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# ADDRESSING MUSIC READING DISORDERS: LEARNING AWARENESS STRATEGIES FOR A PHONOLOGIC MUSIC COMPETENCE

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**Abstract:**
Reading disorders, whether in music or language, share deep cognitive and neural connections and involve overlapping challenges. These issues arise because in music, we primarily deal with sequences of actions or functional temporal hierarchies. Aspects such as note placement and melodic progression are absolutely crucial. Essentially, in temporal hierarchies, some elements represent a sequence rather than a whole. Reading disorders include evident problems with attention and working memory, as well as the onset of limitations in calculation skills, progressive processing, and even motor coordination. The impaired processing of visual and auditory stimuli links musical and verbal reading difficulties to a broader, deeper problem of temporal organization. Indeed, the core problem of developmental dyslexia is identified as a phonological deficit. Therefore, educational approaches aim to compensate for and support deficits in auditory recognition and temporal processing. The aim of this study is therefore to identify a series of methodological perspectives that consider the similarities between music reading difficulties and the typical challenges of verbal dyslexia. However, addressing music-reading difficulties involves distinct, specific neurocognitive, functional, and practical aspects. Specifically, music reading necessarily involves internalized and embodied anticipation and the enactment of a hypertext. Understanding the real challenges a student with SLD faces in music reading involves recognizing and addressing the complex transformation of sound-to-thought actions into written musical notation. This involves designing educational and teaching contexts that foster the integration of emotional and motivational dimensions in the implementation of educational practices, in the selection or design of instruments, and, ultimately, in the evaluation of each student's achievement and personal growth. This leads to a redefinition of the setting, adapting the learning environment in terms of time, materials, and interactions, making the music education offering more responsive and rewarding.

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## 1. Introduction

Scientific and musicological literature has highlighted numerous commonalities between linguistic organization and musical systems. In both domains, hierarchical structures are present, whereby minimal units—such as phonemes and words in language, or notes and musical phrases in music—are organized within complex systems governed by rules (e.g., alternation, opposition, and generation) and by precise functional and semantic constraints (Fitch & Martins, 2014).

A hierarchy consists of a set of functional or positional relationships that form a branching structure, in which the elements of a given set or sequence are progressively connected. When these elements are integrated into a single structure, one element (the root or apex) necessarily emerges as hierarchically prior to the others. In such a structure, semantic or functional loops—whether direct or indirect—are excluded, as no element can be self-referential or hierarchically superior to itself (Fitch & Martins, 2014 : 89).

In music, variations in the sequence of notes give rise to more or less complex melodic structures. In linguistics, commutation tests are commonly used to identify phonemes and determine their distinctive function within a language. If a change in sound results in a change in meaning, the sounds are considered distinct phonemes; otherwise, they are treated as invariant and classified as allophones.

A similar procedure has been applied in musical semiotics to identify distinctive melodic features at both functional and semantic levels (Stefani, 1976). More broadly, music primarily involves sequences of actions, or functional temporal hierarchies, in which the position of notes and the order of melodic progression are crucial. At any given level of a temporal hierarchy, certain elements function as parts of a sequence rather than as a unified whole (Fitch & Martins, 2014 : 89).

It is therefore not surprising that reading, music, and language disorders manifest through a range of associated challenges, including difficulties with attention and working memory, as well as emerging limitations in calculation skills, sequential processing, and motor coordination.

## 2. Purpose of Study: Addressing Music Reading Disorders

Difficulties in music reading are more specifically associated with perceptual and cognitive deficits involving visuospatial, visuomotor, kinesthetic, and attentional processes, as well as with impairments in bodily awareness, gesture, and memory. The framework outlined above supports the identification of a broader condition—commonly observed in children with specific learning disorders (SLD)—characterized by limited automatization of reading skills and reduced phonological awareness.

Impaired processing of stimuli across both auditory and visual modalities further suggests that verbal and musical reading disorders may be traced to a more general, underlying deficit in temporal organization (Gaab et al., 2006; Goswami, 2011).

