boston Naming Test; SFA= Semantic Feature Analysis; MIT= Melodic Intonation Therapy; *P<.05, **P<.01, ***P<.001*

Table 6 presents the mean, median and Z-test for pre and posttest of Boston Naming Test for SFA & MIT. Findings indicated significant mean differences on Boston Naming Test for SFA & MIT. Results showed that mean scores of pre Boston naming test for both therapy subsequently increased on post-test. The z value showed significant difference. t value showed the mean rank (t=3.00).

Table 7 *Mann-Whitney U Test for the Difference between SFA and MIT in Pre and Post Scores of BNT (N=10)*

	SFA		MIT			
Variables	*M*	*Mdn*	*M*	*Mdn*	*U*	*p*
BNT Pre	17.80	18.00	3.36	22.00	65.0	.00
BNT Post	56.20	57.00	3.96	47.00	221.0	.03

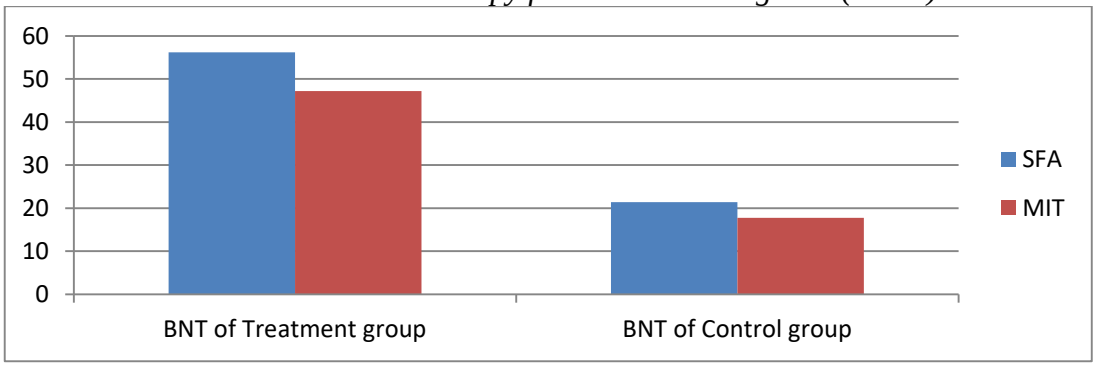
*Note: M= Mean; Mdn= Median; BNT= Boston Naming Test: SFA: Semantic Feature Analysis: MIT= Melodic Intonation Therapy: *P<.05, **P<.01, ***P<.001*

Table 7 represents the Mann-Whitney U scores for SFA and MIT in Pre-Post Scores of BNT. Date results represent mean, median, and u value. The results indicate significant difference between Semantic Feature Analysis and Melodic intonation Therapy. Results of BNT proved that SFA showed higher significance than MIT.

Comparison of Treatment group (Semantic Feature Analysis) and Control group (Melodic Intonation Therapy)

