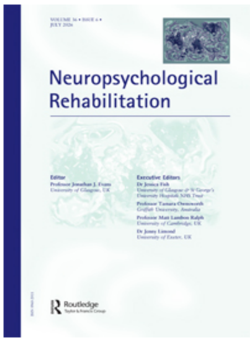

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Music-based interventions for aphasia: A systematic review of clinical approaches and musical components in expressive language rehabilitation

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ABSTRACT
Music-based interventions have been employed in aphasia rehabilitation, modulating components such as rhythm, melody, and prosody to promote language recovery through the engagement of neuroplastic mechanisms. To address the lack of integrative reviews encompassing the full range of clinical applications, we conducted a systematic review of 33 peer-reviewed studies – including randomized controlled trials, pre–post designs, and single-case reports – that quantitatively assessed expressive oral language in patients with aphasia within the context of structured music-based protocols. Specifically, we aimed to comprehensively examine the clinical use of music-based interventions for aphasia, with a focus on the therapeutic role of specific musical components (e.g., melody, rhythm) and their neurofunctional implications for language recovery. Results revealed a range of beneficial interventions, showing improvements both in linguistic behaviour and underlying neural function. This review provides a comprehensive overview of music-based approaches addressed to patients with aphasia, offering a valuable insight into their clinical diversity and therapeutic potential.

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Aphasia; music; rhythm; melody; musical components; systematic review; language rehabilitation

Introduction

Clinical characteristics of aphasia

Aphasia is a condition that can have a devastating impact on the physical, emotional, and relational well-being of those who suffer from it (Bahrami et al., 2017). It is caused by damage to the areas of the brain responsible for language. In classical taxonomic approaches (Clough & Gordon, 2020), aphasia can be broadly distinguished into two main types: fluent and non-fluent. However, although the classical distinction between fluent and

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non-fluent aphasia remains widely used in clinical practice, contemporary neuropsychological models suggest that this dichotomy oversimplifies the complexity of language organization in the brain. Increasing evidence supports the view that aphasia syndromes arise from damage to distributed and interacting neural networks, rather than from isolated cortical regions (Catani & Mesulam, 2008; Mesulam, 1990). From this perspective, fluent and non-fluent aphasias can be more accurately understood in terms of selective disruption of large-scale language-processing systems.

Within this framework, non-fluent aphasias are primarily associated with dysfunction of the dorsal language stream, which supports the mapping of phonological representations onto articulatory motor plans and plays a critical role in syntactic processing (Hickok & Poeppel, 2007, 2015). Broca's aphasia, the prototypical non-fluent syndrome, is characterized by effortful, agrammatic speech, reduced verbal output, and impaired repetition. Lesion-symptom mapping and neuroimaging studies indicate that these deficits do not arise solely from damage to Broca's area, but rather from lesions affecting a broader fronto-parietal network, including premotor cortex and underlying white-matter pathways (Dronkers et al., 2004; Fridriksson et al., 2018). Related non-fluent syndromes, such as transcortical motor aphasia, present with similar impairments in spontaneous speech but preserved repetition, suggesting relative sparing of perisylvian language circuits and disruption of connections with higher-order executive or conceptual systems (Alexander & Benson, 1993).

Conversely, fluent aphasias are predominantly linked to impairment of the ventral language stream, which mediates sound-to-meaning mapping and semantic processing (Friederici, 2011; Hickok & Poeppel, 2007). Wernicke's aphasia is characterized by fluent but often empty speech, frequent semantic and phonological paraphasias, and severe deficits in comprehension. Contemporary neuropsychological accounts emphasize that the core impairment lies in degraded lexical-semantic processing rather than in primary auditory perception, implicating a distributed network involving posterior temporal and inferior parietal regions (Binder et al., 2009; Lambon Ralph et al., 2017). Other fluent aphasias, such as conduction aphasia, are characterized by fluent speech and relatively preserved comprehension but disproportionate difficulty in repetition. This dissociation has been interpreted as reflecting impaired phonological working memory and disrupted interaction between temporal and frontal language systems, particularly involving the arcuate fasciculus (Buchsbaum et al., 2011; Catani et al., 2005). Anomic aphasia, often considered the mildest fluent aphasia, is marked by persistent word-finding difficulties and is now understood as resulting from impairments at different stages of lexical access, including deficits in semantic control mechanisms rather than loss of semantic knowledge per se (Hillis, 2007; Jefferies & Lambon Ralph, 2006).

Taken together, the heterogeneity of fluent and non-fluent aphasia syndromes, as well as their underlying network-level disruptions, highlights how language impairments extend beyond isolated deficits in speech production or comprehension (Hickok & Poeppel, 2015; Mesulam, 1990). Since language functions rely on the coordinated interaction of multiple cognitive and neural systems, damage to these networks often affects not only oral communication but also written language and higher-level communicative abilities, including pragmatic and social language use (Cahana-Amitay & Albert, 2014; Hillis, 2007). These difficulties in reading, writing, and interpersonal communication can significantly impair patients' daily functioning (Code, 2003; Hilari, 2011). Specifically, impairments in lexical access, syntactic processing, and semantic integration interfere with everyday activities such as reading instructions, writing messages, maintaining social relationships, and participating in work or educational contexts (Hilari & Northcott, 2006; Parr et al., 1997). Consequently, aphasia is frequently associated with reduced autonomy, social participation, and overall quality of life, underscoring the importance of comprehensive, functionally oriented assessment and rehabilitation approaches (Cruice et al., 2006).

Music and language: A common ground for aphasia rehabilitation

Given the substantial personal and social impact of aphasia, the identification and integration of novel rehabilitation techniques, complementary to traditional methods, are increasingly crucial for maximizing language recovery and, consequently, improving patients' quality of life (Bahrami et al., 2017). Recent literature suggests two primary approaches to aphasia rehabilitation, contingent upon the extent of the lesion. In case of smaller lesions in the right hemisphere, rehabilitation programmes typically focus on stimulating the perilesional cortex of the left hemisphere, often with varying degrees of contralateral involvement. Conversely, when the lesion primarily affects the left hemisphere – particularly when damage is extensive – interventions usually target homologous language and speech-motor areas in the right hemisphere (Wan & Schlaug, 2013).

Within the scientific literature on aphasia rehabilitation, empirical studies have demonstrated that the systematic application of music can promote brain plasticity and facilitate partial language recovery in aphasic patients with lesions of varying extent and anatomical location (O'Kelly et al., 2016). Clinically, it is observed that patients with non-fluent aphasia may retain the ability to sing, despite significant impairments in spoken language (Akanuma et al., 2016). Empirical evidence showed indeed that music and its components – such as rhythm, melody, and harmony – activate homologous areas of language in the right hemisphere (such as the inferior frontal gyrus, posterior medial premotor cortex, posterior superior temporal gyrus, central operculum, and a sensorimotor network implied in verbal articulation), thus favouring the neural and structural reorganization of the brain (Schlaug et al., 2008). Other studies identified overlapping activations also in the left hemisphere, delineating a network centred on Broca's area and on dorsal and ventral pathways connecting this region with insular, temporal, and parietal areas (Musso et al., 2015). Furthermore, when considering one of the main prosodic components of both music and language, namely rhythm, a recent meta-analysis pointed to an overlap involving regions such as the left inferior frontal gyrus, left supplementary motor area, and bilateral insula – neural substrates usually implicated in temporal hierarchical processing and predictive coding (Heard & Lee, 2020).

Music based interventions for language rehabilitation in aphasia

Building on evidence of shared neural mechanisms between music and language, several music-based interventions have been developed and implemented to support language rehabilitation in patients with aphasia.

Currently, Melodic Intonation Therapy (MIT) is the most widely adopted and extensively studied intervention of this kind. Originally developed by Albert, Sparks and Helm in 1973, MIT aims to improve communication abilities in patients with chronic aphasia by facilitating spontaneous expression within an empathetic relationship with a music therapist (Raglio et al., 2016). Under the guidance of the therapist, patients repeat short, melodically intoned phrases, often accompanied by rhythmic tapping with the left hand. The ultimate goal is to transition from singing to spontaneous speech production with natural prosody. The development of MIT stemmed from the observation that non-fluent aphasic patients often exhibit better singing abilities compared to speaking. MIT is indicated for patients with extensive left-hemispheric lesions due to its strong potential to engage language-related regions in the right hemisphere. In fact, music creates an alternative pathway for brain activation that allows access to language, regardless of damage to the left hemisphere (Grau-Sánchez et al., 2022). MIT's therapeutic effects derive from two primary components: (1) the melodic intonation of words and (2) the rhythmic tapping with the left hand during the pronunciation of syllables (Wan & Schlaug, 2013). Drawing on these elements, MIT exercises incorporate simple melodic patterns into everyday phrases. In this approach, melody is employed to produce exaggerated prosody, thereby facilitating more efficient access to verbal expressions for everyday speech. The MIT programme is structured hierarchically across three levels. At the most basic level, patients intone a series of two-syllable words or phrases. They then progress to pronouncing multi-syllabic words and gradually composing increasingly longer phrases (Albert et al., 1973). Several studies (e.g., Jungblut et al., 2020; Van Der Meulen et al., 2016) have suggested that MIT may have limited effects in treating chronic aphasia, demonstrating improvements only in the repetition of trained material without significant generalization to untrained items. To address this limitation, Jungblut (2009) developed the SIPARI protocol (Singing, Intonation, Prosody, *Atmung*

[German for "breathing"], Rhythm, and Improvisation). SIPARI is a rhythmic-melodic voice training programme focused on encouraging self-initiated planning and sequencing of speech, which has been shown to significantly improve the overall productive language profiles of patients with chronic aphasia. The intervention is grounded in the systematic use of the human voice to integrate pitch, intonation, and rhythmic-temporal processing, with the aim of improving articulatory planning, programming, and sequencing.

Besides MIT, the effects of other music-based intervention approaches have also been investigated in the literature addressing aphasia. As a more general approach, Music Supported Therapy (MST) is frequently proposed to language-impaired patients as a standard rehabilitation method. MST introduces music with the purpose of making therapy more enjoyable. The experience of pleasure associated with listening to or producing music, for instance, can engage neural circuits involved in reward processing, emotional engagement, motivation, and neural plasticity. The integration of aesthetic stimuli into therapeutic protocols, as in the case of MST interventions, may function as a cognitive amplifier by enhancing attention and promoting functional recovery. From this perspective, aesthetic gratification and pleasantness should not be regarded as a merely decorative element, but rather as a core mechanism contributing to psychophysical well-being and to the overall effectiveness of therapeutic interventions (Colombi et al., 2025). Such approach is inspired by evidence showing that music-supported therapy is more efficient and effective than functional motor training without auditory feedback (Bahrami et al., 2017).

