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Audio-Visual Entrainment (AVE) Therapy in Reducing Symptoms of Pseudobulbar Affect (PBA): Two Case Studies

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Abstract

Introduction. Pseudobulbar affect (PBA) is characterized by involuntary episodes of laughter or crying, often associated with neurological disorders, significantly impacting the quality of life. This study investigates the effectiveness of audio-visual entrainment (AVE) therapy in reducing PBA symptoms. **Methods.** The study employed a one-group pretest–posttest experimental design with a sample of 472 individuals from Baghdad, Iraq. Two participants diagnosed with multiple sclerosis and amyotrophic lateral sclerosis underwent 40 AVE sessions over 2 months using the DAVID Delight Pro device. The Center for Neurologic Study-Lability Scale (CNS-LS) was used to measure PBA symptoms before and after the intervention, with a follow-up 3 months postintervention. **Results.** Both participants showed significant reductions in CNS-LS scores postintervention (male: 22 to 14; female: 25 to 12), indicating decreased frequency and intensity of emotional outbursts. The Wilcoxon signed-rank test revealed significant differences between pretest and posttest scores with a large effect size ($r \approx -0.95$). **Conclusion.** AVE therapy effectively reduces PBA symptoms, demonstrating lasting benefits at a 3-month follow-up. This study supports AVE as a promising nonpharmacological treatment for PBA, encouraging further research on its application to other neurological conditions.

Keywords: pseudobulbar affect (PBA); audio-visual entrainment (AVE); CNS-LS; neurological therapy; emotional dysregulation; nonpharmacological intervention

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Introduction

Pseudobulbar affect (PBA) is a neurological disorder characterized by sudden, involuntary, and often inappropriate episodes of uncontrollable laughter or crying, usually disproportionate to the individual's emotional state (Riera, 2024). It commonly manifests in individuals with conditions like multiple sclerosis (MS), traumatic brain injury (TBI), stroke, and amyotrophic lateral sclerosis (ALS; Jain, 2014; Schiffer & Pope, 2005). These episodes, which can be distressing and socially disruptive, significantly impair patients' quality of life by leading to embarrassment, social withdrawal, and difficulties in daily functioning (Cummings, 2017; Rosen, 2008). For some patients, these episodes can be partially controlled voluntarily, while for others, they are uncontrollable (Robinson-Smith & Grill, 2007).

The terminology surrounding PBA varies, with terms like emotional lability, pathological laughter and crying, and emotional incontinence often used interchangeably. Despite this variability, *pseudobulbar affect* remains the most widely accepted term in clinical practice and research (Ahmed & Simmons, 2013; Hicks et al., 2020).

Accurate diagnosis of PBA is challenging due to symptom overlap with other conditions such as depression, essential crying, dacrystic seizures, gelastic seizures, and rapid-cycling bipolar disorder, along with other mood disorders, which complicates effective management (Hicks et al., 2020; Miller et

al., 2011; Work et al., 2011). Scientists attribute PBA to damage in brain regions responsible for regulating emotions and affect. Brain injuries or illnesses can trigger PBA symptoms, which are typically associated with conditions like stroke (28%), Alzheimer's disease/dementia (39%), MS (46%), Parkinson's disease (24%), and TBI (48%; King & Reiss, 2013; Schiffer & Pope, 2005). PBA is believed to result from brain lesions that disrupt the neural circuits regulating emotional expression (Work et al., 2011).

Current treatment approaches include medications like selective serotonin reuptake inhibitors (SSRIs) and the dextromethorphan-quinidine combination, although these offer only partial relief and come with potential side effects (Arciniegas et al., 2014; Schiffer & Pope, 2005). In this context, noninvasive interventions like audio-visual entrainment (AVE) therapy have gained attention. AVE uses rhythmic pulses of light and sound to modulate brainwave activity, promoting relaxation, cognitive enhancement, and mood stabilization (Gallina, 2022). It has shown efficacy in treating conditions such as anxiety, attention-deficit/hyperactivity disorder (ADHD), and chronic pain (Basu et al., 2024; Berg & Siever, 2009). Given its potential to influence neurophysiological processes without significant adverse effects, AVE may be a promising alternative for managing PBA symptoms (Aftanas et al., 2016; Bahrami, 2024).

