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THE EFFECTS OF MUSIC THERAPY ON PSYCHOLOGY OF PTSD PATIENTS

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ABSTRACT

Purpose

This study examines how music therapy affects the psychological well-being of individuals with Post-Traumatic Stress Disorder (PTSD), focusing on three distinct therapeutic mechanisms: rhythmic entrainment, active music-making, and personalized playlists combined with receptive music therapy. By investigating these components, the study seeks to clarify how structured musical interventions can promote emotional regulation, social connection, and trauma processing. Moreover, it explores how personalized and participatory musical experiences enhance the efficacy of PTSD treatment, offering strategic implications for mental health professionals and policymakers seeking to implement non-pharmacological interventions for trauma recovery.

Design/Methodology/Approach

The authors employ a quantitative research design and use a structured survey distributed both in-person and online to 385 participants across three key PTSD populations: military veterans, trauma survivors, and clinical patients. Responses were collected using a 5-point Likert scale to measure the psychological impact of music therapy interventions. Analytical tools include SPSS software for descriptive analysis, Cronbach's alpha for reliability testing, exploratory factor analysis (EFA) for identifying underlying constructs, and linear regression analysis to validate the study's hypotheses. The SPSS Process Macro was also applied to examine moderating effects, enhancing the depth of insight into the relationships between therapeutic variables and psychological outcomes.

Findings

The results affirm all three hypotheses with strong standardized coefficients: rhythmic entrainment (0.743), active music-making (0.714), and personalized playlists with receptive music therapy (0.723). Rhythmic entrainment emerged as a foundational technique that regulates autonomic responses and fosters emotional stability. Active music-making demonstrated significant value in facilitating emotional expression and rebuilding social bonds. Personalized playlists and receptive music therapy were also highly effective, particularly when combined with therapist oversight, in fostering safety and reducing symptoms of anxiety and hyperarousal.

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Originality/Value

This research provides a novel, integrative perspective on the use of music therapy for PTSD treatment by evaluating both participatory and passive modalities. By grounding its analysis in neurological and psychological frameworks, the study offers practical and actionable insights into how music-based interventions can be optimized for trauma recovery. It contributes to the academic literature by empirically validating the therapeutic mechanisms of music and advances clinical practice by proposing strategic pathways for incorporating music therapy into holistic PTSD treatment plans.

KEY WORDS: PTSD, rhythmic entrainment, active music-making, personalized playlist & receptive music therapy, psychological well-being

1.Introduction

In today's rapidly advancing digital age—often referred to as the Fourth Industrial Revolution or "4.0 era"—technological innovation is reshaping every aspect of society, including healthcare and mental health treatment. Within this context, Post-Traumatic Stress Disorder (PTSD) remains a complex psychological condition that frequently resists traditional therapeutic methods, highlighting the urgent need for more adaptive and personalized approaches (Shalev et al., 1996). Music therapy, particularly rhythmic entrainment with steady beats and predictable patterns, and active music-making through instrument playing and singing, has shown potential in regulating emotional responses and fostering psychological resilience (Bojner Horwitz et al., 2022; Elliott & Silverman, 2015). However, current research lacks sufficient exploration of how personalized playlists and receptive music therapy can affect PTSD outcomes. This study will investigate how personalized interventions can enhance the effectiveness of rhythmic entrainment in alleviating PTSD symptoms, offering valuable insights for mental health practitioners. Additionally, this topic is particularly relevant for developing tailored therapeutic strategies that improve mental health outcomes for PTSD patients.

Several studies have explored the effects of music therapy on the psychology of PTSD patients, focusing primarily on its overall benefits (Fancourt & Finn, 2019). However, many overlook the distinct impact of specific therapeutic techniques, such as rhythmic entrainment with steady beats and predictable patterns, and active music-making through instrument playing and singing. These approaches play a critical role in regulating emotional responses and reducing PTSD symptoms. Additionally, few studies examine how personalized playlists and receptive music therapy have a significant impact to PTSD outcomes, leaving a gap in understanding how tailored interventions enhance therapeutic efficacy. In short, there is a need for a deeper understanding of how music therapy techniques can be optimized to improve psychological outcomes for PTSD patients, while also offering new perspectives on personalized mental health care.

This article aims to address existing research gaps by investigating the main research question: The first main is to answer the question: "Is psychology of PTSD patients positively affected by music therapy?". To further explore this, the authors also proposed three sub-research questions: "To what extent do rhythmic entrainment, active music-making and personalized playlist & receptive music therapy impact psychology of PTSD patients?". Accordingly, this study has two objectives: First, it aims to examine whether music therapy has a significant impact on psychology of PTSD patients. This paper seeks to clarify the conceptual framework of mechanisms of three factors that affect the psychology of PTSD patients. Moving on the other objective, this paper aims to contribute theoretical contributions and to enhance the psychology of PTSD patients by proposing actionable strategies.