Participation in a community choir represents another commonly employed intervention, which falls within the broader category of music rehabilitation programmes; However, it does not rely on a specific language training protocol. This kind of musical experience offers post-stroke patients an opportunity to stimulate recovery of verbal memory and, consequently, verbal speech. Aphasic patients may also benefit from this therapeutic technique on a socio-relational level: Group singing provides an opportunity to receive social support, increases feelings of connectedness, mitigates the isolation associated with speech impairments, and fosters improvements in communicative abilities (Tamplin et al., 2013). The shared nature of group singing may also enhance motivation and sustained engagement in rehabilitation, as participating in a collective activity supports continuity, interest, and adherence over time – factors that are critical for maintaining involvement throughout the rehabilitation process. Tamplin et al. (2013) reported on a choir intervention based on breathing and quality of the produced sounds, with a specific emphasis on pitch. Choir participants were instructed to tap their legs to the beat of the song while singing, in order to activate the sensorimotor cortex. Participants reported benefits including increased self-confidence, the development of peer support networks, better mood, and improved communication abilities.

Automatic and formulaic speech: A preserved linguistic resource in aphasia

A clinically significant feature of the linguistic profile in aphasia is the differential preservation of automatic and formulaic speech relative to propositional language. Formulaic language – encompassing song lyrics, stereotyped phrases, social formulas, and overlearned sequences – differs from novel, propositional language in that it is stored and retrieved holistically rather than assembled from individual lexical items (Torrington Eaton & Thomas, 2024). According to the dual-process model of language, these two modes of production (i.e., propositional vs non-propositional) rely on distinct neural substrates: Propositional language depends primarily on left inferior frontal networks, whereas non-propositional and formulaic language engages right frontal and subcortical regions that are often spared in left-hemisphere stroke (Sidtis et al., 2018; Torrington Eaton & Thomas, 2024).

Accordingly, individuals with non-fluent aphasia tend to produce proportionally higher rates of formulaic language than healthy speakers, relying on these preserved pathways to sustain communicative function (Torrington Eaton et al., 2026; Torrington Eaton & Thomas, 2024). Song lyrics are a particularly salient instance of this preserved capacity: Many patients who cannot produce voluntary propositional speech retain the ability to sing words to familiar melodies – a dissociation long recognized as a potential therapeutic entry point (Baker, 2000; Schlaug et al., 2008). The role of formulaic and automatic speech in the residual language repertoire of individuals with aphasia is therefore an important dimension of the broader picture of language recovery, representing a preserved resource that may contribute to rehabilitation outcomes.

Broadening the evidence on music-based aphasia rehabilitation

Evidence accumulated over the past decades suggests that music-based interventions hold meaningful therapeutic potential for patients with aphasia, with beneficial effects documented particularly on verbal production abilities including speech fluency, repetition, and naming (Gu et al., 2024; Haro-Martínez et al., 2021; Liu et al., 2022; Popescu et al., 2022). These gains appear most consistently in patients with non-fluent aphasia – the population most frequently targeted by structured music-based protocols (Haro-Martínez et al., 2021; Koshimori et al., 2025) – and are thought to operate not merely as compensatory strategies, but through the active neuroplastic reorganization of language-relevant networks (Marchina et al., 2023; Schlaug et al., 2009; Sihvonen et al., 2021). At the same time, the overall evidence remains heterogeneous: Outcomes vary considerably depending on the type of intervention, the timing of treatment relative to stroke onset, the severity and profile of the aphasia, and the specific language domains assessed. This variability underscores both the promise and the complexity of music-based rehabilitation and has motivated an expanding body of systematic inquiry into the conditions under which these interventions are most effective.

Over the past five years, a growing body of literature has indeed addressed the application of music-based interventions in the treatment of aphasia, with nine reviews published on this topic. These prior reviews have primarily focused on randomized controlled trials (RCTs) (Gong & Ye, 2024; Gu et al., 2024; Haro-Martínez et al., 2021; Koshimori et al., 2025; Liu et al., 2022; Popescu et al., 2022; Shi & Zhang, 2020; Zhang et al., 2022), while occasionally including case studies (Antony et al., 2025; Shi & Zhang, 2020; Zhang et al., 2022) and other forms of non-randomized evidence (e.g., studies with no control group: Antony et al., 2025). These reviews and meta-analyses provided growing evidence that music-based programmes, particularly MIT, offer meaningful benefits for individuals with non-fluent aphasia. Repetition ability consistently emerged as the most responsive domain (Gu et al., 2024; Haro-Martínez et al., 2021; Koshimori et al., 2025; Liu et al., 2022), especially with interventions exceeding 20 h (Gu et al., 2024), while improvements in naming and functional communication were more variable across studies (Antony et al., 2025; Gong & Ye, 2024; Popescu et al., 2022). Comprehension showed little to no significant change (Gong & Ye, 2024; Haro-Martínez et al., 2021; Liu et al., 2022). Rhythm processing appears central to MIT's effectiveness, particularly in patients with basal ganglia lesions (Shi & Zhang, 2020), supporting its neurobiological relevance. However, outcomes on everyday communication remain modest (Koshimori et al., 2025; Popescu et al., 2022) and methodological weaknesses – such as heterogeneous outcome measures, small sample sizes, and limited neuroimaging data – highlight the need for more rigorous, large-scale trials (Koshimori et al., 2025; Pieri et al., 2023; Zhang et al., 2022).

The mentioned reviews identified multiple methodological limitations affecting both their synthesis processes and the body of primary literature examined. Key issues include the scarcity of high-quality RCTs with adequately sized samples (Haro-Martínez et al., 2021), a moderate to high risk of bias in primary studies (Koshimori et al., 2025), substantial variability in outcome measures accompanied by a lack of assessments of functional communication (Koshimori et al., 2025), the use of non-validated outcome measures that attenuate effect size estimates (Popescu et al., 2022), heterogeneity in control conditions and statistical methods that hampers meaningful comparisons across studies (Koshimori et al., 2025), and statistical uncertainty in effect size estimates (Zhang et al., 2022). Taken together, these limitations underscore the urgent need for more rigorous research, involving larger samples, standardized protocols, validated outcome measures, and appropriate control conditions, to strengthen the evidence basis for the effectiveness of music-based interventions for non-fluent aphasia.

The present review builds upon the study of music training for aphasia by broadening the scope of the analysis to encompass a wider, as compared to previous reviews, range of intervention types, with the aim of providing a comprehensive and integrative account of how music-based approaches are being implemented in clinical contexts. In doing so, this review seeks to capture the heterogeneity of interventions currently employed, ranging from well-established, standardized treatments – most notably, MIT – to less structured practices, such as individual or group-based singing activities. At the same time, we focus on specific musical components (e.g., intonation and rhythm) underlying these interventions, as well as collateral aspects related to music (e.g., pleasantness and motivation) that may influence the rehabilitative outcomes. By systematically mapping this diversity, the present review aims to contribute to advancing the understanding of the therapeutic role of music in aphasia rehabilitation and to offer critical insights to guide both clinical practice and future empirical investigation.

Aims and methods

The present systematic review was conducted to address the following research questions:

- (RQ1) What types of music-based interventions have been employed in aphasia rehabilitation, and which musical components do they incorporate as active elements of the therapeutic process?
- (RQ2) What are the effects of these interventions on language and behavioural outcomes, as measured by standardized assessments?
- (RQ3) What neurophysiological changes are associated with the application of music-based interventions in individuals with aphasia?

To address these questions, the present systematic review aims to analyze studies that have provided quantitative changes in the expressive oral language – as measured by standardized assessment – of patients with aphasia. We conducted this review in accordance with the Preferred Reporting Items for Systematic Review (PRISMA; Liberati et al., 2009). The search was performed until July 2025, with two different databases (PubMed and PsychINFO) used to collect articles of interest using the following keywords: “Music AND aphasia”, “Music AND aphasia AND Rehabilitation”, “Aphasia AND Music Therapy”. Cross-referencing of the selected studies was also considered to identify additional relevant articles. Only articles written in English were considered. This review includes peer-reviewed studies concerning deficits in expressive oral language that were conducted as pre–post designs, as RCTs, or single-case studies in an adult population (aged 18 and over). Only studies involving music-based intervention or protocols with a clearly defined articulation were included. Studies in which music was used merely as a background or ancillary component to the primary rehabilitative intervention administered to patients (e.g., having participants simply listen to music while performing other treatments) were therefore excluded. Meta-analysis, reviews, and articles reporting exclusively qualitative procedures without quantitative data collection were also excluded from this review, as were studies that focused solely on comprehension deficits. While acknowledging the potential risk of publication bias, particularly relevant in clinical research contexts, the decision to include only peer-reviewed articles indexed in scientific databases was made to ensure methodological consistency and comparability across the selected studies. As illustrated in the flow chart (Figure 1), a total of 326 studies were identified from an initial search across the two databases. Based on title and abstract screening, 272 articles were excluded due to irrelevance to the research questions or failing to meet the inclusion criteria. Consequently, 54 articles progressed to full-text review. During this phase, 21 studies were excluded for reasons that included methodological unsuitableness or lack of relevance to the focus on structured music-based protocols for aphasic patients. Ultimately, 33 studies were deemed eligible for inclusion in this systematic review and are summarized in Table 1 (in this table we provided information on the study design, the characteristics of the sample and of the aphasia, as well as the intervention implemented). Two reviewers (M.G. and E.A.) independently screened the titles and abstracts of retrieved records to assess eligibility, followed by full-text evaluation of potentially relevant studies. Disagreements were resolved through discussion. A third reviewer was available if consensus could not be reached. The same two reviewers independently collected and reviewed data from each included study guided by the PICO framework (Eriksen & Frandsen, 2018). Specifically, information was gathered on the study population (age, sex, type and stage of aphasia, etiology), the intervention characteristics (protocol type, duration, intensity, frequency), comparators when available (e.g., standard speech therapy or no treatment), and the reported outcomes (quantitative measures of expressive oral language across different domains). Any discrepancies were resolved through discussion. No automation tools were used in either the selection or data collection process and study authors were not contacted for additional information.