It is no coincidence that the core deficit in developmental dyslexia is widely recognized as a phonological deficit; consequently, educational support approaches aim to compensate for impairments in auditory recognition and temporal processing.

The aim of this study is therefore to identify a range of methodological perspectives that take into account the similarities between music reading difficulties and the typical challenges associated with verbal dyslexia. However, while this approach is valuable, it may prove insufficient to address the full complexity of the needs involved, as music reading encompasses distinct neurocognitive, functional, and practical dimensions.

Music reading, in fact, requires continuous awareness of both antecedent and consequent elements at every moment, enabling performers to maintain full control over what they are executing. Such awareness of structural relationships is generally considered essential for advanced interpretation and for shaping expressive musical meaning. Importantly, this should be understood not merely as an acquired automatism, but as a cognitive process that must be integrated into music reading instruction from the earliest stages of structured musical learning.

Although expert musicians can balance structural awareness with immediate pattern recognition, this capacity develops gradually and should be fostered early in the learner's development—particularly in students who experience difficulties in encoding and decoding sound-based material.

This process requires careful sequencing and structuring of educational tools and practices. It involves recognizing the positions of notes across notational systems, identifying musical intervals in relational and proportional terms, distinguishing and applying rhythmic durations within metric frameworks, and perceiving and selecting appropriate accents and articulations. It also includes shaping sound in terms of timbre and intensity as forms of context-sensitive expression. In this sense, music reading closely approaches the prosodic and paralinguistic dimensions of language.

## 3. Literature Review: Theoretical Background

Within this framework, one of the most compelling hypotheses for explaining both verbal and musical difficulties is that of a specific deficit in the accurate processing of sound rise time (Goswami et al., 2010). This perspective links syllabic and prosodic structuring—and, more broadly, the rhythm of speech—to impairments in slow temporal modulations and in those related to the amplitude envelope (Greenberg, 2006).

The persistence of difficulties in rhythmic and metric perception among individuals with developmental dyslexia—even in educational contexts supported by sound- and music-based interventions—suggests that the deficit may primarily involve the neurocognitive mechanisms underlying musical processing, and only secondarily affect verbal processing (Lawendowski et al., 2014).

Contrary to what has been proposed in the literature (Flaugnacco et al., 2013), we argue that *levels of musical processing* cannot be reduced solely to those intrinsic to the discipline—namely, time (rhythm and meter), melody (contour, intervallic structure, tonal organization), and harmony (polyphonic and chordal structures).

In addition, it is necessary to consider—similarly to verbal language—the presence of multiple levels of organization in music: a *morphosyntactic level* (the combination of sounds into nuclei or melodic cells), *a pragmatic level* (the organization of musical discourse in relation to context), a *lexical level* (expressive and stylistic structuring), and, finally, a *level of semantic expression* or attribution.

Much as prosody in verbal language conveys meaning (e.g., imperative, interrogative, and declarative forms), *musical communication* is conveyed through expressive, *quasi-grammatical* intonations. These intonational patterns can assume both *communicative and lexical functions*—such as emphasis, irony, sarcasm, or humor—and are further articulated through accents, variations in intensity, and rhythmic and metric structures.

### 3.1 Music as Embodied and Enacted Hypertext

From the earliest stages of learning, music reading requires the cognitive system to decode notational forms that are not inherently intuitive, and to encode sequences of musical actions across multiple and distinct levels of understanding. It should also be noted that writing itself represents the formalization of thought, intention, and sequences of executive actions—or, more broadly, a network of expressive gestures interacting with a musical instrument or the voice.

For this reason, music reading necessarily entails an internalized, embodied, and enacted anticipation of a hypertextual structure. As Umberto Eco suggests, if semiosis occurs only in the presence of culturally predefined and socially institutionalized sign functions, then the very concept and experience of semiosis in the perceptual domain must be understood as fundamentally metaphorical (Eco, 1997 [1998: 106–107]).