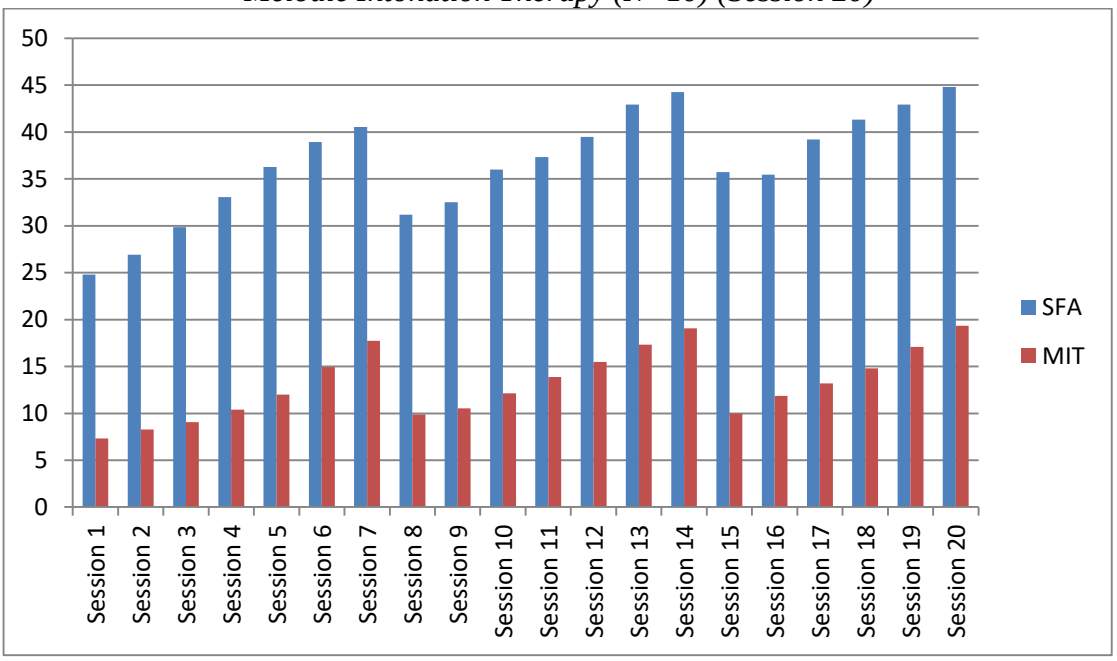
The progression of effective therapy protocols is paramount to supporting individuals with communication disorders. As in aphasia multiple therapy protocols are effective for increasing the language of individuals. Among these protocols, two have emerged as highly impactful for aphasia: Semantic feature analysis and melodic intonation therapy. While both approaches have shown promise in facilitating improvements in speech and language skills, semantic feature analysis stands out as the more effective option. The outcome of therapy sessions of these two therapy protocols is shown by the chart further:

Figure 1 *Showing Difference between Mean Scores of Pre and Post Semantic Feature Analysis and Melodic Intonation Therapy for Boston Naming Test (N=10)*



Note: SFA=Semantic Feature Analysis; MIT= Melodic Intonation Therapy

Figure 2 *Showing the Difference in Obtained Scores Percentage of Semantic Feature Analysis and Melodic Intonation Therapy (N=10) (Session 20)*



Note: SFA=Semantic Feature Analysis; MIT= Melodic Intonation Therapy

Figure 2 explains that Semantic Feature Analysis (SFA) yields superior results than Melodic Intonation Therapy after a series of 20 sessions on each individual. Both groups received 20 therapy sessions, with equal intensity and duration. The study found that participants, who went under SFA, demonstrated significantly better outcomes in word retrieval as compared to those who received MIT. Moreover, the gains made through SFA were more pronounced and sustained over time.

Table 11 *Mean and Standard Deviation of Semantic Feature Analysis and Melodic Intonation Therapy (N=10) (Sessions=20)*

Variables	*M*	*SD*
Semantic Feature Analysis	36.68	5.64
Melodic Intonation Therapy	13.21	3.64

Note: M=Mean: SD=Standard Deviation

Table 11 displayed the difference between the mean scores of semantic feature analysis and melodic intonation therapy. The mean score for semantic feature analysis is significantly high from melodic intonation therapy. The mean for semantic feature analysis is (*M*=36.68; *SD*=5.64), and for melodic intonation therapy it is (*M*=13.21; *SD*=3. 64).

Discussion

The purpose of the study was to know the effectiveness of melodic intonation therapy and semantic feature analysis. Different hypotheses were presented to analyze the effectiveness of Semantic Feature Analysis and Melodic Intonation Therapy. The post result outcome was also concluded.

The first hypothesis was H1: Semantic Feature Analysis is likely to be more effective for Non-Fluent Aphasia than Melodic Intonation Therapy. Mann Whitney U Test was used for between-groups research analysis. The test results of the Boston Naming Test proved that SFA was more successful than Melodic Intonation Therapy. The test results of the Boston Diagnostic Aphasia Examination showed that Semantic Feature Analysis and Melodic Intonation Therapy stated the same results.