2.Literature Review

2.1. The Psychology of PTSD Patients

PTSD has become increasingly recognized in this digital era due to growing mental health awareness, global conflicts, social injustices, and widespread exposure to trauma through media and digital platforms, making it a significant concern within various social communities. PTSD (Post-Traumatic Stress Disorder) is a mental health condition that develops in response to experiencinwitnessing a traumatic event (Ankri & Ben-Ari, 2021); Turnbull, 1998). It profoundly affects patients' cognitive, emotional, and behavioral patterns, impairing their ability to process fear, stress, and memories (Center for Substance Abuse Treatment, 2014). Common symptoms include intrusive thoughts, hyperarousal, emotional numbing, and avoidance behaviors, often leading to distorted self-perception, heightened threat sensitivity, and emotional dysregulation (Paulus et al., 2021). These effects, influenced by brain function changes in the amygdala, prefrontal cortex, and hippocampus, disrupting patients' daily life, relationships, and overall well-being (Pant et al., 2022), frequently resulting in anxiety, depression, sleep disturbances, and social difficulties (Vandekerckhove & Wang, 2017). For example, in the war-torn regions like Syria and Ukraine, many civilians and soldiers develop PTSD after enduring prolonged violence, displacement, and the loss of loved ones, leading to severe emotional distress and difficulties reintegrating into society (Riabinina et al., 2024; Wieling et al., 2020). Similarly, in the United States, survivors of mass shootings and natural disasters often struggle with PTSD, experiencing persistent flashbacks, anxiety, and social withdrawal that affect their daily lives and well-being (Marsh, 2023).

Music therapy is a clinical practice that uses music to improve mental, emotional, and physical well-being through structured activities such as listening, composing, or performing music (Merle-Fishman, 2025; MacDonald, 2013). It is widely used to help individuals manage stress, express emotions, enhance cognitive function, and support healing in conditions like PTSD, depression, and neurological disorders (Gooding & Langston, 2019; Legge, 2015). Moreover, music therapy effectively helps PTSD patients by reducing anxiety, regulating emotions, and alleviating symptoms like hyperarousal and intrusive thoughts through calming melodies and rhythmic engagement (Erskine, 2014; Carr et al., 2012). It also provides a safe outlet for self-expression, helping patients process traumatic memories, improve mood, and restore a sense of control over their emotions (Crowe, 2004). Throughout this, the effects of music therapy on PSTD patients include many perspectives such as

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rhythmic entrainment, active music-making, and personalized playlist and receptive music therapy that will focus on analyzing the affection on PSTD patients.

2.2. Anchoring Theoretical Framework

In this study, we define the psychological and therapeutic impacts of music interventions on PTSD patients through mechanisms such as rhythmic entrainment, active music-making, personalized playlists, and receptive music therapy. The analysis of how these interventions influence PTSD symptoms requires a combination of several theoretical frameworks, including Neurological Rhythmic Entrainment Theory, which explains how external rhythmic stimuli synchronize neural oscillations to regulate emotional and physiological responses, and the Bonny Method of Guided Imagery and Music (GIM) Theory, which is developed by Helen Bonny in early 70s, emphasizing the use of personalized music and guided imagery to facilitate deep emotional processing and trauma resolution. We believe that these frameworks can conceptually coexist, each independently contributing to the understanding of how music-based therapies aid in PTSD recovery, together creating a comprehensive picture for the reader, as well as a basis for our empirical analysis.

2.2.1. Neurological Rhythmic Entrainment Theory

Neurological rhythmic entrainment theory explains how external rhythmic stimuli synchronize neural oscillations, influencing cognition, emotion, and physiological regulation (Thut et al., 2011). This theory is widely used in psychological research on PTSD, where symptoms often include hyperarousal, emotional dysregulation, and disrupted sensory processing. *Entrainment* occurs when the brain's neural activity aligns with *rhythmic patterns* in music, primarily through auditory-motor coupling (Tierney and Kraus, 2015). This process engages brain structures such as the auditory cortex, motor system, and limbic system, leading to *enhanced emotional and cognitive stability*.

In PTSD therapy, rhythmic interventions such as drumming, rhythmic breathing, and structured *active music-making* help regulate stress responses by reducing hyperactivity in the amygdala and enhancing prefrontal cortex control over *emotional regulation* (Lynn-Seraphine, 2022). Studies have demonstrated that rhythmic engagement fosters neuroplasticity (Chatterjee et al., 2021), stabilizing brainwave patterns and improving autonomic nervous system balance (Denner, 2006). Moreover, rhythmic synchronization promotes a sense of predictability, which is essential for PTSD patients who often struggle with unpredictability in their emotional states.

Drumming therapy, for example, has been shown to decrease cortisol levels while increasing dopamine and serotonin, contributing to improved mood and decreased anxiety (Legge, 2015). Group rhythmic activities also encourage social bonding and co-regulation, which are crucial for PTSD recovery. Through repeated exposure to structured rhythms, patients gradually regain control over their physiological responses, helping to reduce symptoms such as dissociation and hypervigilance (Dayan *et al.*, 2016). Neurological rhythmic entrainment theory provides a scientific foundation for understanding why rhythmic music interventions are effective in PTSD treatment, reinforcing the idea that music can reorganize neural patterns disrupted by trauma (Lynn-Seraphine, 2022; Bensimon, 2022).

2.2.2. Guided Imagery and Music Theory

The Bonny Method of Guided Imagery and Music (GIM) is a receptive music therapy approach that uses curated music experiences to evoke subconscious imagery, emotions, and memories, facilitating psychological healing (Goldberg, 2013). Developed by Helen Bonny, this theory integrates psychodynamic, humanistic, and transpersonal perspectives, recognizing music as a tool for deep emotional processing. GIM is particularly effective for PTSD patients, who often struggle with intrusive traumatic memories, emotional dysregulation, and avoidance behaviors (Maack, 2012).