The primary outcome of interest was the quantitative change in expressive oral language among patients with aphasia following music-based interventions. This outcome domain included measures such as naming accuracy, verbal fluency, repetition, sentence production, and spontaneous speech. When multiple tools were used to assess these domains (e.g., Aachener Aphasia Test, Boston Diagnostic Aphasia Examination, Boston Naming Test, Western Aphasia Battery, or language-specific adaptations), all available information concerning language outcomes were collected and reported without prioritizing one measure over another. We reported the results that, in the

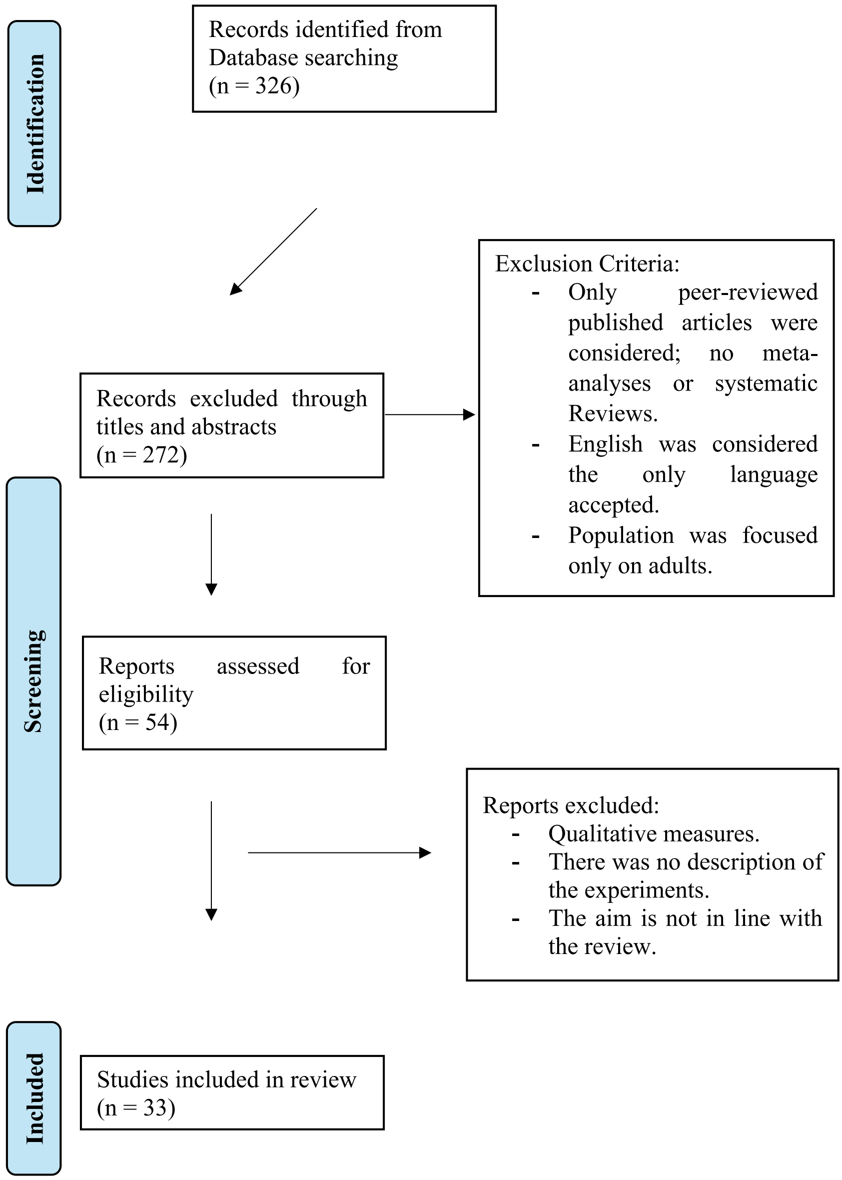

Figure 1. Prisma flowchart of the search strategy and studies selection process.

post-intervention period, indicated whether and to what extent significant changes were observed in language-related outcomes. Outcomes exclusively related to comprehension or qualitative observations were excluded. For missing or unclear information, no assumptions were made: In these cases, variables were coded as "not available".

Given the heterogeneity of designs, interventions, and outcome measures, results were synthesized narratively. The findings from each study were systematically reviewed and reported in detail, with an emphasis on providing a

Table 1. Characteristics of included studies.

Reference	Study type	Type of evaluation pre-post	Number of participants	Mean age (SD)	Males	Females	Aphasia type	Stage	Music-based intervention	Duration single session (min)	Times a week	Treatment lenght (weeks)	Follow up	Duration follow up	Aetiology	Lesion location
Akanuma et al., 2016	Pre-Post design	Language	10	63.7 (7.60)	9	1	Various Types	Chronic	Singing Therapy	30	1	10	0	0	Stroke	LH and bilateral
Baker, 2000	Case series	Language	2	31 (1.00)	1	1	Non-fluent	Subacute to chronic	MMIT	30	4–8	46478.00	0	0	TBI	LH
Belin et al., 1996	Case series	Brain changes & Language	7	49.7	/	/	Non-fluent (2 Broca. 5 global)	Subacute to chronic	TMR (Therapie Melodique et Rythmique)	/	/	4–486	0	0	Stroke	LH
Bonakdarpour et al., 2003	Pre-Post design	Language	7	52.4	4	3	Non-fluent (5 Broca. 2 subcortical)	Chronic	MIT adapted to Farsi	/	3–4	5	1	1 Month	Stroke	LH
Breier et al., 2010	Case series	Brain changes & Language	2	52	2	0	Non-fluent	Chronic	MIT	30	4	3	0	0	Stroke	LH
Conklyn et al., 2012	RCT	Brain changes & Language	16 (+14 control)	57.55 (16.8)	16	14	Broca	Acute to Chronic	MMIT	10 −15	2	1	0	0	Stroke	LH
Cortese et al., 2015	Pre-Post design	Language	6	59.8 (9.3)	5	1	Broca	Chronic	TMR adapted to Italian	30–40	4	4	1	6 Months	Stroke	LH
Curtis et al., 2020	Pre-Post design	Language	3	58 (7.12)	2	1	Non-fluent	Chronic	MIT	50	3	5	0	0	Stroke	LH
Haro-Martínez et al., 2017	Pre-Post design	Language	4	66.5 (5.02)	0	0	Non-fluent	Chronic	MIT adapted to Spanish	30	3	6	0	0	Stroke	LH
Haro-Martínez et al., 2019	Pilot randomized crossover	Language	22 (−2 dropout): 2 groups of 10 subjects	G1: 66.9 (14.7); G2: 61.1 (14.1)	12	8	Non-fluent	Chronic	MIT adapted to Spanish	30	2	6	1	3 Months	Stroke	LH
Hatayama et al., 2021	Case series	Language	1	67	0	1	Non-fluent	Chronic	MIT	30	1	82 (over 52 months)	1	6 Months	Stroke	LH
Hough, 2010	Case series	Language	1	69	1	0	Broca	Chronic	MIT without tapping	/	3	8	0	0	Stroke	LH
Impellizzeri et al., 2025	Case series	Brain changes & Language	1	59	0	1	Broca, Non-fluent	Chronic	Neurologic Music Therapy (NMT): MIT + Therapeutic Singing (TS)	45	3	8	0	0	Stroke	LH
Jungblut et al., 2020	Case series	Brain changes & Language	3	47	2	1	Non-fluent	Chronic	SIPARI	60	2	Five years	0	0	Stroke	LH

(*Continued*)

Table 1. Continued.

Reference	Study type	Type of evaluation pre-post	Number of participants	Mean age (SD)	Males	Females	Aphasia type	Stage	Music-based intervention	Duration single session (min)	Times a week	Treatment lenght (weeks)	Follow up	Duration follow up	Aetiology	Lesion location
Jungblut et al., 2022	RCT	Brain changes & Language	22 (−2 dropout): 2 groups of 10 subjects	56.25	13	7	Broca or global	Chronic	SIPARI	45	2	16–17	0	0	Stroke	LH
Lim et al., 2013	RCT	Language	12 (+9 control)	56.45 (5.75)	15	6	Non-fluent	Subacute to chronic	Singing Therapy + MIT	60	2	4	0	0	Stroke	LH and RH
Liu et al., 2024	Single-blind parallel RCT	Language	60 (20 + 20 + 20)	G1: 55.40 (14.56); G2: 49.50 (35.25); G3: 54.90 (16.81)	45	15	Non-fluent	Chronic	Singing (all received Speech language t.)	30 (+ 20 di rTMS)	5	3	0	0	Stroke	LH
Marchina et al., 2023	Pre-Post design	Brain changes & Language	14	54.0 (14.2)	13	1	Non-fluent	Chronic	MIT	90	5	15	1	1 Month	Stroke	LH
Martzoukou et al., 2021	Case series	Brain changes & Language	1	64	1	0	Broca	Chronic	MIT adapted to Greek	30–40	3	12	1	3 Months	Stroke	LH
Piccolo et al., 2023	Case series	Language	1	57	0	1	Global	Subacute to chronic	NMT: Symbolic Communication Training Through Music (SYCOM) + Musical Speech Stimulation (MUSTIM)	/	2	26	0	0	Stroke	LH
Raglio et al., 2016	RCT	Language	10 (+10 control)	61.3 (12.76)	14	6	Non-fluent	Chronic	Rhytmic and Singing Therapy	30	2	15	0	0	Stroke	LH
Schlaug et al., 2008	Pre-Post design	Brain changes & Language	2	52.5 (5.5)	2	0	Broca	Chronic	MIT	90	5	8	0	0	Stroke	LH
Schlaug et al., 2009	Pre-Post design	Brain changes & Language	6	/	/	/	Non-fluent	Chronic	MIT	90	5	15	0	0	Stroke	LH
Sihvonen et al., 2021	Single-blind RCT	Brain changes & Language	27 (+11 control)	56.1 (13.4)	23	15	/	Acute	Listening or listening + singing or audiobook	60	7	8	1	3 Months	Stroke	Mixed LH and RH
Sihvonen & Särkämö, 2021	Single-blind RCT	Brain changes & Language	31 (control group not included in the analyses)	55.4 (13.4)	18	13	/	Subacute	Listening	60	7	8	1	3 Months	Stroke	Mixed LH and RH

Siponkoski et al., 2023	Single-blind crossover RCT	Language	50 (23 + 27)	64 (12.3)	22	28	/	Chronic	Group MIT + choir + tablet at home	90	1 (group session) + 3 at home	16	1	9 Months	Stroke (53 stroke. 1 TBI)	/
Stahl et al., 2013	Pre-Post design	Language	15	56(10)	9	6	Broca or global	Chronic	Singing Therapy or rhythmic therapy	60	3	6	1	3 Months	Stroke	LH
Ueda et al., 2024	Case series	Language	1	60	0	1	Non-fluent	Subacute	MIT adapted to Japanese	20	5	2	0	0	Stroke	LH
Van Der Meulen et al., 2014	RCT	Language	16 (+11 control)	53.1 (12)	11	16	Non-fluent	Subacute	MIT	75	4	12	0	0	Stroke	LH
Van Der Meulen et al., 2016	RCT	Language	10 (+7 control)	58.1 (15.12)	11	6	Non-fluent	Chronic	MIT	75	4	6	1	6 weeks	Stroke	LH
Wan et al., 2014	RCT	Brain changes & Language	11 (+9 control)	54.8 (9.5)	18	2	Broca	Chronic	MIT	90	5	15	0	0	Stroke	LH
Zhang et al., 2021	RCT	Language	20 (+20 control)	Exp: 52.90 (9.08); Control: 54.05 (10.81)	31	9	Broca or global or transcortical	Subacute	MIT (control received ST)	30	5	8	0	0	Stroke	LH
Zhang et al., 2023	RCT (open label. randomized exp + control)	Brain changes & Language	62 total. 40 completed (−22 dropout)	Exp: 50.15 (15.44); Control: 51.6 (12.27)	33	7	Broca or global or transcortical	Subacute	MIT (control received ST)	30	5	4	0	0	Stroke	LH

Note. The symbol "/" indicates information that was not reported in the original study.

comprehensive account of the interventions tested and the main results obtained. This approach allowed us to capture the diversity of methodologies and therapeutic strategies employed, while offering an exhaustive overview of the evidence available on music-based interventions for aphasia.