Multiple researches have been conducted on the efficacy of Semantic Feature Analysis. These researches proved that this therapy is effective for developing naming abilities in older adults that suffer from aphasia. But the literature lacks comparative studies. In this study, the results of assessment measures showed improvement in adults that were having Semantic Feature Analysis. It is crucial to understand that when used in combination with the BDAE, semantic feature analysis (SFA), and melodic intonation therapy (MIT) each treatment technique is specifically designed to target a different element of language problems in aphasia because the therapy was not designed for each subscale/factor of BDAE, test results varied While Melodic Intonation Therapy and Semantic Feature Analysis have both showed potential in a few scenarios. This test was used for the diagnostic purpose that's why the results didn't show much improvement in the speech expository, auditory, reading, and writing domains in the post-test results. The results for BNT were significantly positive in adults having SFA because it evaluates a person's capacity to name objects or images (Kaplan et al., 2005). Moreover, the gains made through SFA were more pronounced and sustained over time.
2nd hypothesis stated that Post-test results are significantly higher than pre-test results after using Semantic Feature Analysis and Melodic Intonation Therapy. The post-test results revealed an increase in the pre-Boston name test mean scores for both melodic intonation therapy and semantic feature analysis. The considerable improvement in post-test scores over pre-test scores shows that the use of Semantic Feature Analysis (SFA) has produced exceptional results. The post-test results of individuals having Melodic Intonation Therapy were also improved. The post-test results of BDAE were not significantly different from pre-test results because the therapeutic intervention was not designed for all domains of BDAE rater the therapy focuses on retrieving naming abilities in individuals suffering from aphasia (Chen et al., 2023). In BDAE, each therapeutic strategy is tailored to address specific aspects of language deficits in aphasia (Tabei et al., 2016). The post-test results of BNT were significant that showed the therapeutic intervention worked and the individual was able to give responses more effectively. By comparing the effectiveness of these two therapy protocols, this study aimed to provide speech and language pathologists with valuable insights into the most efficacious and beneficial treatment approach for aphasia. Efstratiadou's (2018) research study evaluated the effectiveness of SFA. 21 studies based on a total of 55 patients with aphasia concluded. The study concluded at the point that Semantic Feature Analysis brings positive improvements in patients with aphasia. Except for the variations in the SFA protocol, the effectiveness is never hampered (Efstratiadou et al., 2018).

Limitations

The current study faced several methodological challenges. Firstly, the sample size was notably small, limiting the breadth of the findings. This constraint impacts the generalizability of the data, making it challenging to apply the results to a broader population. Another significant challenge was the time-consuming nature of efficacy studies, requiring substantial resources and effort.

Additionally, the subjectivity in identifying and selecting semantic features posed a hurdle. Different perspectives on what constitutes relevant features among individuals introduced inconsistency in the application of Semantic Feature Analysis (SFA) and Melodic Intonation Therapy (MIT). Moreover, while SFA aimed to identify semantic features, it did not always offer a comprehensive explanation for the associations between specific features and words or concepts. Furthermore, the study's controlled environment might not accurately reflect real-world conditions, potentially influencing participant behavior and outcomes. The findings may not seamlessly translate to practical clinical settings, where various variables can impact results. Moreover, the availability of adults for therapy sessions posed a logistical challenge, and the study's outcomes were hindered by noisy therapy environments, which could have affected the results negatively. These limitations collectively impacted the study's scope and applicability.

4. Conclusion

Findings of this study revealed interesting identifications. As a consequence, it is abundantly obvious from the post-results analysis that Semantic Feature Analysis (SFA) is a more successful and effective strategy when compared to Melodic Intonation Therapy in the context of enhancing communication and language abilities. SFA showed that it was able to promote language recollection and understanding through the systematic and focused identification of semantic characteristics, producing better and more reliable outcomes than the more conventional Melodic Intonation Therapy. The data is compelling in favor of using SFA as a vital and cutting-edge technique in language therapy and rehabilitation, providing potential paths for patients with aphasia.

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