This study aims to evaluate the effectiveness of AVE therapy in alleviating symptoms of PBA, marking the first investigation of its kind within the Arabic and Iraqi context. The operational definition of AVE in this research is based on its use through the DAVID Delight Pro device, which is widely recognized for its therapeutic applications across various neurological and psychological conditions (Siever, 2004). By addressing this gap in the literature, the study provides valuable insights and opens new avenues for exploring AVE's potential in treating other neurological disorders. The significance of this research lies in several key aspects: It represents the first Arabic and Iraqi study to specifically address PBA and the first to explore the use of AVE technology for this condition at both the national and international levels. This research's findings can inspire further studies involving different populations and age groups affected by PBA. Additionally, this study lays the groundwork for investigating the broader applications of AVE technology in treating other disorders, thereby enriching scientific literature with cutting-edge research amidst ongoing technological advancements. The specific objectives of this research are to assess the prevalence and severity of PBA within a sample from the Iraqi community in Baghdad and to evaluate the effectiveness of AVE therapy in reducing PBA symptoms.

Research Scope. This study focuses on a sample of adults aged 18 and above residing in Baghdad Governorate during 2024. The sample includes individuals of both genders and various educational backgrounds. The scope is limited to Baghdad due to the challenges in finding sufficient participants diagnosed with PBA, leading to a restricted sample size.

Methods and Materials

This study utilized a one-group pretest–posttest experimental design to assess the effectiveness of AVE therapy in reducing PBA symptoms. This design measured participants' symptoms before and after the intervention without including a control group. The target population for this research included adults aged 18 years and above residing exclusively in Baghdad Governorate during 2023 and 2024, covering both genders and all educational levels.

Due to the challenge of obtaining a sample of individuals diagnosed with PBA and the difficulty in locating such participants, social media platforms were used to distribute a survey incorporating the research tool, "the Center for Neurologic Study-Lability Scale (CNS-LS)" (Moore et al., 1997). The survey was shared voluntarily, allowing participation from anyone interested or experiencing psychological or neurological issues. The final sample comprised 472 participants with diverse educational backgrounds, including males and females. Table 1 outlines the details of the survey sample. It is important to note that formal informed consent was not obtained at this stage since the survey was conducted online. The participants had an average age of 28.56 years (*SD* = 9.23), ranging from 18 to 61 years.

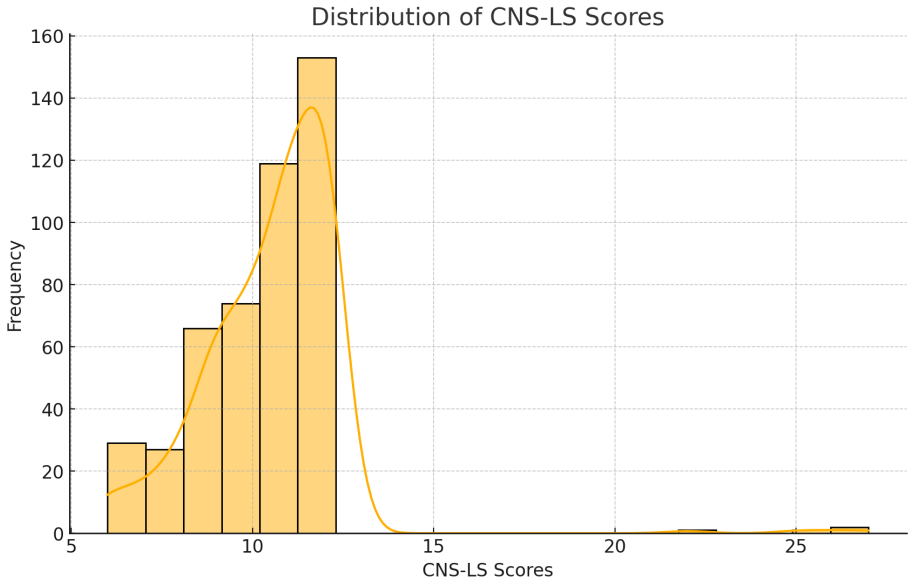
Table 1
Distribution of Survey Sample by Gender and Educational Level

Gender	Educational Level	Sample Size
	Elementary School	3
	High School	16
	Intermediate	7
	Institute (after Intermediate School)	3
Female	Institute (High School)	5
	College	248
	Master's Degree	38
	Doctorate	20
	Literate	12
Total for Females		**352**
	Elementary School	2
	High School	7
	Intermediate	1
	Institute (after Intermediate School)	1
Male	Institute (High School)	3
	College	63
	Master's Degree	19
	Doctorate	23
	Literate	1
Total for Males		**120**
Total Survey Sample		**472**