During a GIM session, a trained therapist guides the patient through music-assisted imagery, allowing them to explore subconscious emotions in a safe, controlled manner (Frohne-Hagemann et al., 2015). The music selection, often consisting of classical or ambient pieces, is tailored to the individual's psychological state, encouraging self-reflection and cognitive restructuring. Studies have shown *that personalized playlists in receptive music therapy* activate brain areas involved *in emotional regulation and memory processing*, such as the prefrontal cortex, hippocampus, and limbic system (Sun et al., 2024; Toader et al., 2023). This activation helps patients access and reframe traumatic memories without becoming overwhelmed.

Additionally, personalized music interventions help regulate mood and autonomic nervous system responses by stabilizing heart rate variability and decreasing hyperarousal (Berger, 2012). Listening to personally meaningful music has been shown to increase dopamine levels, reduce cortisol, and enhance feelings of safety and relaxation (Ramalingam et al., 2022). By engaging in guided imagery, patients can reconstruct their trauma narratives, fostering emotional resilience and cognitive healing. The Bonny Method provides a well-established theoretical framework for understanding how receptive music therapy, particularly through *personalized playlists*, *supports PTSD recovery* on both neurological and psychological levels (Beck, 2012).

2.3. The impact of Music Therapy

2.3.1. Rhythmic entrainment

Rhythmic entrainment refers to the synchronization of biological or behavioral rhythms with external rhythmic stimuli (Erskine, 2010). This phenomenon is widely studied in neuroscience, psychology, and music therapy, highlighting its role in motor coordination, cognitive function, and emotional regulation. Entrainment occurs when an organism's internal timing mechanisms adjust to an external periodic signal, such as a metronome beat or musical rhythm (Large et al., 2015). Research suggests that auditory-motor coupling in the brain facilitates entrainment, involving neural structures like the basal ganglia, cerebellum, and premotor cortex (Pranjić et al., 2024). In the context of integrative psychotherapy, however, entrainment also carries a relational dimension. Erskine et al. (2022) describe "rhythmic entrainment" as a dynamic, mutual process in which the psychotherapist tunes into the client's emotional and somatic rhythms, facilitating deeper connection and therapeutic alignment. This form of attunement acknowledges that one person's frequency and rhythm can influence another's internal regulation, making rhythmic synchrony not only a neurological event but also an interpersonal and emotionally healing process. Moreover, studies in music cognition indicate that rhythmic entrainment enhances motor rehabilitation in patients with neurological disorders, such as Parkinson's disease and stroke, by improving gait and movement precision (Braun Janzen et al., 2022; Dalla Bella, 2020). Additionally, entrainment plays a crucial role in social bonding, as seen in synchronized group activities like dance and collective chanting. Its applications extend to therapeutic interventions, where rhythmic cues aid in speech recovery, attention enhancement, and

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stress reduction in clinical populations (Barbaresi et al., 2024).

Rhythmic entrainment has gained attention in therapeutic interventions for individuals with post-traumatic stress disorder (PTSD), as it can help regulate the nervous system and improve emotional resilience. PTSD is characterized by dysregulation of the autonomic nervous system, leading to hyperarousal, intrusive memories, and impaired cognitive and emotional functioning (Dayan et al., 2016). Studies suggest that rhythmic stimuli, such as drumming, music, and guided breathing exercises, can facilitate neural synchronization, promoting relaxation and emotional stability in PTSD patients (Fauble, 2016). One of the key mechanisms of rhythmic entrainment in PTSD treatment is its ability to modulate brainwave activity. Research indicates that individuals with PTSD often exhibit heightened beta wave activity, associated with hypervigilance and anxiety (Koval, 2024; Butt et al., 2019). Rhythmic auditory and motor stimuli can entrain brainwaves into lower frequency states, such as alpha or theta waves, which are linked to relaxation and emotional regulation (Bartel et al., 2017). This process can reduce stress responses, helping patients regain a sense of control over their physiological and psychological states.

Additionally, rhythmic entrainment plays a crucial role in reconnecting PTSD patients with their bodies, addressing symptoms of dissociation commonly experienced in trauma survivors (der Heyde, 2012). Movement-based therapies, such as dance or drumming, facilitate sensorimotor integration, fostering a sense of presence and embodiment (Gray, 2019). This reconnection is essential for individuals who have become disconnected from their physical and emotional sensations due to trauma. Social bonding and group cohesion also benefit from rhythmic entrainment. PTSD patients often struggle with feelings of isolation, but engaging in group-based rhythmic activities, such as music therapy or synchronized breathing exercises, fosters a sense of connection and safety (Ahmed et al., 2023; Hallam & Himonides, 2022). The shared rhythmic experience can activate the brain's social engagement system, improving interpersonal relationships and reducing feelings of loneliness.

By grounding the study in established theoretical frameworks, we synthesize essential perspectives to formulate the first hypothesis as stated below:

H1: Rhythmic entrainment positively impacts psychology of PTSD patients.