Results

This section presents the findings of the systematic review, which revealed a considerable variety in terms of design, sample characteristics, intervention type, and outcome measures. Following an overview of the methodological characteristics of the 33 included studies, the results are organized around the three research questions that guided this review: the types of music-based interventions employed and their core musical components (RQ1); the effects of these interventions on language and behavioural outcomes as measured by standardized assessments (RQ2); and the neurophysiological changes associated with their application in individuals with aphasia (RQ3).

Study characteristics

Study design

The examined studies presented a variety of research designs, including nine pre–post designs (Akanuma et al., 2016; Bonakdarpour et al., 2003; Cortese et al., 2015; Curtis et al., 2020; Haro-Martínez et al., 2017; Marchina et al., 2023; Schlaug et al., 2008, 2009; Stahl et al., 2013), 14 randomized control trials (Conklyn et al., 2012; Haro-Martínez et al., 2019; Jungblut et al., 2022; Lim et al., 2013; Liu et al., 2024; Raglio et al., 2016; Sihvonen et al., 2021; Sihvonen & Särkämö, 2021; Siponkoski et al., 2023; Van Der Meulen et al., 2014; Van Der Meulen et al., 2016; Wan et al., 2014; Zhang et al., 2021; Zhang et al., 2023), and 10 case series and single-case studies (Baker, 2000; Belin et al., 1996; Breier et al., 2010; Hatayama et al., 2021; Hough, 2010; Impellizzeri et al., 2025; Jungblut et al., 2020; Martzoukou et al., 2021; Piccolo et al., 2023; Ueda et al., 2024). Data were collected pre – and post-treatment for all the studies, with two studies also collecting follow-up data after one month (Bonakdarpour et al., 2003; Marchina et al., 2023), five studies after three months (Haro-Martínez et al., 2019; Martzoukou et al., 2021; Sihvonen et al., 2021; Sihvonen & Särkämö, 2021; Stahl et al., 2013), two studies after six months (Cortese et al., 2015; Hatayama et al., 2021), and one study after nine months (Siponkoski et al., 2023). In addition to the pre – and post-intervention evaluations, two studies also conducted an intermediate assessment phase during the treatment (Hatayama et al., 2021; Marchina et al., 2023). Another study collected data twice during the treatment: Once after two weeks and again after four weeks (Stahl et al., 2013). One study collected data at the end of each treatment period over a period of five years (Jungblut et al., 2020).

Among the studies that measured data at baseline and after the treatment, 19 of those collected data only relating to language (Akanuma et al., 2016; Baker, 2000; Bonakdarpour et al., 2003; Cortese et al., 2015; Curtis et al., 2020; Haro-Martínez et al., 2017; Haro-Martínez et al., 2019; Hatayama et al., 2021; Hough, 2010; Lim et al., 2013; Liu et al., 2024; Piccolo et al., 2023; Raglio et al., 2016; Siponkoski et al., 2023; Stahl et al., 2013; Ueda et al., 2024; Van Der Meulen et al., 2014; Van Der Meulen et al., 2016; Zhang et al., 2021). In addition to collecting data on language outcome, the remaining studies included in this review also collected data on brain modifications.

Although RCTs are the gold standard for evaluating clinical efficacy (Zabor et al., 2020), their implementation in aphasia rehabilitation is often constrained by small sample sizes, patient heterogeneity, and the intensive nature of the protocols. The present review therefore adopted an inclusive approach to study design, recognizing that pre–post studies and single-case investigations offer complementary insights into rehabilitative trajectories and individual responsiveness, albeit with limited capacity for causal inference.

Sample range

A total of 521 subjects are reported in the included studies: Of these, 67 who took part in pre–post designs (Akanuma et al., 2016; Bonakdarpour et al., 2003; Cortese et al., 2015; Curtis et al., 2020; Haro-Martínez et al., 2017; Marchina et al., 2023; Schlaug et al., 2008, 2009; Stahl et al., 2013), 434 took part in RCTs (Conklyn et al., 2012; Haro-Martínez et al., 2019; Jungblut et al., 2022; Lim et al., 2013; Liu et al., 2024; Raglio et al., 2016; Sihvonen et al., 2021; Sihvonen & Särkämö, 2021; Siponkoski et al., 2023; Stahl et al., 2013; Van Der Meulen et al., 2014; Van Der Meulen et al., 2016; Wan et al., 2014; Zhang et al., 2021; Zhang et al., 2023), where 131 of whom participated as part of the control groups. Finally, 20 subjects participated in single case studies (Baker, 2000; Belin et al., 1996; Breier et al., 2010; Hatayama et al., 2021; Hough, 2010; Impellizzeri et al., 2025; Jungblut et al., 2020; Martzoukou et al., 2021; Piccolo et al., 2023; Ueda et al., 2024). Sample size in the studies ranged from 1 (Hough, 2010) to 60 (Liu et al., 2024). A total of 333 of the subjects were male, 171 were female, and the gender of 13 participants was not specified in two studies (Belin et al., 1996; Schlaug et al., 2009).

Overall, these numbers highlight a marked variability in sample size across the included studies, reflecting both the methodological diversity of the field and the practical challenges inherent in clinical research on aphasia rehabilitation. While RCTs account for the largest proportion of participants, a substantial number of studies relied on small samples or single-case designs, which limits statistical power and generalizability of findings. The wide range in sample size, combined with an uneven gender distribution, underscores the need for caution when interpreting aggregated results and highlights the importance of future studies with larger, more balanced, and systematically characterized samples.

Type of aphasia and etiology

The majority of the studies included in this review were conducted on patients whose aphasia was attributable to ischemic events resulting in lesions in the left hemisphere. Studies involving individuals with primary progressive aphasia or other neurodegenerative forms of aphasia were not included in this review, as these conditions are characterized by distinct etiological mechanisms and clinical trajectories clearly differentiating them from post-stroke aphasia. Accordingly, their inclusion would have required a separate theoretical framework and intervention rationale, beyond the scope of the present review. Participants with right-hemisphere lesions (Akanuma et al., 2016; Lim et al., 2013; Sihvonen et al., 2021; Sihvonen & Särkämö, 2021) or aphasia due to causes other than ischemic events, such as traumatic brain injuries (Baker, 2000; Siponkoski et al., 2023), were only included in a limited number of cases. In the majority of the included studies, participants were enrolled in intervention programmes during the chronic phase of aphasia (i.e., more than six months after the onset of the condition). In approximately one-third of the studies individuals were examined in the acute (Conklyn et al., 2012; Sihvonen et al., 2021) or subacute (Baker, 2000; Belin et al., 1996; Lim et al., 2013; Piccolo et al., 2023; Sihvonen & Särkämö, 2021; Ueda et al., 2024; Van Der Meulen et al., 2014; Zhang et al., 2021; Zhang et al., 2023) phase of the disorder.

The vast majority of these studies focused on individuals with non-fluent aphasia (Broca's aphasia), although patients with other diagnoses, such as global aphasia or others, were also included in some cases (Akanuma et al., 2016; Belin et al., 1996; Bonakdarpour et al., 2003; Jungblut et al., 2022; Piccolo et al., 2023; Stahl et al., 2013; Zhang et al., 2021; Zhang et al., 2023).

When considered as a whole, this distribution reflects a predominant focus of the current literature on chronic, non-fluent aphasia of post-stroke origin, particularly following left-hemispheric ischemic lesions. This emphasis may partly reflect the fact that individuals with non-fluent aphasia often preserve the ability to sing despite severe impairments in spoken language, thereby enabling the implementation of rehabilitation approaches that integrate singing-based musical activities (Akanuma et al., 2016). While this focus aligns with the clinical targets of most music-based rehabilitation protocols, it also may limit the generalizability of findings to other aphasia subtypes, etiologies, and phases of recovery. Future research may therefore benefit from systematically examining the differential effects of music-based interventions across aphasia profiles and recovery stages, in order to better delineate their scope and clinical applicability.

Language outcomes assessment

In the reviewed studies, different tests were used to evaluate language outcomes. The majority of studies employed standardized batteries specifically developed for aphasia assessment. The most frequently used instruments were the Aachener Aphasia Test (AAT; Huber et al., 1983), included in seven studies (Cortese et al., 2015; Jungblut et al., 2020; Jungblut et al., 2022; Raglio et al., 2016; Stahl et al., 2013; Van Der Meulen et al., 2014; Van Der Meulen et al., 2016), the Boston Diagnostic Aphasia Examination (BDAE; Goodglass & Kaplan, 1983), included in 12 studies (Belin et al., 1996; Curtis et al., 2020; Haro-Martínez et al., 2017; Haro-Martínez et al., 2019; Liu et al., 2024; Marchina et al., 2023; Martzoukou et al., 2021; Schlaug et al., 2008; Sihvonen & Särkämö, 2021; Siponkoski et al., 2023; Zhang et al., 2021; Zhang et al., 2023), and the Western Aphasia Battery (WAB; Kertesz, 1982, 2022), included in nine studies (Breier et al., 2010; Conklyn et al., 2012; Curtis et al., 2020; Hatayama et al., 2021; Hough, 2010; Impellizzeri et al., 2025; Lim et al., 2013; Liu et al., 2024; Siponkoski et al., 2023), either in their full or partial form. The AAT, BDAE, and WAB are comprehensive aphasia batteries designed to provide a broad exploration of communicative abilities, with results commonly used to classify patients' language profiles and provide an evaluation of aphasia severity. The AAT is designed to examine verbal performance in both language comprehension and expression, across oral and written modalities. Its subtests systematically probe linguistic processing at multiple levels, including phonemic, lexical, morphologically complex, and sentence-level units. The BDAE provides a broad evaluation of language function through structured assessment of spontaneous and conversational speech, auditory comprehension, oral expression (including repetition and naming), as well as reading and writing abilities, thereby capturing both receptive and expressive language skills. Finally, the WAB focuses on the principal language domains most affected in aphasia – namely, spontaneous speech production (including discourse formulation and picture description tasks), auditory comprehension, repetition, and naming – offering a concise yet multidimensional profile of language performance. Most of the reviewed studies administered the entire battery of subtests, providing a comprehensive evaluation of language abilities. However, some studies selected only specific subtests to target particular language domains. Specifically, Van Der Meulen et al. (2014; 2016) administered only the repetition and naming subtests of the AAT, while Raglio et al. (2016) focused on picture description and spontaneous speech. Akanuma et al. (2016), using the Japanese Standard Language Test of Aphasia (SLTA 1977), administered picture naming, word fluency, and picture description subtests. Conklyn et al. (2012) developed a shortened task assessing repetition and responsiveness, based on the WAB, to reduce administration time. A smaller number of studies included language assessments that were not embedded within comprehensive aphasia batteries. To specifically assess picture naming, the Boston Naming Test (2nd edition or short form; BNT-2; Kaplan et al., 2000) was employed in nine studies (Breier et al., 2010; Curtis et al., 2020; Marchina et al., 2023; Martzoukou et al., 2021; Raglio et al., 2016; Schlaug et al., 2008; Sihvonen et al., 2021; Sihvonen & Särkämö, 2021; Zhang et al., 2023). In several cases, subtests from standardized batteries were combined with additional tasks to complement the assessment and to capture more ecologically valid measures of verbal communicative abilities. Specifically, Van Der Meulen et al. (2014; 2016) supplemented the AAT with the Sabadel Story Retelling Task (Van Eeckhout et al., 1982), which evaluates information content in connected speech, and the Amsterdam-Nijmegen Everyday Language Test (ANELT; Blomert et al., 1995), which assesses verbal communication in everyday social interaction contexts. Importantly, as all studies employed multiple test assessment measures to evaluate the effects of music-based interventions, this methodological approach allows for a more fine-grained analysis of the specific language components and underlying mechanisms targeted by each intervention, making it possible to examine whether particular approaches were selectively beneficial for distinct verbal domains or for expressive versus comprehension-related processes.