After administering the CNS-LS and analyzing the collected data, the results revealed key statistical information related to CNS-LS scores. The overall mean CNS-LS score for the survey sample was 10.56 (*SD* = 2.08), with males averaging a score of 10.26 (*SD* = 2.71) and females averaging 10.66 (*SD* = 1.80). The median CNS-LS score across all groups was 11.00, while the most frequently occurring score (*mode*) was 12.00. The *range* of CNS-LS scores spanned from a minimum of 6.00 to a maximum of 27.00 for the total sample. Notably, the sample comprised 472 participants, 120 males and 352 females. The confidence level for these findings was 95%, providing a solid basis for interpreting the data.

To further analyze the data distribution, a *Shapiro-Wilk* test was conducted to assess normality. The test produced a statistic of 0.727 with a *p*-value of 4.603×10^{-27}. Given that the *p*-value is well below the .05 threshold, we reject the null hypothesis that the data follow a normal distribution. These results confirm that the CNS-LS scores are not normally distributed (see Figure 1).

Figure 1. *Distribution of Raw Scores Obtained by Survey Sample Participants.*



Participants

The research population consisted of adults aged 18 to 61 years residing in Baghdad Governorate, representing both genders and various educational backgrounds. Given the rarity of PBA, the final sample included only two individuals who met the study's inclusion criteria: a 39-year-old male diagnosed with MS and a 39-year-old female diagnosed with amyotrophic ALS.

The study used a survey approach with 472 participants, screened using the CNS-LS. The survey was distributed online to identify individuals with high PBA scores. Out of the participants, only two were diagnosed with neurological conditions associated with PBA, reflecting the rarity of the condition in this population. Statistical analysis provided insights into the severity of symptoms, showing significant emotional lability in these identified cases.

Inclusion Criteria.

1. Diagnosis of a neurological disorder associated with PBA (e.g., MS, ALS).
2. Frequent episodes of emotional lability.
3. Willingness to participate for the entire duration of the study.

Exclusion Criteria

1. Absence of a neurological disorder associated with PBA.
2. Inability to complete the AVE therapy sessions.
3. Current use of medications that affect emotional lability.

This study was approved by the Scientific and Ethical Committee of the Iraqi Association for Psychotherapy (Approval Number: IAP-2023-04-05) on April 5, 2023. All participants provided informed consent prior to their inclusion in the study. The research was conducted following the ethical standards laid down in the 1964 Declaration of Helsinki (World Medical Association, 2013) and its later amendments. No experiments involving animals were conducted in this study.

Instruments

Pseudobulbar Affect (PBA) Scale. The CNS-LS is a self-assessment tool comprising seven items designed to measure the frequency of PBA symptoms. Although the scale has been translated into several languages (Chen et al., 2024), it has not previously been available for clinical or research use among Arabic-speaking populations. The CNS-LS allows respondents to assess their experiences with PBA symptoms, facilitating accurate and objective diagnosis by specialists. Originally developed and validated by Moore et al. (1997) in a population of patients with ALS and MS, the CNS-LS quantitatively evaluates aspects of PBA such as frequency, severity, emotional lability, degree of voluntary control, and appropriateness.

The scale includes four items related to laughter and three related to tears, each rated on a 5-point Likert scale (*never*, *rarely*, *occasionally*, *often*, *very often*), scoring from 1 to 5 per response. In patients with ALS, a score of 13 or higher suggests a likely diagnosis of PBA, while in those with MS, a score of

17 or higher indicates a high probability of PBA (Ahmed & Simmons, 2013; Moore et al., 1997).

Psychometric Properties of the PBA Scale.

a) ***Translation Validity.*** The research tool was translated from English to Arabic to ensure its suitability and validity in the Iraqi context. The back-translation method was employed to maintain translation accuracy (Butcher & Han, 1996). Two independent bilingual experts translated the items from English to Arabic, Professor Dr. Nabil Abdul Aziz Al-Badri (University of Tikrit) and the researcher. The translations were then consolidated into a single version and back-translated into English by Asst. Prof. Dr. Muzaffar Jawad Ahmed (Psychological Research Center, Ministry of Higher Education and Scientific Research) and the researcher. This back-translated version was compared with the original to ensure accuracy. Minor adjustments were made to align the psychological meanings with the Iraqi context. Finally, an Arabic language expert, Asst. Prof. Dr. Israa Al-Gharbawi (Psychological Research Center, Ministry of Higher Education and Scientific Research) reviewed the translation for linguistic accuracy.