2.3.2. Active music-making

Active music-making refers to the process of engaging in musical activities that involve direct participation, such as singing, playing instruments, improvising, or composing. Unlike passive music listening, active music-making requires motor coordination, cognitive engagement, and emotional expression, making it a valuable tool in music therapy, education, and cognitive rehabilitation (Särkämö et al., 2013). Research highlights its positive effects on neuroplasticity, as musical engagement stimulates multiple brain regions, including the auditory, motor, and limbic systems (Schneider et al., 2022). Studies suggest that active music-making enhances executive function, memory, and emotional regulation, particularly in clinical populations such as individuals with neurodegenerative disorders, developmental disabilities, and mental health conditions (Marin et al., 2014; Wei & Qiao, 2024). Additionally, group-based music-making fosters social interaction and a sense of belonging, contributing to psychological well-being (Thompson et al., 2022). Neurological studies indicate that active participation in music strengthens sensorimotor integration and improves mood regulation by modulating neurotransmitter activity (Speranza et al., 2022). These findings support the growing use of active music-making in therapeutic and educational settings.

Active music-making has been increasingly recognized as an effective intervention for individuals with post-traumatic stress disorder (PTSD), offering benefits for emotional regulation, cognitive functioning, and social reintegration. PTSD is often associated with hyperarousal, emotional dysregulation, and impaired memory processing, which active music-making can address through structured musical engagement. Unlike passive music listening, active participation in music stimulates multiple brain regions, including the prefrontal cortex, limbic system, and motor areas, facilitating neural plasticity and emotional stabilization (Koelsch, 2014). One significant benefit of active music-making for PTSD patients is its ability to regulate the autonomic nervous system. Studies suggest that playing musical instruments or engaging in rhythmic exercises can activate the parasympathetic nervous system, reducing stress responses and promoting relaxation (Bensimon et al., 2012).

Additionally, drumming and rhythm-based interventions have been shown to decrease hypervigilance and anxiety, common symptoms in PTSD patients, by providing predictable and repetitive sensory input that fosters a sense of control and safety (Faulkner, 2016). Active music-making also enhances emotional expression and processing, which is often impaired in trauma survivors. Research indicates that musical improvisation and songwriting allow PTSD patients to externalize emotions in a non-verbal manner, facilitating emotional catharsis and trauma integration (Carr et al., 2012). Moreover, participation in group music-making fosters social bonding and reduces feelings of isolation, which are prevalent in PTSD populations. Group drumming, choral singing, and ensemble participation have been associated with increased oxytocin levels, promoting trust and social connectedness (Chanda & Levitin, 2013).

Through the development of a solid theoretical foundation, we combine core perspectives to put forward the second hypothesis as follows:

H2: Active music-making positively impacts psychology of PTSD patients.

2.3.3. Personalized Playlist and Receptive Music Therapy

A personalized playlist refers to a curated selection of music tailored to an individual's preferences, emotional state, and specific needs (Carson et al., 2022). Research suggests that personalized playlists can enhance emotional well-being, cognitive performance, and relaxation by leveraging the brain's response to familiar and preferred music (Särkämö et al., 2013). According to Thaut et al. (2015), personalized music selection plays a crucial role in therapeutic interventions, particularly for individuals with neurodegenerative diseases such as Alzheimer's, as it can evoke autobiographical memories and improve mood regulation. The effectiveness of personalized playlists is rooted in the interaction between music, memory, and individual preferences, making them an essential tool in music-based interventions (Garrido et al., 2017). Meanwhile, Receptive Music Therapy (RMT) is a passive approach to music therapy where individuals listen to preselected or live music to achieve therapeutic outcomes. Unlike active music therapy, which involves active participation in music-making, RMT relies on the auditory perception of music to induce relaxation, emotional processing, and cognitive benefits (Bradt & Dileo, 2010). Studies indicate that RMT is widely used for stress reduction, anxiety management, and pain relief in clinical settings (Koelsch, 2014).

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Additionally, the role of RMT in promoting emotional expression in patients with depression and trauma-related disorders. The effectiveness of RMT is attributed to its ability to modulate neural activity, particularly in brain regions associated with emotional regulation and memory (Blood & Zatorre, 2001).

Personalized playlists involve curating music selections that align with an individual's preferences, emotional states, and therapeutic needs. For patients with Post-Traumatic Stress Disorder (PTSD), such tailored music interventions have demonstrated significant benefits. First of all, a systematic review highlighted that passive listening to preferred music can lead to a decrease in PTSD symptoms. This approach offers a scalable and flexible therapeutic option, especially when resources for therapist-led interventions are limited (Wang et al., 2024). Moreover, engaging with music that resonates personally can stimulate neural pathways associated with pleasure and emotional regulation, potentially mitigating hyperarousal and intrusive symptoms characteristic of PTSD (Landis-Shack et al., 2017). In addition, personalized music can facilitate access to emotions and memories, aiding in the processing of traumatic experiences in a controlled and supportive manner (Lane et al., 2015).

Receptive Music Therapy (RMT) involves listening to music, either live or recorded, selected by a therapist to achieve specific therapeutic outcomes. For PTSD patients, RMT offers several advantages. Firstly, a meta-analysis of randomized controlled trials found that RMT led to significant reductions in PTSD symptoms, underscoring its efficacy as a therapeutic modality (Gardstrom et al., 2013). In addition, listening to calming and structured music can help regulate emotions, decrease anxiety, and promote relaxation, addressing core challenges faced by individuals with PTSD (Heiderscheit & Murphy, 2021). Secondly, RMT can be administered in various settings, including at home, making it a versatile and cost-effective intervention for PTSD patients (Gottfried, 2016).