Given that the studies were conducted in different linguistic contexts, the standard English versions of the tests were used in studies such as Belin et al. (1996), Schlaug et al. (2008), and Curtis et al. (2020), whereas adapted and validated versions were employed for other languages, including Italian (Cortese et al., 2015; Raglio et al., 2016), Spanish (Haro-Martínez et al., 2017; Haro-Martínez et al., 2019), Chinese (Liu et al., 2024; Zhang et al., 2021; Zhang et al., 2023), Japanese (Akanuma et al., 2016; Ueda et al., 2024), and Farsi (Bonakdarpour et al., 2003). In addition, Raglio et al. (2016) administered two subtests – picture description and spontaneous speech – from the Italian version of the Aachener Aphasia Test (Luzzatti et al., 2023), together with all subtests from the Milan Protocol (Ciurli et al., 1996), which assesses oral and written language abilities across spontaneous production, naming, comprehension, repetition, reading, and writing. Finally, Bonakdarpour et al. (2003) employed the Farsi Aphasia Test (FAT), the only aphasia battery available in Farsi, which was developed to closely resemble the BDAE with respect to the language domains assessed. Overall, the availability of language assessment instruments adapted to different orthographies and linguistic systems, with carefully controlled parameters, is essential to ensure that language deficits can be evaluated in a comparable manner across speakers of different mother tongues, thereby allowing the results of the reviewed studies to be meaningfully and validly compared, in line with recent recommendations from international collaborative initiatives such as the Collaboration of Aphasia Trialists (COST Action IS1208, 2013–2017).

Music-based interventions and core musical components

An analysis of the available literature on music-based interventions for the treatment of non-fluent aphasia reveals a wide range of rehabilitative techniques, each targeting specific musical components (e.g., rhythm, melody, intonation, etc.) and language outcomes (see Table 2). Across these approaches, two components recur as central therapeutic elements: melodic intonation, which

Table 2. Music-based intervention protocols, core musical components, targeted outcome domains, and evidence of efficacy.

Intervention protocol	Core musical components	***Targeted language outcomes:***	Repetition	Naming	Comprehension	Production	Spontaneous speech	Articulatory planning	Other variables	Efficacy for targeted outcomes
Melodic Intonation Therapy (MIT) / Modified MIT (MMIT)	Melodic – Prosodic Modulation; Rhythmic – Temporal Scaffolding; Vocal – Motor Integration		⊙	⊙	⊙	⊙			Verbal fluency	Repetition shows most consistent gains, especially >20 h of therapy. Improvements in fluency and sentence production; naming outcomes more variable; limited effects on comprehension.
SIPARI	Melodic – Prosodic Modulation; Rhythmic – Temporal Scaffolding; Vocal – Motor Integration; Sub-lexical and Formulaic Vocal Material		⊙	⊙	⊙		⊙	⊙	Executive functions (attention, working memory)	Significant improvements in global productive language, repetition, naming, and spontaneous speech; positive effects on Token Test; benefits for working memory and attention.
Singing Therapy / Therapeutic Singing	Melodic – Prosodic Modulation; Aesthetic – Emotional Engagement		⊙	⊙		⊙			Verbal fluency	Effective for naming, and repetition of single words and sentences; improvements in speech production as connected speech, particularly with intact right hemisphere; enhanced motivation and adherence.

(*Continued*)

Table 2. Continued.

Intervention protocol	Core musical components	***Targeted language outcomes:***	Repetition	Naming	Comprehension	Production	Spontaneous speech	Articulatory planning	Other variables	Efficacy for targeted outcomes
Community Choir	Melodic – Prosodic Modulation; Rhythmic – Temporal Scaffolding; Vocal–Motor Integration; Social and Interactive Musical Context; Aesthetic–Emotional Engagement					⊙			Verbal memory	Improvements in communication and verbal memory; strong psychosocial benefits including mood, self-confidence, and reduced isolation.
SYCOM (NMT)	Musical Cueing and Structured Sound Mapping								Symbolic and functional communication	Improved symbolic communication and Token Test performance.
MUSTIM (NMT)	Sub-lexical and Formulaic Vocal Material; Musical Cueing and Structured Sound Mapping								Non-propositional (automatic) language; long term memory	Effective in stimulating automatic verbal output and lyric completion.
Rhythmic Therapy	Rhythmic–Temporal Scaffolding							⊙	Formulaic speech	Improved production of conventional expressions; facilitation of speech initiation via motor cortex activation.
Vocal Music Listening	Aesthetic–Emotional Engagement								Verbal memory; general language recovery	Positive effects on verbal memory recovery and language-network neuroplasticity, especially in acute phase.

appears to facilitate speech production by engaging preserved right-hemisphere vocal and auditory-motor networks, and rhythm, which provides an external temporal scaffold supporting articulatory planning, syllabic segmentation, and motor sequencing. These elements rarely operate in isolation; rather, they interact with one another and with broader cognitive resources such as attention and working memory, a synergy that will be examined in greater detail in the Discussion.

Melodic intonation therapy (MIT)

One of the most prominent and widely utilized protocols is MIT (Albert et al., 1973). As previously described, MIT is a structured therapeutic method that employs melodic and rhythmic elements of singing to facilitate and enhance speech production, covering a continuum that ranges from single words and short phrases to complex sentences, propositional language, and extended utterances. MIT is frequently employed as a complementary rehabilitation method – though in some cases also as a primary intervention – alongside more traditional forms of language therapy (Speech Language Therapy). Two-thirds of the studies included in this review (Baker, 2000; Belin et al., 1996; Bonakdarpour et al., 2003; Breier et al., 2010; Conklyn et al., 2012; Cortese et al., 2015; Curtis et al., 2020; Haro-Martínez et al., 2017; Haro-Martínez et al., 2019; Hatayama et al., 2021; Hough, 2010; Impellizzeri et al., 2025; Lim et al., 2013; Marchina et al., 2023; Martzoukou et al., 2021; Schlaug et al., 2008, 2009; Siponkoski et al., 2023; Ueda et al., 2024; Van Der Meulen et al., 2014; Van Der Meulen et al., 2016; Wan et al., 2014; Zhang et al., 2021; Zhang et al., 2023) incorporated MIT as a key component of the rehabilitation pathway, either in its original format or in a modified version.

In certain cases, particularly in the context of more severe aphasic conditions, MIT has been modified and successfully adapted by altering specific components (Baker, 2000; Conklyn et al., 2012; Hough, 2010), such as removing the tapping element or introducing more complex melodic structures (as opposed to the original version, which typically relies on two-tone intervals) to accommodate patients' specific needs. For example, regarding the efficacy of the tapping component, Curtis et al. (2020) investigated whether the effectiveness of MIT is influenced by deficits in rhythm processing, an element frequently reported in aphasic patients (Zipse et al., 2014). Their findings suggest that aphasic patients without rhythmic deficits benefit more from the standard version of MIT, whereas those with rhythm processing difficulties show better outcomes when the rhythmic component is removed. Furthermore, in non-English-speaking contexts, MIT has been adapted for use in other languages, including Chinese (Zhang et al., 2021; Zhang et al., 2023), Farsi (Bonakdarpour et al., 2003), French (Belin et al., 1996), Greek (Martzoukou et al., 2021), Italian (Cortese et al., 2015), Japanese (Ueda et al., 2024), and Spanish (Haro-Martínez et al., 2017; Haro-Martínez et al., 2019). In one study

(Siponkoski et al., 2023), MIT was also administered in a group setting (whereas it is traditionally administered individually).

At a mechanistic level, the therapeutic efficacy of MIT is grounded in the interaction of several core musical components. Central to the protocol is melodic intonation, which capitalizes on the relative preservation of singing abilities in individuals with non-fluent aphasia by embedding verbal utterances within simplified melodic contours that closely follow the natural prosody of spoken language rather than complex musical melodies (Marchina et al., 2023; Zipse et al., 2012). This melodic modulation, particularly when combined with pitch variation, has been shown to facilitate connected speech production in Broca's aphasia through the engagement of right-hemisphere neural circuits that are often spared following left-hemispheric lesions (Schlaug et al., 2009; Zumbansen et al., 2014).

Rhythm constitutes a second essential component of MIT and operates synergistically with melodic intonation by providing an external temporal scaffold for speech production. Through regular syllabic pacing and rhythmic scanning, MIT supports articulatory timing and motor planning, promoting synchronization between linguistic formulation and motor execution (Merrett et al., 2014; Zumbansen et al., 2014). This rhythmic framework is further reinforced by left-hand rhythmic tapping, a distinctive feature of the protocol that serves multiple therapeutic functions: It selectively recruits right-hemisphere motor networks, supports syllabic segmentation, and facilitates audio-motor coupling during speech production and spontaneous speech (Marchina et al., 2023; Merrett et al., 2014; Schlaug et al., 2009). Notably, left-hand rhythmic tapping has been identified as a unique and potentially critical component of MIT, warranting systematic isolation in control conditions to clarify its specific contribution to treatment outcomes (Marchina et al., 2023).