To the extent that semiosis and hypertext overlap within perceptual experience, a relational structure emerges in the musical domain—hierarchically organized into schemas and sublevels—which refers to a multiplicity of contents, some explicit and others open to individual interpretation. In this sense, hypertext can be understood as a symbolic ecosystem characterized by three fundamental properties: fluidity, recursion, and embodied symbolic interaction. These features imply the continuous reconstruction of symbolic relations, the extension of symbolic action beyond its original context, and its dependence on real-time coordination between bodily movement and interface feedback (Li & Wang, 2026:5).

Emotional energy is frequently conveyed through multimodal metaphorical interactions involving images, text, and sound. This synergy is grounded in two key processes: sensory synesthesia, which generates intermodal resonance, and emotional embodiment, which shapes internalized expressive impulses (Li & Wang, 2026 :11).

Within this framework, the music reader—even in the presence of specific learning disorders (SLD)—effectively becomes the author of multiple hypertexts, constructing nodes of connection and interconnection while simultaneously defining their functional, temporal, and spatial organization. In these terms, the reader assumes an active role in selecting the most effective and expressive interpretative strategies, thereby developing greater control over and awareness of their own reading processes (Eco, 1997; 2007).

### 3.2 From Enacted Thought to Written Form and Vice Versa

At this stage, it should be evident that understanding the actual difficulties experienced by students with specific learning disorders (SLD) in music reading requires addressing *the complex, multifaceted process by which enacted musical thought is translated into written form*, and vice versa.

Most current approaches to SLD tend to focus remediation on the fundamental dimensions of musical experience—namely, articulatory (action), acoustic (sound), and auditory (perception) processes. Such approaches often treat learning difficulties as if they could be addressed in isolation, by developing discrete skills that are subsequently combined into broader abilities and competencies. This perspective reflects a largely mechanistic paradigm, with strong affinities to cognitive-behavioral models of human information processing. However, it risks neglecting the roles of the body, sensory experience, and intersubjectivity, thereby falling short of an organismic, embodied, and sociocultural understanding of learning.

At the same time, it remains essential to foster the gradual development of a deep phonological awareness of musical material, alongside the ability to segment the continuous sound stream into meaningful units—such as musical phrases, melodic and rhythmic cells, individual notes, intervals, and durations—without losing sight of the expressive coherence of the musical flow (François & Schön, 2011; François, Tilmann & Schön, 2012).

Within this perspective, cognitive development in music education involves cultivating a form of phonological awareness analogous to phonemic awareness in language, in which sounds are analyzed and organized into discrete units. This process unfolds in parallel with the progressive acquisition of analytical skills that enable learners to interpret sound phenomena in terms of underlying musical structures.

This perceptual-cognitive dimension entails the capacity to segment the sound stream systematically, thereby allowing the identification and differentiation of notes, intervals, durations, melodic and rhythmic cells, and larger musical phrases.

### 3.3 Phonological Skills as the Timing Quality of Musical Sound Flow

This perspective points to the need for a structured, gradual educational process—far from mere rote learning—aimed at fostering deep learning. Within this process, a dynamic network of interactions among distinct, even minimal and highly specific skills is established, ultimately leading to a more complex and integrated understanding of musical forms.

From a methodological standpoint, it is essential to maintain a focus on expressive quality and meaning-making in music reading. Analytical procedures should not devolve into the pursuit of simple automatization; rather, they should serve to enhance, rather than replace, the expressive and semantic richness of the musical sound flow.

The development of a network of musical "phonological" skills—particularly those related to pitch, rhythm, and timing—can foster significant cognitive growth by strengthening temporal processing and memory, and, consequently, phonological awareness in language. A key factor in this process is the improvement of rhythmic competence, while targeted training in pitch and rhythm supports the mapping between phonemes and graphemes, thereby facilitating more efficient linguistic processing.

It is therefore increasingly evident that temporal processing—namely, the brain's capacity to perceive and manipulate time-dependent acoustic information—plays a crucial role in the development of literacy skills.

Recent research suggests that rhythmic reproduction tasks—which integrate auditory perception and motor response (e.g., clapping in time)—can be considered reliable predictors of phonological awareness and reading abilities (Flaugnacco et al., 2014; Lundetræ & Thomson, 2018; Dees & Cooper, 2025; Drakoulaki et al., 2025).