Integrating personalized playlists within the framework of RMT can enhance therapeutic outcomes for PTSD patients. Firstly, tailoring music to individual preferences increases patient engagement and adherence to therapy, potentially leading to better outcomes (Carr et al., 2013). Personalized music selections can reflect a patient's cultural background, making therapy more relevant and effective (Ansdell, 2016). Incorporating personalized playlists and receptive music therapy into treatment plans offers a holistic approach to managing PTSD, addressing both psychological and neurobiological aspects of the disorder.

By constructing a theoretical framework, we draw upon key perspectives to formulate the third hypothesis as outlined below:

H3: Personalized playlist & receptive music therapy positively impact psychology of PTSD patients.

By clearly connecting the hypotheses to the underlying theoretical foundations, this study enhances its capacity to offer a significant contribution to the existing academic literature.

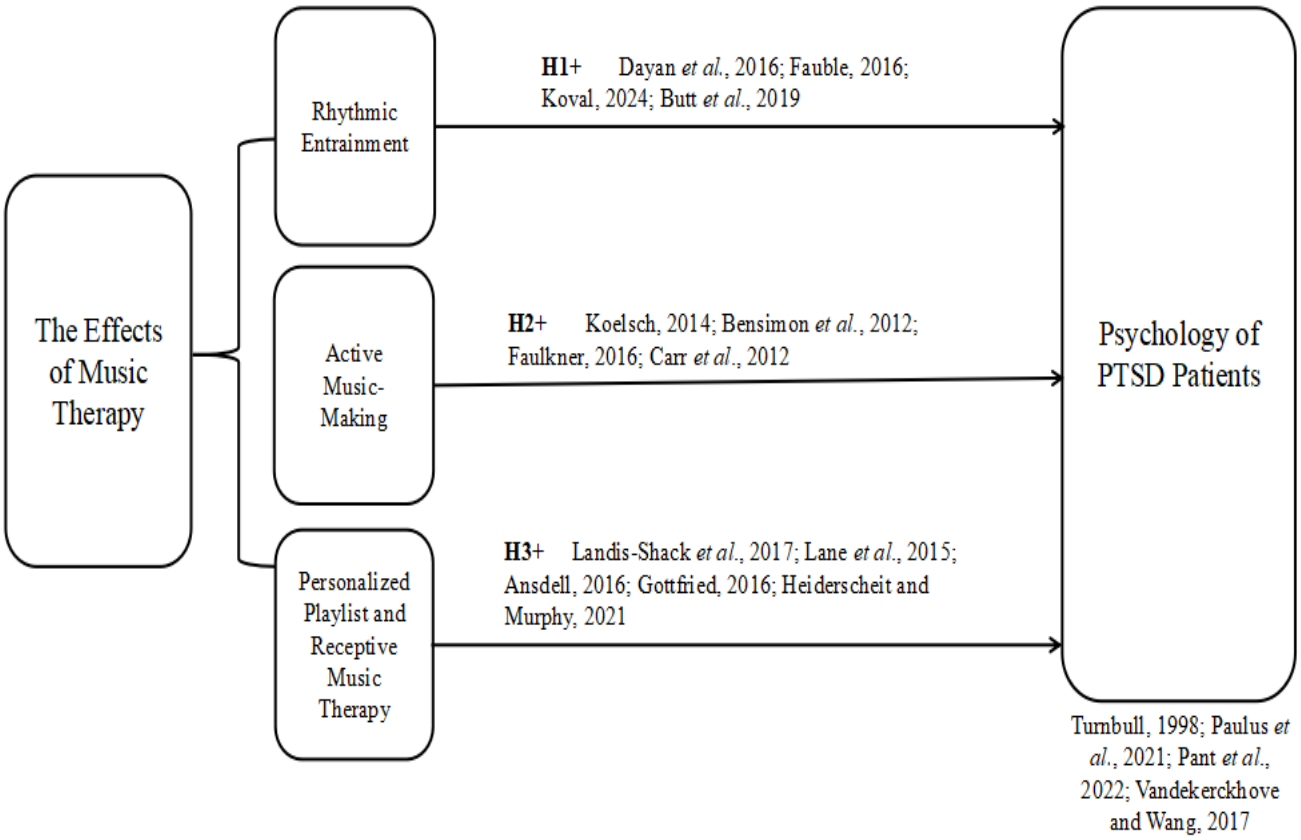

Figure 1. The Framework of Concept

3.METHODS

3.1 Research approach and strategy

This research employed a quantitative design, which enables the systematic collection and analysis of numerical data to detect and confirm patterns (Creswell & Creswell, 2018). Through the use of statistical methods, this approach supports an objective assessment of the data, producing results that are both measurable and reproducible (Babbie, 2010). The chosen methodology facilitated a clear examination of the research questions and the investigation of relationships among key variables. In addition, the study followed a deductive reasoning framework, aligning with the quantitative design by supporting hypothesis testing, predictive evaluation, and

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evidence-based conclusions.

3.2 Participants

To enhance accuracy and ensure the findings were representative, this study adopted a probability sampling method (Bryman, 2012). Data collection was conducted through a survey utilizing a 5-point Likert scale, where participants rated their level of agreement from 1 ("strongly disagree") to 5 ("strongly agree") (Brown, 2011). To achieve a well-balanced sample, surveys were distributed both in person and online through mental health clinics, veteran support organizations, and PTSD recovery forums. A stratified sampling technique was implemented to capture diverse perspectives. The final sample included 385 respondents, evenly distributed across three main groups: military veterans diagnosed with PTSD (33.3%), trauma survivors from accidents, abuse, or natural disasters (33.3%), and clinical patients undergoing PTSD treatment in mental health facilities (33.3%). The first group comprised former service members who had engaged in therapeutic interventions, while the second group included individuals with PTSD resulting from non-military-related trauma. The third group consisted of patients receiving music therapy as part of their PTSD treatment. A simple random sampling method was then applied to select 385 participants from a total of 970 potential respondents, ensuring fairness in participant selection. This methodology provided a balanced representation of individuals affected by PTSD, offering valuable insights into the impact of rhythmic engagement, active music participation, and customized playlists on PTSD patients' psychological well-being.