In addition, early phases of MIT rely on choral production between therapist and patient, which may reduce performance-related anxiety, promote imitation-based learning, provide prosodic support, and enhance temporal synchronization of speech output (Merrett et al., 2014). Finally, the use of exaggerated prosodic patterns emphasizes the melodic features inherent to natural speech, exploiting the right hemisphere's specialization for melodic and prosodic processing and further differentiating intoned speech from ordinary spoken output (Schlaug et al., 2009). Together, these components position MIT as a multimodal intervention that integrates melodic-prosodic modulation, rhythmic-temporal scaffolding, and audio-motor coupling to facilitate language recovery.

Singing therapy

Beyond the intonation-based approach that characterizes MIT, several studies have implemented interventions that place greater emphasis on musical and vocal expression, incorporating singing exercises and practices. In some cases, such interventions are referred to as Singing Therapy (ST) or Therapeutic

Singing (TS) (Akanuma et al., 2016; Impellizzeri et al., 2025; Lim et al., 2013; Liu et al., 2024; Raglio et al., 2016; Sihvonen et al., 2021; Siponkoski et al., 2023; Stahl et al., 2013), where patients are encouraged to sing familiar or personally meaningful songs or to engage in vocal improvisation. These interventions are primarily administered individually, although there are examples of studies examining how group-based musical activities (e.g., choir sessions with breathing and vocal exercises) may contribute to the rehabilitation of language functions (Siponkoski et al., 2023).

In this case, the approach is more flexible and less structured than the MIT protocol. Although melodic, intonational, and rhythmic components are still present, music is primarily integrated through the use of familiar songs (Akanuma et al., 2016; Impellizzeri et al., 2025), forms of formulaic language (namely, conventional expressions used in communication) (Stahl et al., 2013), and free improvisational activities conducted in interaction with the therapist (Raglio et al., 2016). These elements enhance patient motivation, rhythmic attunement, and emotional engagement, which in turn support spontaneous verbal expression.

Neurologic music therapy (NMT)

Within the field of aphasia rehabilitation, NMT (Thaut & Hoemberg, 2014) is also employed as a therapeutic approach that leverages musical components to support cognitive, sensory, and motor functions. NMT has been applied through the integration of various techniques – MIT among them (e.g., Impellizzeri et al., 2025) – with the aim of promoting language recovery in individuals with aphasia. This integrative approach allows for the combination of complementary methods. For instance, in the study by Impellizzeri et al. (2025), MIT was implemented alongside TS (Tabei et al., 2016) to address emotional components of the recovery process and enhance patient engagement and motivation. Moreover, the intervention designed by Piccolo et al. (2023) combined other NMT-based strategies, such as Symbolic Communication Training Through Music (SYCOM; Thaut & Hoemberg, 2014) – which uses musical instruments to facilitate communication by playing according to a pattern corresponding to increasingly complex words or phrases – and Musical Speech Stimulation (MUSTIM; Thaut & Hoemberg, 2014) – which utilizes familiar musical materials (e.g., songs or rhymes) to stimulate non-propositional speech by prompting patients to complete interrupted lyrics. From a functional perspective, the inclusion of SYCOM and MUSTIM within NMT-based interventions highlights the strategic use of preserved automatic and memory-driven processes to support communication in aphasia. SYCOM facilitates communicative abilities by mapping linguistic content onto structured musical patterns, allowing patients to rely on sensorimotor and associative mechanisms rather than on purely propositional language generation. In this way, communication is scaffolded through predictable sound-action contingencies, which may reduce cognitive load and support symbolic expression even in the presence of severe expressive impairments. Complementarily, MUSTIM capitalizes on the strong coupling between familiar musical material and long-term memory representations. By prompting patients to complete interrupted lyrics or rhythmic sequences, MUSTIM exploits overlearned verbal-musical associations stored in long-term memory, thereby eliciting non-propositional speech that is often relatively preserved in aphasia (Piccolo et al., 2023; Thaut & Hoemberg, 2014). Together, these approaches suggest that music-based stimulation can act as a gateway to verbal output by reactivating automatized linguistic sequences and implicit memory traces, enabling patients to participate in communicative exchanges even when generative language mechanisms are compromised.

SIPARI

Two studies by the same author (Jungblut et al., 2020; Jungblut et al., 2022) applied the SIPARI technique (Jungblut, 2009) by implementing a vocal-rhythmic training protocol specifically developed by Jungblut to support the rehabilitation of patients with chronic aphasia. As mentioned in the Introduction, SIPARI focuses on improving the planning, programming, and sequencing of speech movements, with particular emphasis on executive functions such as working memory and attention. Based on the components mentioned above, SIPARI adopts a bi-hemispheric approach: Melodic elements initially engage residual right-hemisphere resources, while progressively emphasizing rhythmic and temporal features to support phonological and segmental processing in the left hemisphere. The use of sub-lexical vocal material embedded in rhythmic-melodic sequences reduces semantic load and allows severely impaired patients to train core speech-motor functions. SIPARI also targets executive functions by requiring the coordination of attentional control and working memory resources, fostering the integration of melodic-rhythmic patterns with verbal output. In this way, the protocol promotes neuroplastic reorganization and functional language recovery beyond automatic singing, even in advanced stages of aphasia (Jungblut et al., 2020).

Rhythmic therapy

Focusing on specific musical features, some interventions have emphasized prosodic rhythm. Two studies (Raglio et al., 2016; Stahl et al., 2013) employed rehabilitative techniques specifically targeting rhythm through Rhythmic Therapy protocols designed to isolate the temporal component of speech. Temporal control is typically implemented through external rhythmic cues, such as percussion beats or metronomic pacing, which act as an external pacemaker to regulate syllabic timing and duration and to support speech initiation and segmentation at the syllabic level. These interventions are usually designed to improve the production of common and stereotyped phrases by training patients to speak formulaic texts.

Musical listening

Finally, other interventions have involved simpler forms of musical engagement, such as listening to vocal music. In such cases, participants were invited to listen to selected songs to evaluate whether daily exposure to vocal music could promote the recovery of verbal memory and language abilities following stroke (Sihvonen & Särkämö, 2021). Beyond its structural auditory features, as mentioned before, listening to music provides a pleasurable and emotionally engaging experience that recruits reward-related neural circuits and supports motivation and attentional engagement. From this perspective, the integration of aesthetically gratifying musical stimuli may act as a cognitive amplifier, fostering psychophysical well-being and facilitating functional recovery through mechanisms related to reward processing and neural plasticity (Colombi et al., 2025).

Taken together, these diverse approaches underscore the versatility of music-based interventions in aphasia rehabilitation, highlighting the potential of musical elements, not only as therapeutic tools for enhancing speech and language functions, but also as means to support emotional engagement, cognitive stimulation, and social participation throughout the recovery process.

Programme structure

The duration of the intervention varied in terms of the length of individual sessions, the number of weekly sessions, and the total duration of the treatment. A single session length ranged from a minimum of 10-15 min using MMIT (Conklyn et al., 2012) to a maximum of 90 min using MIT (Schlaug et al., 2008; Schlaug et al., 2009; Wan et al., 2014).

The weekly frequency reported across the analyzed articles appears to be heterogeneous: For example, Akanuma et al. (2016) described a single weekly intervention of ST, whereas Baker (2000) reported 30-minutes interventions of MMIT with a frequency up to eight times per week.

The temporal variability observed in the single session and in the frequency of the programmes is also noted in the overall duration of the various treatments. The shortest training was described by Conklyn et al. (2012), consisting of just two sessions in total withing one week (this was due to scheduling difficulties for acute hospital care and short hospital stays for patients). In contrast, Belin et al. (1996) and Baker (2000) reported treatment durations that varied among participants, ranging respectively from four to 27 weeks and from one month to nine years. Analyzing the individual musical treatment described by the authors, a considerable variability in their implementation emerges, particularly with respect to MIT. In its original form, MIT required high-frequency weekly sessions of approximately 45 min for a period ranging from three to six weeks (Albert et al., 1973). In the analyzed articles, the duration of the single session, though longer than originally proposed, was reported as 75 min in two studies (Van Der Meulen et al., 2014; Van Der Meulen et al., 2016) and 90 min in three studies (Schlaug et al., 2008; Schlaug et al., 2009; Wan et al., 2014).

The analysis of programme structure reveals substantial heterogeneity in terms of session length, weekly frequency, and total duration of these interventions, raising important considerations regarding their clinical feasibility and long-term sustainability. For example, many MIT-based protocols relied on long and highly intensive schedules. While such intensity has been associated with meaningful neuroplastic changes, it may pose practical challenges in standard rehabilitation settings and may not be sustainable for all patients, especially those with limited tolerance to fatigue. Conversely, in acute and subacute phases, feasibility constraints related to short hospital stays and scheduling demands have prompted the use of brief or modified interventions (e.g., MMIT), suggesting that reduced session duration may represent a viable alternative in intensive care contexts. Evidence indicates that treatment effectiveness is not determined solely by intervention intensity, but also by the timing of its administration relative to aphasia onset. It is suggested that there exists an inverse relationship between time since onset and treatment efficacy, with music-based interventions (particularly MIT) yielding more pronounced gains when introduced in the subacute phase compared to the chronic stage (Van Der Meulen et al., 2014). In this regard, while differences between music-based interventions and standard speech and language therapy may be less evident in chronic aphasia, early implementation appears to confer a relative advantage in promoting recovery of repetition and expressive language abilities (Lim et al., 2013). The variability observed in overall treatment duration further highlights the diversity of implementation strategies across studies. These findings suggest that programme structure is not merely a methodological detail, but a central factor influencing the applicability, scalability, and continuity of music-based rehabilitation. Evidence also suggests that sustainability may be enhanced by interventions that promote patient engagement and adherence, such as those incorporating pleasurable musical experiences, group-based formats, or home-based delivery (e.g., Siponkoski et al., 2023). Tailoring intervention intensity and components to individual clinical profiles may improve efficiency by optimizing resource allocation and avoiding non-beneficial therapeutic elements.

Treatment effectiveness on language and behavioural outcomes

Across the included studies, music-based interventions consistently yielded their most robust benefits in the domain of expressive language, with repetition emerging as the single most responsive outcome and consistent gains also reported for naming, speech production, and spontaneous speech. By contrast, comprehension outcomes – which fall outside the primary focus of the present review, centred on oral and expressive language production – were reported less consistently and are summarized here only as complementary information. The following paragraphs detail these outcomes by language domain.