b) ***Reliability*. The Cronbach's alpha coefficient** was calculated using data from 472 participants who completed the CNS-LS scale online as part of our search for individuals with PBA. The alpha value was approximately $\alpha = 0.73$, indicating good internal consistency among the questionnaire items. This suggests that the CNS-LS questions reliably measure the intended concept. With Cronbach's alpha values ranging from 0 to 1, a value of 0.73 indicates an acceptable level of consistency, supporting the reliability of the scale results in this study (Cronbach, 1951).

Test-Retest Method. To assess reliability, the research tool was readministered online to a randomly selected sample of 50 individuals 2 weeks after their initial participation. This interval was chosen to ensure participant availability while maintaining consistency between tests. Pearson's correlation coefficient between the scores from both applications was calculated, resulting in a reliability coefficient of 0.81, indicating strong reliability (Weiten et al., 1991).

DAVID Delight Pro Device. The DAVID Delight Pro is a Canadian-made portable device offering nonpharmacological treatments for various conditions, including concussions, TBI, and cognitive disorders. It utilizes AVE and cranial electrotherapy stimulation (CES) technologies, which are noninvasive methods to enhance mental and physical performance. These technologies can be used individually or together to improve sleep, reduce cognitive decline, and treat conditions such as ADHD, seasonal affective disorder (SAD), depression, insomnia, and anxiety (Mind Alive Inc., 2024; see Figure 2).

Figure 2. *DAVID Delight Pro Device.*

The DAVID Delight Pro device consists of the Delight Pro unit, the patented multicolor glasses with a carrying case for the glasses, headphones, an A/C power adapter, an AUX stereo jack, a 9-volt battery, a handheld carrying case, a quick start guide, a user manual, and an instruction CD (see Figure 3).

Research has shown that AVE technology effectively guides the brain to different brainwave states, increases neurotransmitter production, and enhances cerebral blood flow. Additionally, CES technology effectively increases blood flow and stimulates neurotransmitters such as serotonin, endorphins, and norepinephrine (Aftanas et al., 2016; Siever, 2012).

Figure 3. *Components of the DAVID Delight Pro Device.*

The DAVID Delight Pro device offers five categories of therapeutic sessions: activation, meditation, brain booster, sleep, and mood enhancement, each with multiple options. It also features customizable sessions and incorporates CES technology with a 100 Hz frequency. The sessions are designed based on research to target various mental and physical functions, such as enhancing focus, improving sleep, and reducing stress (Mind Alive Inc., 2024).

Procedures

Given the difficulty in locating individuals diagnosed with PBA, social media platforms were used to distribute a survey incorporating the CNS-LS (Moore et al., 1997; Smith et al., 2004). The survey was completed by 472 participants via Google Forms between April 20, 2023, and January 27, 2024. Data analysis revealed a non-normal distribution, prompting the calculation of the 95th percentile (score = 12) to identify participants with high CNS-LS scores. Four participants exceeded this threshold, with two diagnosed with neurological conditions (MS and ALS) and scoring between 22 and 27. After structured interviews, two were excluded due to the absence of neurological conditions and PBA symptoms.

The two remaining individuals were confirmed to have neurological conditions, and the structured interviews further indicated that they exhibited symptoms consistent with emotional lability syndrome (see Table 2).

Table 2

Percentile Scores of Individuals Diagnosed With Neurological Diseases and Symptoms of Pseudobulbar Affect (PBA)

Gender	Age (Years)	Educational Level	Occupation	Suffering from MS, ALS, Alzheimer's Disease, or Parkinson's Disease	CNS-LS Score	Percentile
Male	39	Postgraduate	Employee	Yes	22	25.0
Female	39	College	Employee	Yes	25	50.0

After confirming the PBA diagnosis and obtaining participants' agreement, informed consent was secured for AVE therapy sessions. The process included:

1. **Pretest Assessment:** Participants completed a paper version of the CNS-LS to establish baseline emotional lability scores.
2. **AVE Therapy Intervention:** Over 2 months, participants underwent 40 AVE sessions using the DAVID Delight Pro device (20–30 min per session, five times weekly), primarily using the "brain boosting" mode.
3. **Posttest Assessment:** Participants retook the CNS-LS to assess symptom changes.
4. **Follow-Up Assessment:** 3 months postintervention, the CNS-LS was administered again, with regular check-ins for monitoring.