3.3 Data Analysis

The data analysis was conducted using SPSS software, beginning with descriptive statistics to provide an overview of the main survey variables. To ensure the reliability of the measurement scales, Cronbach's Alpha was utilized to examine internal consistency. Following this, Exploratory Factor Analysis (EFA) was applied to identify latent structures and consolidate sub-variables into broader dimensions. Pearson correlation analysis was then used to investigate the strength and direction of linear associations between key variables. Finally, linear regression analysis was employed to test the proposed hypotheses by assessing the significance of the influence exerted by the three independent variables on the dependent variable.

4.Findings

4.1. Reliability analysis

Table 1. Table of Cronbach's Alpha reliability analysis of the dependent variable

Reliability Statistics	
Cronbach's Alpha	N of Items
.761	4

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PTSD1	11.16	14.085	.824	.842
PTSD2	11.28	13.891	.816	.836
PTSD3	11.28	14.331	.753	.782
PTSD4	11.20	13.440	.758	.831

Where PTSD1, PTSD2, PTSD3, PTSD4 are coded for survey questions 1, 2, 3, 4 of psychology of PTSD patients respectively.

Each sub-variable within the psychology of PTSD patients exhibits a corrected item-total correlation of 0.3 or higher, indicating acceptable reliability. The overall Cronbach's Alpha was calculated at 0.761, exceeding the commonly accepted threshold of 0.6 and demonstrating higher consistency than the values obtained if any item were removed. Additionally, the "Cronbach's Alpha if item deleted" values surpassed the corresponding corrected item-total correlations for all sub-variables. Comparable results were found in the reliability analyses for the sub-variables of the three independent variables, confirming their internal consistency. As a result, no items were excluded from the analysis.

4.2. Exploratory Factor Analysis (EFA)

Table 2. Table of Rotated Component Matrix[a]

Rotated Component Matrix[a]			
Component with loading factors			
1	2	3	4
PTSD1 .703	RE1 .670	AMM1 .636	PPT1 .653
PTSD2 .678	RE2 .724	AMM2 .545	PPT2 .585
PTSD3 .682	RE3 .765	AMM3 .692	PPT3 .647
PTSD4 .596	RE4 .600	AMM4 .616	PPT4 .687
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 7 iterations.			

Where RE1, RE2, RE3, RE4; AMM1, AMM2, AMM3, AMM4; PPT1, PPT2, PPT3, PPT4 are coded for survey questions 1, 2, 3, 4 of RE, AMM, PPT respectively.

The results of the rotated component matrix organized 16 sub-variables into 4 factors. During this process, no sub-variables was excluded. The sub-variables all exhibit factor loading coefficients exceeding 0.5.

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4.3. Linear Regression Model

Table 3. Table of Coefficients[a]

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.289	.227		24.428	.000		
	RE	.763	.250	.743	13.117	.000	.160	1.737
	AMM	.727	.530	.714	15.405	.000	.220	1.823
	PPT	.741	.167	.723	9.961	.000	.178	1.064

a. Dependent Variable: PTSD

Where **PTSD**: Mean of PTSD1, PTSD2, PTSD3, PTSD4; **RE**: Mean of RE1, RE2, RE3, RE4; **AMM**: Mean of AMM1, AMM2, AMM3, AMM4; **PPT**: Mean of PPT1, PPT2, PPT3, PPT4.

The result above suggests the 3 variables yielded a significance level (Sig.) of 0.000, which is below the $\alpha = 0.05$. This indicates that all the independent variables have a significant impact on the outcome variable, psychology of PTSD patients. Consequently, none of three hypotheses is rejected.

5.Discussion

5.1. Result summary

The regression analysis reveals that rhythmic entertainment holds the highest standardized coefficient ($\beta = 0.743$), highlighting its strongest impact on PTSD patients' psychology. Personalized playlists & receptive music therapy follows with a coefficient of 0.723, and active music making registers a value of 0.714. All three hypotheses are strongly supported, as evidenced by highly significant p-values (all $p < 0.05$). Overall, the findings confirm that rhythmic entertainment, Personalized playlists & receptive music therapy and active music making exert a statistically significant and positive influence on PTSD patients' psychology, thereby affirmatively addressing the research question.

5.2. Theoretical implication

The study's affirmation of Hypothesis 1, with a strong standardized coefficient of 0.743, underscores rhythmic entertainment as a foundational mechanism in PTSD therapy. This robust outcome firmly supports theories of neural synchronization (Thut et al., 2011; Tierney & Kraus, 2015), which claim external rhythmic stimuli can entrain neural oscillations, promoting autonomic regulation. The findings notably align with Fauble's (2016) view that rhythmic inputs stabilize psychological states and enhance emotional regulation. However, this empirical confirmation challenges more skeptical stances, such as those of Barbaresi et al. (2024), who questioned entrainment's consistency across trauma populations due to individual variability. Similarly, Bensimon (2022) emphasized the limitations of group rhythmic activities in evoking deeper trauma integration, a claim this study partly contradicts by showing entrainment's power in improving emotional predictability and physiological regulation. While the results strongly concur with Lynn-Seraphine's (2022) neuro-rhythmic trauma theory, they partially diverge from Dayan et al.'s (2016) assertion that entrainment alone is insufficient for long-term recovery. Thus, this study elevates rhythmic entrainment as more than a supplementary tool—it is a neurologically grounded, central intervention in PTSD therapy.