Music-based interventions have generally shown promise in improving communication and language skills in patients with non-fluent aphasia. Specifically, the analyzed studies have shown that these training programmes can lead to significant improvements in repetition, a language outcome that appears particularly responsive to interventions incorporating melodic-prosodic modulation and rhythmic temporal scaffolding (Bonakdarpour et al., 2003; Conklyn et al., 2012; Cortese et al., 2015; Jungblut et al., 2020; Jungblut et al., 2022; Lim et al., 2013; Liu et al., 2024; Siponkoski et al., 2023; Van Der Meulen et al., 2014; Zhang et al., 2021; Zhang et al., 2023). Improvements were also reported in naming (Akanuma et al., 2016; Bonakdarpour et al., 2003; Cortese et al., 2015; Impellizzeri et al., 2025; Jungblut et al., 2020; Jungblut et al., 2022; Lim et al., 2013; Martzoukou et al., 2021; Schlaug et al., 2008; Siponkoski et al., 2023; Zhang et al., 2021; Zhang et al., 2023). Heterogeneous results emerged for comprehension (Belin et al., 1996; Cortese et al., 2015; Curtis et al., 2020; Impellizzeri et al., 2025; Jungblut et al., 2022; Martzoukou et al., 2021; Raglio et al., 2016; Zhang et al., 2021), possibly reflecting the fact that most music-based protocols primarily target expressive rather than receptive language mechanisms. Improvements were also documented in speech production – at both the word and sentence level (Breier et al., 2010; Conklyn et al., 2012; Haro-Martínez et al., 2017; Hatayama et al., 2021; Hough, 2010; Impellizzeri et al., 2025; Martzoukou et al., 2021; Schlaug et al., 2008; Schlaug et al., 2009; Siponkoski et al., 2023; Wan et al., 2014), and spontaneous speech (Belin et al., 1996; Bonakdarpour et al., 2003; Hatayama et al., 2021; Impellizzeri et al., 2025; Jungblut et al., 2022; Martzoukou et al., 2021; Raglio et al., 2016; Schlaug et al., 2009; Zhang et al., 2021; Zhang et al., 2023), particularly in interventions integrating melodic intonation, rhythmic pacing, and audio-motor coupling, which may support articulatory timing, speech initiation, and the production of formulaic and connected speech. In addition, performance on standardized measures such as the Token Test improved in studies employing integrative or multimodal music-based approaches, including NMT-derived protocols (Impellizzeri et al., 2025; Jungblut et al., 2020; Piccolo et al., 2023). In contrast to these findings, Van Der Meulen et al. (2016) reported only limited improvements in the communication abilities of aphasic patients or no significant changes at all in BDAE subtest scores (Haro-Martínez et al., 2019).

As said before, MIT – the most extensively studied music-based training programme – was originally developed with the aim of rehabilitating language abilities in individuals with chronic aphasia (Albert et al., 1973). However, Van Der Meulen et al. (2014) observed that administering the programme during the subacute phase could enhance recovery outcomes, leading to significant improvements in verbal abilities. They also reported that the effectiveness of repetition training decreased as the time between the onset of aphasia and the start of therapy increased. Similarly, Lim et al. (2013), in a comparison between a standard lexical rehabilitation programme (SLT) and a music-based programme (NMT), found that while differences in outcomes among chronic patients were not significant, subacute patients receiving music-based training showed marked improvements in language abilities, unlike those treated with SLT, where improvements were not statistically significant. These results suggest that treatment effectiveness may be strongly modulated by timing of intervention.

Neurophysiological brain changes

Across the studies that incorporated neuroimaging, music-based interventions – particularly MIT – were consistently associated with measurable changes in brain function and structure, converging on a recurring pattern: A reactivation of perilesional left-hemisphere language regions accompanied, in patients who respond successfully, by a progressive normalization of the initially compensatory right-hemisphere recruitment, alongside structural remodelling of the right arcuate fasciculus. Importantly, in several studies these neural changes correlated directly with behavioural gains in language performance, supporting the interpretation that music-based interventions act through treatment-induced neuroplasticity rather than through nonspecific or spontaneous recovery. The following paragraphs detail these functional and structural findings across imaging modalities.

The use of MIT in chronic aphasic patients has been associated with changes in brain functioning. Consistent evidence suggests that MIT specifically increases recruitment of left-hemisphere regions while reducing activation in their right-hemisphere homologues.

While repetition of spoken words tends to increase blood flow in the right hemisphere, repetition of words using MIT has been associated with increased activation in Broca’s area and a corresponding decrease in activation in right-hemisphere regions (Belin et al., 1996). Conklyn et al. (2012), using fMRI, observed that from the early stages of treatment there is activation of areas in the right hemisphere homologous to those typically involved in speech. Belin et al. (1996) demonstrated that, as treatment progresses, there is a reactivation of perilesional regions in the left hemisphere, accompanied by a deactivation of homotopic areas in the Wernicke’s region of the right hemisphere. In a SPECT (Single-Photon Emission Computed Tomography) study of a Greek adaptation of MIT, Martzoukou et al. (2021) documented reactivation of perilesional areas in the left hemisphere and improved perfusion in fronto-parietal and temporal regions of the right hemisphere, with effects sustained three months post-treatment. Breier et al. (2010), using MEG, further confirmed a similar pattern of neurophysiological changes in language-related brain activity following MIT: Regardless of treatment outcome, patients exhibited increased activation in left-hemisphere regions. Furthermore, patients who responded successfully to the intervention showed a concurrent decrease in right-hemisphere activation, whereas non-responders exhibited increased activation in both hemispheres. Consistently, Wan et al. (2014), using Diffusion Tensor Imaging (DTI), observed a significant reduction in fractional anisotropy – a quantitative biomarker of white matter integrity – underlying the right inferior frontal gyrus, the right posterior superior temporal gyrus, and the right posterior cingulum. Jungblut et al. (2020) highlighted that continuous application of SIPARI may support late-stage neuroplasticity of frontal area, which are supposed to be involved in executive functions. Continuous assessment also allowed to find that the intervention influenced the activation of the left posterior part of superior temporal gyrus and a left-lateralized dorsolateral prefrontal-parietal network, both of which are known to be involved in domain-general aspects of active phonological memory. These mechanisms may represent key factors in supporting long-term rehabilitation in severely impaired chronic non-fluent patients.

Other studies showed a strengthening of connections between language-related areas and a functional expansion of right-hemisphere networks. Schlaug et al. (2009) found an increase in both the number of fibres and the volume of the right arcuate fasciculus. Marchina et al. (2023) reported through fMRI data improvements in spontaneous speech production and fluency (in terms of Correct Information Units [CIUs] per minute) following intensive MIT, accompanied by activation in a right-hemisphere network involving the posterior inferior frontal gyrus, supramarginal gyrus, supplementary motor area, and superior temporal gyrus. Notably, imaging signal changes over time were significantly correlated with behavioural improvements. Finally, Zhang et al. (2023) showed through DTI that MIT, compared to traditional speech therapy, led to increased structural connectivity of the right arcuate fasciculus, including enhanced fractional anisotropy, fibre number, and path length in various frontal, temporal, limbic, and subcortical regions.

Other areas have also been found to be impacted by the musical interventions. Impellizzeri et al. (2025), using fMRI data, observed bilateral increased activation in the superior frontal and parietal regions, the superior temporal gyrus, and the supplementary motor area following an integrated NMT approach (combining MIT and TS). The study also revealed engagement of the limbic system and the left cerebellum, suggesting a widespread cortical reorganization mediated by rhythmic, melodic, and emotional components. Jungblut et al. (2022), comparing the SIPARI protocol to conventional speech therapy through fMRI, found additional activation in the left superior frontal gyrus in the experimental group. This area is associated with executive processing and complex verbal tasks, leading the authors to hypothesize that the direct and musically structured nature of SIPARI may enhance language rehabilitation.

Discussion

Effectiveness of music-based interventions and neurophysiological evidence

The studies reviewed here provide evidence that music-based programmes can produce meaningful improvements in the expressive language skills of individuals with aphasia, with positive outcomes documented both relative to no treatment or waitlist conditions (Van Der Meulen et al., 2014; 2016) and in direct comparison with standard speech and language therapy (Jungblut et al., 2022; Zhang et al., 2021), as well as in the form of an additive benefit when combined with conventional rehabilitation (Raglio et al., 2016; Siponkoski et al., 2023). Among these, MIT remains the most frequently cited. Neurophysiological evidence suggests that MIT facilitates language recovery by promoting the activation of right-hemisphere homologous regions, compensating for impaired left-hemisphere areas. Moreover, MIT has been associated with structural brain changes, including increased volume and number of fibres in the right arcuate fasciculus (Schlaug et al., 2008), as well as a reduction in fractional anisotropy underlying the right inferior frontal gyrus, the right posterior superior temporal gyrus, and the right posterior cingulum (Wan et al., 2014). These microstructural changes – which likely reflect axonal sprouting and increased myelination – are functionally consequential: They strengthen the fronto-temporal connections that the right hemisphere requires to carry out auditory-motor coupling and vocal articulation, functions normally subserved but the left hemisphere language network but unavailable after a stroke (Schlaug et al., 2009; Wan et al., 2014).

Across multiple imaging modalities, the neurophysiological effects of music-based interventions converge on a coherent mechanistic picture. In MIT repeated intonation training progressively recruits a right-hemisphere network – encompassing the IFG, SMG, SMA, and STG, interconnected by the arcuate fasciculus – that compensates for the auditory-motor coupling, phonological processing, and articulatory planning functions disrupted by left-hemisphere damage (Marchina et al., 2023; Schlaug et al., 2009). Functional changes in the right posterior IFG, the homologue of Broca's area, were the only imaging measure to correlate significantly with gains in speech fluency (Marchina et al., 2023), and the treatment-specificity of this reorganization is confirmed by DTI evidence showing that MIT – unlike conventional speech therapy – selectively enhances structural connectivity along the right arcuate fasciculus (Zhang et al., 2023). These effects are not limited to active singing: Sihvonen et al. (2021) showed in an RCT that post-stroke listening to vocal music strengthened resting-state functional connectivity in the left inferior parietal language network, predicting improvements in verbal memory – consistent with the variable neurodisplacement theory. Further evidence that musical structure drives unique neural engagement comes from SIPARI, where treatment-specific activation of the left superior frontal gyrus – linked to verbal working memory and executive sequencing – was absent in speech therapy controls (Jungblut et al., 2022), suggesting that musically organized training reaches executive-language circuits that purely linguistic tasks do not.

The question of which component of music-based interventions plays the most important role in language rehabilitation remains a subject of ongoing debate (Stahl et al., 2011; Stahl et al., 2013). Across the various protocols described, intonation and rhythm emerge as core therapeutic components. Melodic modulation of speech appears to facilitate access to preserved vocal and auditory-motor networks, allowing patients to engage language production through alternative neural pathways when canonical left-hemispheric circuits are compromised (Grau-Sánchez et al., 2022; Wan & Schlaug, 2013). At the same time, rhythmic structuring provides an external temporal scaffold that supports articulatory planning, sequencing, and predictive timing, processes that are often disrupted in non-fluent aphasia (Jungblut et al., 2020; Wan & Schlaug, 2013). Rhythm and intonation do not operate in isolation, but interact with executive functions such as attention and working memory by integrating temporal patterns with vocal output (Jungblut, 2009; Jungblut et al., 2020). It is worth noting, however, that prosody is not merely a musical or acoustic property of speech: It also carries essential linguistic information, including the lexical stress patterns that disambiguate formally identical words (e.g., the noun *PREsent* versus the verb *preSENT*), syntactic boundaries, and pragmatic intent. The training of intonation in music-based interventions may therefore contribute not only to the fluency and melodic quality of speech output, but also to the recovery of semantically and syntactically meaningful prosodic contrasts.