Data were collected at three points: pretest, posttest, and follow-up, utilizing interviews, observations, self-reports, and third-party feedback. The therapeutic program was then initiated accordingly.

Program Planning and Objectives

The program planning process involved defining the research objectives, outlining the scientific content, and clarifying the procedures, strategies, and approaches for applying AVE technology. The sessions were carefully structured by specifying their duration, type, and frequency. These sessions were conducted at the Iraqi Association for Psychotherapy in Baghdad from February 10, 2024, to April 11, 2024, with the primary goal of alleviating the symptoms of PBA in the participants.

Instructions for Implementing the Therapeutic Program

The program began with participant training, during which they were instructed on properly using the AVE device. This included the correct positioning of the glasses and headphones, along with a thorough explanation of the technology and details of each session. A presession protocol instruction guide was provided to support the participants' engagement. Additionally, two AVE devices were prepared for home use, with daily follow-ups to ensure adherence to the treatment schedule.

Participants were also advised to maintain healthy sleep and nutrition throughout the program. This included recommendations to sleep well and consume breakfast before the sessions while avoiding unhealthy foods that could potentially interfere with their overall well-being during the treatment. Biological factors, such as metabolism, were closely monitored, with reminders for participants to use the restroom before starting a session to prevent interruptions.

As part of the program guidelines, participants were instructed to avoid taking any medications, if possible, to ensure that external factors did not influence the effects of the AVE therapy. A quiet, distraction-free environment was recommended for the sessions to maximize the therapeutic effects. Each participant attended five weekly sessions, lasting between 20 and 30 min, over 2 months, completing 40 sessions. Upon completion of the program, the Emotional Lability scale was administered to assess the effectiveness of the therapy.

Session Content. Each session with the DAVID Delight Pro device is designed to modulate brainwave frequencies and improve cognitive function. Based on established literature and previous research using this technology, the "brain-boosting" session was identified as most suitable for achieving the study's goals. This session is recognized for enhancing focus, cognitive performance, and mental clarity. After the completion of 40 sessions, the devices were returned, and the posttest assessment using the Emotional Lability scale was administered to evaluate changes in participants' symptoms.

Data Analysis. Due to the small sample size and non-normal distribution of scores, nonparametric statistical methods were employed. The Wilcoxon signed-rank test was used to compare pretest and posttest CNS-LS scores, while effect sizes were calculated to assess the magnitude of observed changes.

Detailed Case Studies.

Case Study 1: Male, Age 39, Postgraduate Employee. This case involves a 39-year-old male diagnosed with MS 10 years ago. He frequently experienced episodes of emotional lability, characterized by uncontrollable laughter and crying, though he had no other significant comorbidities. His baseline characteristics included a CNS-LS pretest score of 22. He worked as an office employee, had a postgraduate degree, and lived in Baghdad with his wife and two children.

Before the intervention, the participant reported experiencing significant distress due to frequent emotional outbursts, which negatively impacted both his personal and professional life. To address this, he underwent a therapeutic intervention consisting of 40 AVE sessions conducted over 2 months, utilizing the brain boosting protocol.

Following the intervention, the participant's CNS-LS posttest score decreased to 14, indicating a marked improvement. Self-report questionnaires and interviews measured improvements in mood stability and overall mental well-being. Furthermore, feedback from family members and colleagues gathered through structured interviews revealed noticeable positive changes in his emotional regulation, demonstrating the effectiveness of AVE therapy.

Case Study 2: Female, Age 39, College Employee. This case centers around a 39-year-old female diagnosed with amyotrophic ALS 5 years ago. She frequently experienced uncontrollable crying episodes without any appropriate emotional triggers. Aside from her ALS diagnosis, she had no additional neurological or psychiatric conditions. At baseline, her CNS-LS pretest score was 25. She worked as an office employee, held a college degree, and lived in Baghdad as a single individual.

Before the intervention, the participant experienced significant distress due to unpredictable crying episodes, which severely impacted her social interactions and work performance. To address these symptoms, she underwent 40 AVE therapy sessions over 2 months, following the brain-boosting protocol.