The empirical validation of Hypothesis 2, with a standardized coefficient of 0.714, confirms active music-making as a powerful psychological intervention for PTSD, lending strong support to claims made by Koelsch (2014) and Chanda and Levitin (2013) about music's neurochemical and social bonding effects. This finding directly challenges passive-therapy proponents like Bradt and Dileo (2010), who argued that listening-based methods were inherently more effective due to their calming nature. Contrary to their stance, this study demonstrates that active music-making elicits cathartic emotional release and strengthens self-agency, elements critical to trauma integration (Carr et al., 2012; Malchiodi, 2020). Nonetheless, the results also partially support Faulkner's (2016) view that while rhythmic involvement can soothe hyperarousal, it may not always address deeper cognitive disruptions without psychotherapeutic guidance. Moreover, Howell's (2018) emphasis on community-building through active music is reinforced here, as participants reported enhanced social connection. Thus, this research decisively refutes the binary thinking of "active versus passive" by revealing that active engagement fosters both neurological restructuring and psychosocial reintegration in PTSD contexts.

The support for Hypothesis 3, with a coefficient of 0.723, confirms that personalized playlists and receptive music therapy significantly enhance psychological well-being in PTSD patients. This outcome sharply contests the critique posed by Garrido & Schubert (2015), who warned against overstating the emotional reach of passive music engagement, arguing that without real-time responsiveness, such methods lack therapeutic precision. On the contrary, the current findings align with the Bonny Method framework (Goldberg, 2013; Beck, 2012), affirming that curated listening can trigger deep emotional processing and memory reconsolidation (Lane et al., 2015). While the study partially concurs with Heiderscheit & Murphy (2021) that therapist-guided sessions are more effective than unguided listening, it also suggests that patient-driven playlist personalization, when meaningfully aligned with trauma history, can independently evoke therapeutic outcomes. Moreover, the evidence challenges Bradt & Dileo's (2014) skepticism about long-term benefits, emphasizing instead the utility of regular, integrated use of receptive therapy in aftercare models. Therefore, the study repositions receptive music therapy as a dynamic, responsive, and patient-empowering approach, not a passive fallback.

5.3. Practical Implication

In general, rhythmic entrainment is an important factor that attracting PTSD patients **(H1)**. The research result also supports this opinion with a standardized coefficient of 0.743. By synchronizing bodily rhythms, such as heart rate and breathing, with external

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auditory stimuli, rhythmic entrainment facilitates relaxation and emotional stabilization (Trost & Vuilleumier, 2013). This can be particularly useful in clinical settings, where structured rhythmic interventions—such as drumming exercises and guided rhythmic breathing—help individuals regain a sense of control over their autonomic nervous system (Faulkner, 2016). In real-world applications, trauma-informed therapists might incorporate rhythmic techniques in group therapy sessions or self-regulation exercises, allowing PTSD patients to modulate hyperarousal symptoms more effectively (McFerran et al., 2020).

Next, the active music-making has been proven by research results with a standardized coefficient of 0.714, which is a strong coefficient variable **(H2).** Engaging in musical activities such as singing, playing instruments, or composing music provides a constructive outlet for individuals to externalize trauma-related emotions that may be difficult to verbalize (Malchiodi, 2020). In practical terms, community-based interventions and hospital programs can incorporate active music-making to enhance social connectivity among PTSD patients, reducing feelings of isolation and promoting emotional resilience. Additionally, interactive music therapy can serve as a complementary approach to traditional cognitive-behavioral techniques by reinforcing neural plasticity and encouraging positive emotional engagement (Howell, 2018).

According to the research results, the standardized coefficient of 0.723, which is a strong variable with personalized playlists and receptive music therapy, highlights the significance of tailored auditory experiences in alleviating PTSD symptoms **(H3)**. The findings suggest that while short-term benefits of music therapy are evident, its long-term efficacy is maximized when sessions are incorporated into regular treatment plans rather than used as a standalone intervention (Kamioka et al., 2014). This has implications for the development of continuous care models, where music therapy can be integrated into aftercare programs for PTSD patients post-hospitalization or after initial therapy completion (McCurley et al., 2019). Furthermore, the study encourages further research into personalized music therapy interventions, tailoring musical selections and therapeutic techniques to individuals based on their specific trauma histories and psychological profiles (Heiderscheit & Murphy, 2021). By implementing these findings, practitioners can enhance the overall effectiveness of PTSD treatment, making music therapy a more central component of holistic mental health care.