Furthermore, the development of phonological awareness can be supported through targeted training in musical intonation and rhythmic articulation, aimed at strengthening skills such as rhyming, blending, and phonemic segmentation. In this regard, it is not incidental that music education programs based on nursery rhymes and children's songs are particularly effective in fostering rhyme awareness compared to phonological training approaches that do not involve singing (Carboni, 1991; Trehub & Trainor, 1998; Corbeil, Trehub, & Peretz, 2013).

Musical learning activities—especially those involving rhythm—constitute a powerful form of training for multiple cognitive, neural, and sensorimotor functions. They require the simultaneous engagement of auditory, motor, and visual systems, thereby strengthening neural connectivity.

Any interaction involving musical experience, whether through listening or performance, in individual or group contexts, can generate a cognitive-motivational cycle associated with gratification and a sense of empowerment in participants (Dell'Anna et al., 2021, p. 7). This engagement is supported by neural synchrony, understood as the coordinated activation of brain regions that enhances the efficiency and strength of neural connections, particularly during repetitive and engaging activities such as singing or instrumental performance (Toader et al., 2023).

Finally, the acquisition of musical competence—as a set of creative skills and abilities—emerges through exploratory and participatory processes within a generative system. In such a system, progressively formed structures flexibly integrate external dynamics through synergies, thereby supporting the modulation, guidance, or exploitation of emergent patterns of interaction (Schiavio & Kimmel, 2021).

## 4. A Circular Methodological Path: From Practices to Strategies and Back Again

### 4.1 Shared Brain Mechanisms: Modules, Sequences, and Action Patterns

Musical perception, from both a psychological and neuroscientific perspective, involves the rapid—if not instantaneous—organization of heterogeneous auditory stimuli into functionally meaningful acoustic patterns. In other words, it requires the formation or recognition of structured representations that can interact with memory systems, both for information storage and for the retrieval of experiential and performative content (Vuust et al., 2022; Domingues et al., 2025).

Comparable processes are also observed in verbal and spoken communication. In essence, both music and language exhibit syntactic organization insofar as, in both domains, the continuous acoustic stream is transformed by the mind into a system of discrete units. These units are hierarchically structured through recurrent combinations, giving rise to modules and sequences, and ultimately to patterns of action, as well as functional rules and norms of communication and expression (Patel et al., 1998).

This analytical approach is grounded in a central hypothesis of cognitive neuroscience, namely, the partial sharing of syntactic processing operations. It thus points to the existence of shared neural mechanisms for the processing of sound and phonological structure, common to both music and language.

Music and language are regarded as “syntactic” systems because both unfold as temporally organized, hierarchically structured sequences, rather than simple linear chains of sounds. Current evidence highlights that violations of syntactic rules in both domains elicit similar early brain responses, as measured by event-related potentials (ERPs) associated with early syntactic processing. When individual words or musical notes are integrated into larger hierarchical structures, unexpected violations of these structures engage a common processing mechanism, with no significant differences observed between music and language processing (Sun et al., 2018).

### 4.2 Shared Resources Hypothesis for Syntactic Integration

To support the syntactic processing hypothesis—which proposes that linguistic and musical systems engage similar neural responses—it is necessary to adopt a model in which syntactic processing results from the interaction between “resource networks” (primarily frontal brain regions) and “representation networks” (primarily temporal brain regions). This framework has led to the Shared Syntactic Integration Resource Hypothesis (SSIRH), which distinguishes between domain-specific representations stored in long-term memory (e.g., lexical knowledge and syntactic features in language, or chords and harmonic structures in music) and shared neural resources that operate on these representations during structural processing (Patel, 2003; Kunert et al., 2015).

Behavioral and neurophysiological evidence indicates that performance in semantic processing and melodic analysis correlates with spontaneous brain activity in the bilateral precentral gyri and the superior temporal plane (Breshears et al., 2018). In fact, both music and language rely on hierarchical, structured sequences that are processed through shared auditory–motor integration mechanisms, particularly involving left-lateral prefrontal regions. In both domains, continuous acoustic input must be segmented into discrete units (phonemes or words versus notes or chords), which are then organized into higher-order hierarchical structures such as musical or linguistic phrases.