Postintervention assessments showed a CNS-LS posttest score of 12, demonstrating a significant reduction in the frequency and severity of her crying

episodes. Emotional stability and a noticeable decrease in anxiety, particularly in social settings, were reported through self-assessments and interviews. Additionally, structured interviews with her colleagues revealed positive feedback regarding her improved emotional control and professionalism, further validating the benefits of AVE therapy in managing her symptoms.

Follow-Up and Participant Retention. To assess the long-term effects of AVE therapy, follow-up evaluations were conducted 3 months postintervention using the CNS-LS, ensuring consistency with initial assessment methods. Participant retention was supported through regular contact via scheduled phone and email check-ins, reminding participants of upcoming assessments and addressing any concerns. The same assessment tools and procedures were applied consistently. Additionally, small incentives were provided to encourage continued participation and minimize dropout rates.

Statistical Methods. Data collected via Google Forms were exported as a Microsoft Excel file and then transferred to SPSS version 26.0 for analysis. The data were carefully reviewed for errors and omissions before proceeding with nonparametric statistical analysis. Microsoft Excel and SPSS were used to analyze the data and achieve the study's objectives.

Results

Various data collection methods were employed throughout the study to understand the participants' experiences comprehensively. Semistructured interviews were conducted before and after the intervention, focusing on emotional lability, the impact on daily life, and the participants' perceptions of AVE therapy. In addition to the interviews, participants were observed during the sessions to monitor their engagement and emotional responses. Any notable behavioral changes were carefully recorded.

Self-reported measures were also an integral part of the assessment process. CNS-LS scores were collected prior to the intervention and again after its completion, along with daily logs tracking emotional outbursts and mood fluctuations. External feedback from family members and colleagues was gathered as well in order to validate the participants' self-reported improvements and to identify any potential discrepancies between their perceptions and those of third parties.

The initial CNS-LS scores for the participants were 22 for the male and 25 for the female. After completing 40 AVE sessions, both participants exhibited significant improvements in their posttest scores, with the male scoring 14 and the female scoring 12 (see Table 3).

Table 3
Pretest and Posttest CNS-LS Scores for Sample Individuals

Gender	Pretest CNS-LS Score	Posttest CNS-LS Score
Male	22	14
Female	25	12

Follow-Up Results

At the 3-month follow-up, participants were reassessed using the CNS-LS. The results indicated that the improvements observed immediately postintervention were largely sustained, with participants maintaining lower CNS-LS scores than at baseline. These findings suggest that AVE therapy has a lasting effect on reducing symptoms of PBA.

Discussion

The 3-month follow-up results support the long-term efficacy of AVE therapy in reducing PBA symptoms. The sustained improvements in CNS-LS scores indicate that the benefits of AVE therapy extend beyond the immediate treatment period, highlighting its potential as a durable intervention for PBA. These results suggest that AVE therapy could provide a lasting solution for managing PBA symptoms, particularly important for improving the quality of life in individuals with neurological conditions.

The persistence of these benefits over 3 months suggests that AVE therapy may induce long-term neurophysiological changes. This durability is crucial because it implies that the therapy does not merely provide temporary relief but could potentially alter underlying neural mechanisms associated with PBA. Further follow-up at longer intervals (e.g., 6 months, 1 year) is recommended to confirm these findings and explore the persistence of treatment effects over time. Longitudinal studies will be essential to understand how AVE therapy maintains its effects and whether periodic booster sessions are necessary to sustain these benefits.

When comparing the results of the current study with those of other studies, significant agreement is found. Thomas and Siever (1989) showed significant improvements in motor activity and vascular motor activity using AVE technology, supporting its effectiveness in enhancing physiological responses. Joyce and Siever (2000) demonstrated that AVE technology effectively reduced behavioral disorders in a school environment, enhancing learning. Berg and Siever (2004) found a significant reduction in depressive symptoms in elderly individuals using AVE technology, indicating its benefit as a nonpharmacological treatment. Siever (2008) reported improvements in attention and cognitive functions, supporting its use in educational settings. Siever and Collura (2017) highlighted the positive impact of AVE technology on brainwave patterns and improvements in anxiety, ADHD, and cognitive decline. These studies collectively reinforce the therapeutic potential of AVE technology across various domains.