Rhythm also appears to contribute to motor planning and execution, as it provides a stable temporal cue that enables the brain to initiate motor activity by activating the motor cortex. The execution of specific actions during musical exercises has been shown to activate Broca's area, which is responsible for integrating sensory and motor information. This repeated activation would promote the connection between distant brain regions and create new connections between neurons. In some cases, rhythm appears more crucial than singing (Stahl et al., 2011), particularly in patients with damage to the basal ganglia, which mediate rhythmic segmentation in language production. In fact, the effectiveness of singing has not been consistently supported by numerous cross-sectional studies when compared to rhythmic language interventions. Rhythm can be modulated either through verbal cues or through the touch of the left hand, which activates the sensorimotor networks in the right hemisphere that may serve as a compensatory function in language recovery (Albert et al., 1973; Musso et al., 1999), enhancing the efficacy of the musical component in rehabilitation. From this perspective, music-based rehabilitation can be understood not merely as a compensatory strategy, but as a means of reorganizing language production through the coupling of auditory, motor, and cognitive control systems. This convergence suggests that the therapeutic efficacy of music-based interventions in aphasia lies in their capacity to harness shared neural and cognitive mechanisms underlying musical and linguistic processing. In some cases, building on the hypothesis that non-fluent aphasic patients are significantly more likely to exhibit impairments or anomalies in rhythmic discrimination, it has been suggested that adapting MIT to the individual rhythmic abilities of the patient is essential to maximize its effectiveness, for example by removing the rhythmic component (Curtis et al., 2020). Moreover, within a holistic framework that simultaneously considers the individual patient's characteristics and needs and the optimal modalities for implementing the rehabilitation pathway, it is important to account for multiple factors – such as timing of the intervention relative to the clinical stage of aphasia (e.g., acute, subacute, or chronic) and the integration of varied therapeutic approaches – that may jointly support an effective recovery of language functions. For example, although MIT was originally designed for chronic non-fluent aphasia and is commonly introduced after, or alongside, standard speech and language therapy, emerging evidence suggests that earlier administration during the acute phase may lead to greater improvements in linguistic abilities (Van Der Meulen et al., 2014). This consideration highlights the importance of tailoring music-based interventions to the neurocognitive profile of patients with aphasia and their rehabilitation programme as a whole, paying special attention to musical and rhythmic abilities. This will optimize therapeutic outcomes and support a more personalized, evidence-based approach to language rehabilitation.

When considering the neurophysiological mechanisms discussed earlier and the role of preserved formulaic language as a therapeutic resource, we can point to two distinct but potentially complementary modes of action in music-based rehabilitation – one operating through long-term neuroplastic reorganization, the other through immediate access to overlearned linguistic sequences – which need not be mutually exclusive (Torrington Eaton et al., 2026). Yet the critical limitation earlier documented by Stahl et al. (2013) warrants attention: both singing and rhythmic therapy improved the production of formulaic speech but failed to generalize to non-formulaic, propositional language. An integrated approach could address this gap – beginning with music-elicited formulaic language as the therapeutic entry point, then progressively manipulating the psycholinguistic parameters of target items toward greater semantic novelty and syntactic complexity, leveraging music as a scaffold toward propositional communication rather than as a therapeutic destination in itself.

The clinical reality of these results, however, becomes evident when examining empirical data. Indeed, a direct comparison of the controlled evidence across the reviewed interventions reveals a meaningful asymmetry. For MIT, RCTs yield a phase-dependent picture: In subacute non-fluent aphasia, MIT produced significant improvements in both trained-item repetition and functional verbal communication (Van Der Meulen et al., 2014), whereas in the chronic phase the same group found only a limited and transient effect restricted to trained items, with no generalization to untrained material, naming, or daily-life communication (Van Der Meulen et al., 2016). In contrast, SIPARI demonstrated clinically significant improvements across multiple expressive language measures – including repetition, naming, and articulation and prosody in spontaneous speech – in two controlled studies with chronic severely non-fluent aphasia patients, with the active speech therapy control group remaining within measurement error throughout (Jungblut et al., 2020; Jungblut et al., 2022). Notably, an earlier controlled study on SIPARI was independently reviewed in two successive Cochrane Reviews, providing external validation of its findings (Jungblut et al., 2020). However, it would be premature to conclude that SIPARI represents the most effective music-based intervention for aphasia rehabilitation at large: to date, all published controlled evidence for SIPARI has been generated exclusively with German-speaking patients, leaving open the question of whether its therapeutic effects generalize to speakers of other languages and different linguistic systems. This limitation reflects a broader challenge across the reviewed corpus, where the heterogeneity of study designs, patient populations, outcome measures, and linguistic contexts makes direct comparisons difficult and overall conclusions tentative. There is therefore a pressing need for well-controlled, adequately powered, and cross-linguistically validated trials that can provide robust and replicable evidence on which interventions work best for which patients.

Future research should aim to further disentangle the specific contributions of melody, rhythm, and motor components within music-based therapies, for instance by designing studies that selectively isolate individual musical – prosodic components in order to evaluate their distinct roles in the rehabilitation process of language abilities. At the same time, another promising line of research could focus on the exploration of the specific neural mechanisms underlying the effects of music-based interventions across different aphasia subtypes. Longitudinal studies assessing the long-term efficacy and neural plasticity associated with personalized interventions are also needed to provide further insights into how music-based approaches can be systematically integrated into standard long-term clinical practice.

These considerations regarding individualization and efficacy extend beyond neurocognitive factors alone and call attention to the experiential dimension of rehabilitation. It is therefore important to acknowledge that, in addition to the technical aspects of incorporating music in rehabilitation, a significant contribution is derived from the pleasurable experience associated with integrating music into therapeutic practice. Rather than representing a secondary outcome, the pursuit of aesthetic gratification has been demonstrated to be a central mechanism for enhancing patient engagement, motivation, and neuroplasticity. In this regard, music-based interventions – particularly those involving shared or group-based activities – may also promote social participation and relational support, with positive effects extending beyond the individual patient to the broader caregiving context (Siponkoski et al., 2023). Moreover, the use of engaging and familiar musical material has been shown to foster active participation and sustained involvement in rehabilitation, supporting motivation and adherence to therapeutic programmes (Impellizzeri et al., 2025). Pleasurable musical experiences have been shown to recruit reward-related neural circuits that actively support functional recovery. Aesthetic experience might exert a role as a cognitive amplifier which stabilizes and reinforces rehabilitative gains, thus promoting more efficient and sustained recovery of language functions (Colombi et al., 2025).

Interdisciplinary models and clinical implementations

From a practical perspective, music-based protocols such as MIT are most commonly administered by speech and language therapists, whose expertise in language rehabilitation may not encompass specialized musical competencies. Neuropsychologists can play a key role in profiling patients' cognitive, motor, and musical abilities guiding the personalization of intervention protocols. Moreover, the involvement of music therapists or clinicians with formal training in music-based rehabilitation may enhance the precision with which musical parameters such as rhythm, melody, tempo, and motor synchronization are manipulated to meet individual therapeutic goals (Bradt et al., 2010). An interdisciplinary approach integrating speech and language therapists, neuropsychologists, and music therapists may represent the most effective model for delivering music-based aphasia rehabilitation. Alternatively, targeted training programmes, workshops, or continuing education initiatives could equip speech and language therapists and rehabilitation professionals with foundational musical competencies relevant to clinical practice. Such integrative models may optimize therapeutic efficacy while ensuring that interventions remain both evidence-based and feasible within standard clinical settings. Music-based interventions may indeed turn out to be effective when strategically integrated with conventional speech and language therapy. Rather than replacing traditional rehabilitation methods, music-based protocols can complement standard linguistic exercises, Such integrative approaches would allow clinicians to flexibly alternate or combine therapeutic modalities according to the patient's current rehabilitation phase, linguistic profile, and tolerance to treatment intensity. This synergistic model aligns with contemporary views of rehabilitation as a dynamic and multimodal process, in which different therapeutic techniques interact to support recovery through complementary mechanisms.

In addition, music-based interventions also present advantages in terms of economic sustainability and feasibility within standard rehabilitation settings. Unlike other innovative therapeutic approaches that require advanced technological devices, specialized software, or costly equipment (e.g., interventions that implement virtual reality headsets), most music-based protocols can be implemented using minimal and low-cost resources. This characteristic makes these interventions accessible in both hospital and non-clinical contexts. From a health-care systems perspective, the relatively low economic burden associated with these interventions supports their scalability and potential integration into routine clinical practice without substantially increasing treatment costs.

While these considerations highlight the theoretical and clinical relevance of integrating music in aphasia rehabilitation, they should be interpreted in light of some methodological constraints characterizing the current body of evidence. Two limitations of the present review must be acknowledged. First, although the initial search was limited to two databases specific to the psychological and medical fields, we were nevertheless able to identify a considerable number of articles relevant to our research question. Future reviews could expand this investigation by including additional scientific literature databases, in order to capture a more comprehensive body of evidence. In this regard, future investigations may also benefit from examining non-indexed and unpublished materials, which could provide additional insights into the range and effectiveness of music-based interventions in aphasia rehabilitation. Second, the studies included in the review are characterized by considerable heterogeneity in design, sample size, intervention protocols, and outcome measures, which may have influenced the comparability of findings and the strength of conclusions. In this context, the substantial variability in study designs currently characterizing the literature represents both a limitation and an informative feature of the complexity of the field. Future systematic reviews may therefore benefit from delimiting the scope of investigation to specific study designs to frame the available evidence within more homogeneous methodological boundaries. Such an approach could facilitate a more organized and coherent synthesis of results, allowing for clearer inferences regarding intervention efficacy, mechanisms of action, and clinical applicability.

Despite these limitations, the present synthesis offers valuable overviews into the role of music-based programmes in aphasia rehabilitation and underscores the importance of further high-quality, large-scale, and longitudinal research in this area.

Artificial intelligence disclosure

During the preparation of this manuscript, ChatGPT (GPT-5.2, OpenAI) was used exclusively for language editing and stylistic refinement.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Preregistration

This systematic review was preregistered on the Open Science Framework (OSF; https://osf.io/htng7/, doi:10.17605/OSF.IO/RZ9WC).

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