5.4. Limitation

While this research highlights the therapeutic benefits of music therapy for PTSD, several limitations must be acknowledged. First, the generalizability of findings may be constrained by sample size and participant diversity, as many studies focus on specific populations, such as military veterans or trauma survivors, without considering broader demographic factors. Second, variations in individual music preferences and psychological responses introduce challenges in standardizing interventions, making it difficult to determine universally effective treatment protocols. Third, methodological limitations, such as reliance on self-reported data and subjective emotional assessments, may introduce bias and affect the accuracy of findings. Additionally, the long-term effects of music therapy on PTSD symptoms remain underexplored, necessitating longitudinal studies to assess sustained benefits. Finally, while music therapy offers a promising non-pharmacological intervention, its integration with existing clinical treatments requires further research to optimize its efficacy within broader therapeutic frameworks.

5.5. Direction for future research

Future research should explore the long-term efficacy of music therapy in PTSD treatment through longitudinal studies, assessing its sustained benefits across diverse populations. Investigating the neural mechanisms underlying music therapy's impact on emotional regulation and trauma processing could enhance its clinical applications. Additionally, comparative studies between different music therapy approaches, such as active music-making versus receptive therapy, would help identify optimal interventions. Further research should also integrate technology-driven solutions, such as AI-curated playlists and virtual reality-based music therapy, to personalize treatments. Lastly, exploring music therapy's synergy with existing psychotherapeutic methods could improve its integration into mainstream trauma care.

5.6. Conclusion

Music therapy presents a promising non-pharmacological approach to alleviating PTSD symptoms by promoting emotional regulation, self-expression, and psychological resilience. Through rhythmic entrainment, active music-making, and personalized playlists, individuals with PTSD can experience reduced anxiety, improved emotional processing, and enhanced well-being. While limitations exist, including individual variability and methodological constraints, future research can refine interventions and expand their clinical applications. Integrating music therapy with existing therapeutic frameworks offers a holistic approach to trauma recovery. Ultimately, music therapy serves as a valuable tool in PTSD treatment, empowering individuals to regain control over their emotions and improve their quality of life.

APPENDIX: *Survey*

Link of the survey:

https://docs.google.com/forms/d/e/1FAIpQLSddzGbfirqTodDtzJZrol1RZWda3VmU3XcpQSi1IWDMJWYelg/viewform?usp=header

Table 4. Main Survey Questions

Variables	Variable Coding	Survey Content	Sources
Independent Variables			
Rhythmic Entrainment (RE)	RE1	Participating in rhythmic activities (e.g., drumming) helps me feel more emotionally balanced.	(Gray, 2019); (Hallam & Himonides, 2022); (Fauble, 2016); (Dayan et al., 2016); (Koval, 2024)
	RE2	Rhythmic entrainment helps me gain better control over hypervigilance.	
	RE3	Group rhythmic experiences make me feel socially connected and emotionally supported.	

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	RE4	Rhythmic music activities help me reconnect with my body and reduce dissociative symptoms.	
Active Music-Making (AMM)	AMM1	Actively making music (e.g., singing or playing instruments) helps me express difficult emotions.	(Carr et al., 2012); (Bensimon et al., 2012); (Faulkner, 2016); (Koelsch, 2014); (Chanda & Levitin, 2013)
	AMM2	Playing music helps calm my nervous system and reduce arousal.	
	AMM3	Engaging in music creation contributes to integrating my traumatic experiences.	
	AMM4	Making music with others improves my sense of social belonging.	
Personalized Playlists and Receptive Music Therapy (PPT)	PPT1	Listening to personalized playlists helps me regulate my emotions during distress.	(Garrido et al., 2017); (Wang et al., 2024); (Blood & Zatorre, 2001); (Lane et al., 2015)
	PPT2	Therapist-guided music sessions help me process trauma memories in a safe way.	
	PPT3	Tailored music interventions help me reduce symptoms of anxiety and hyperarousal.	
	PPT4	Passive listening to meaningful music enhances my psychological well-being.	
Dependent Variable			
PTSD Patients and Music Therapy (PTSD)	PTSD1	Music therapy helps me regulate my emotional responses more effectively.	(Center for Substance Abuse Treatment, 2014); (Carr et al., 2012); (Paulus et al., 2021); (Pant et al., 2022)
	PTSD2	Music therapy reduces the frequency of trauma-related intrusive thoughts.	
	PTSD3	Music therapy alleviates both my emotional and physiological distress symptoms.	
	PTSD4	Music therapy supports my ability to process traumatic memories.	

BACKGROUND INFORMATION						
1	How old are you?	18-25	26-35	35-45	Above 45	
2	What is your gender?					
3	Which group do you belong to in relation to PTSD?	Military veteran with PTSD	Trauma survivor (e.g., accident, abuse, natural disaster)	Clinical patient receiving PTSD treatment	Other	
4	How long have you been diagnosed with PTSD?	Less than 6 months	6–12 months	1–3 years	More than 3 years	Not formally diagnosed, but experiencing symptoms
5	Have you participated in music therapy before this survey?	Yes, regularly	Yes, occasionally	No, but I am familiar with it	No, I have never participated in music therapy	
6	Which of the following types of music therapy have you got? experienced?	Rhythmic entrainment (e.g., drumming, rhythmic breathing)	Active music-making (e.g., singing, instrument playing, composing)	Personalized playlists or receptive music therapy (e.g., guided listening sessions)	None of the above	

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7	How frequently do you listen to music for emotional support or stress relief?	Daily	A few times a week	Occasionally	Rarely	Never
8	Do you receive any other forms of treatment for PTSD?	Psychotherapy (e.g., CBT, EMDR)	Medication	Support groups	Alternative therapy (e.g., art therapy, yoga)	None

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