Regarding PBA studies, the PRISM Study Team (Brooks et al., 2013) confirmed the prevalence of PBA symptoms across multiple neurological conditions, providing valuable epidemiological data. This extensive data set underscores the widespread impact of PBA and the necessity for effective interventions. The Cleveland Clinic (2025) focused on the effectiveness of the dextromethorphan/quinidine (DM/Q) combination in reducing PBA episodes in patients with amyotrophic ALS and MS. Their findings align with the current study, demonstrating that targeted interventions can significantly mitigate PBA symptoms. The Mayo Clinic Staff (2018) study demonstrated that Nuedexta, a combination of DM/Q, reduced the frequency and severity of PBA episodes, making it an effective treatment option. This further supports the role of pharmacological treatments in managing PBA symptoms, albeit with potential side effects. Finally, Young and Nguyen (2020) highlighted the effectiveness of DM/Q treatment in a complex case of PBA, supporting its use in severe neurological cases. This case study approach provides a detailed understanding of how AVE technology and pharmacological treatments can be integrated for comprehensive PBA management.

The evidence from these studies collectively supports the effectiveness of AVE technology as a treatment for PBA symptoms, confirming our study's results and enhancing confidence in using AVE technology as an effective therapeutic method. The alignment of findings across different studies and conditions emphasizes the robustness of AVE technology as a versatile and potent intervention.

Limitations

Some limitations in this study should be considered. The small sample size is a notable constraint, reflecting PBA's inherent rarity, making finding more cases difficult. Given the limited availability of individuals with PBA, recruiting a control group was deemed impractical and scientifically irrelevant for this research, as including individuals without neurological conditions would not provide meaningful comparisons.

The recruitment process was conducted through an online public form, where participants voluntarily completed the survey. Since participation was anonymous and voluntary, informed consent was not required at this initial screening stage. However, formal consent was obtained from the final participants before the intervention phase began.

Potential confounding factors, such as variations in daily routines, dietary habits, or concurrent therapies, could have influenced the outcomes. Controlling these variables in a real-world setting is nearly impossible, but future studies might explore more controlled environments or detailed participant monitoring to address these issues.

Despite these limitations, the study provides valuable preliminary insights into the potential efficacy of AVE therapy for managing PBA symptoms and sets a foundation for larger, more controlled investigations.

Recommendations

Based on the findings of this research, several recommendations are proposed to enhance the use of AVE technology and its integration into therapeutic practices. First, combining AVE technology with psychotherapy is highly recommended to avoid the adverse side effects often associated with pharmacological treatments. This combination could yield the most effective therapeutic results, offering a holistic approach to managing conditions like PBA.

Additionally, AVE technology should be applied to other neurological and psychological patient groups. Given AVE therapy's noninvasive and side-effect-free nature, many patients could benefit from this innovative approach, making it a valuable addition to existing treatment options.

Further efforts should focus on providing advanced laboratory devices that align with contemporary Neurotherapy techniques. These devices are essential for effectively treating a wide range of psychological, mental, and neurological disorders, enabling more precise and personalized interventions.

Finally, there is a pressing need to establish psychological and neurological laboratories equipped with AVE technology. Incorporating these laboratories into the curriculum for undergraduate and graduate students is crucial, as they play a significant role in developing modern psychotherapeutic and neurotherapeutic methods and techniques. This will enhance educational outcomes and advance clinical practice in these fields.

Suggestions

In light of the study's findings, several suggestions are proposed to advance the application of AVE technology and related research. It is recommended that similar studies be conducted with additional demographic variables to broaden the understanding of how different populations respond to AVE therapy. Expanding the scope to include more diverse demographic groups would provide deeper insights and strengthen the generalizability of the findings.

Similar studies nationwide by colleges and universities are also suggested to identify the primary issues affecting these populations. The results of such studies should be communicated to decision-makers, allowing them to implement appropriate measures to address the identified problems.

Furthermore, there is merit in utilizing international measurement tools that have been standardized for the Iraqi environment. By incorporating global benchmarks, researchers can enhance the comparability of findings across different settings while maintaining local relevance.

It is also worth exploring the application of AVE technology in treating other neurological disorders. Given its effectiveness in managing PBA symptoms, AVE may benefit other conditions.

Media awareness campaigns are highly recommended to encourage the widespread use of AVE technology. These campaigns would play a crucial role in informing the public about the advantages of utilizing safe, noninvasive technologies such as AVE to enhance mental functioning and alleviate the symptoms associated with neurological disorders.

Finally, encouraging further research on biofeedback and neurofeedback devices is essential. Opening the field to new studies that investigate the use of these devices in daily life and mental health, alongside psychotherapy, could lead to innovative approaches to treating various psychological and neurological conditions.

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Author Disclosures

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