From this functional perspective, music and language also share neural resources for processing key temporal parameters, such as pitch and rhythm. Pitch corresponds to linguistic intonation and inflection in speech and to melody in music, while rhythm relates to prosodic patterns in language and temporal organization in music. These correspondences suggest that, although music and language are distinct systems, they rely on partially overlapping neurocognitive mechanisms for the construction and regulation of structured sound sequences.

### 4.3 Learning Disorders in Music as Problems of Thought in Action

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The parallel between linguistic syntax and musical structure further highlights the fact that prosody, understood as the expressive organization of speech, also exhibits a hierarchical structure. In this system, units smaller than the sentence already contribute to defining levels of prosodic organization.

Languages are structured through patterns of stress, rhythm, and intonation. Syllables—the "beats" of a word—combine to form rhythmic units known as metrical feet, which constitute the primary units for stress assignment. These in turn form prosodic words, created by the grouping of one or more feet.

Prosodic words then combine to form larger prosodic units, such as intermediate and intonational phrases, and ultimately the complete utterance. These phrases are closely linked to syntactic structures and contribute to the overall intonation and rhythmic organization of speech (Heffner & Slevc, 2015).

Similarly, in music, individual notes can be organized into metrical units, measures, and phrases, which collectively shape the temporal structure, pitch organization, and expressive dynamics of a musical sequence. It is therefore not incidental that the structure and expression of musical phrases are sometimes described in terms of "musical prosody" (Palmer & Kelly, 1992; Large & Palmer, 2002).

The capacity of music to convey a wide range of emotional information, much like speech prosody, provides both experiential and cultural evidence that challenges perspectives denying any semantic dimension in musical communication. Likewise, a substantial body of research shows that such information is processed and recognized through patterns of pitch, duration, and intensity, in ways that closely parallel the mechanisms underlying prosodic processing in language (Coutinho & Dibben, 2012).

**4.4 Expressive Growth Improves Executive Functions and Working Memory**

It is evident that, in everyday educational contexts—whether in academic music training or other learning environments—any instructional method or intervention designed for students with developmental learning disorders must address significant challenges in executive functions and, consequently, the associated implications for working memory, cognitive skills, and personal organization (Rodriguez-Gomez & Talero-Gutiérrez, 2022). These complex learning dynamics are often accompanied by difficulties in verbal processing and emotional regulation, as well as by anxious or impulsive behaviors.

Similarly, students frequently show marked difficulty in initiating assigned tasks and in completing them. Furthermore, learners with specific learning disorders (SLD) may exhibit considerable variability in performance, both in task comprehension and in the quality of musical execution.

These dysfunctions are typically associated with deficits in executive control processes, such as attentional focus, timing of activation, and sustained concentration, and are often linked to reduced sensory discrimination. In addition, difficulties in body awareness and in both fine and gross motor coordination may emerge, sometimes accompanied by motor restlessness or instability.

Taken together, these factors underscore that difficulties in music learning—particularly in the development and organization of reading skills—are closely connected to this broader neurocognitive framework. Consequently, the design of effective pedagogical methods and strategies must explicitly take these dimensions into account, not only to enhance literacy and academic performance but also to support students' expressive and artistic development.

In this regard, effective interventions for students with specific learning disorders should integrate multisensory approaches, explicit instruction, and assistive technologies.

Such approaches can improve literacy and academic outcomes while fostering expressive and creative growth. Moreover, individualized strategies—such as the decomposition of complex tasks into smaller, sequential learning units, the use of graphic organizers, and the provision of alternative modalities for demonstrating knowledge (e.g., oral presentations or digital productions)—enable students with SLD to overcome specific difficulties while leveraging their strengths

## 5. Learning Strategies and Enlightened Educational Practices

### 5.1 Holistic Strategies

As extensively discussed above, musical learning stimulates motor systems in close synergy with the development of auditory perception, particularly within teaching–learning contexts that emphasize active engagement in vocal and instrumental performance.

Through audio–motor integration, musical training establishes robust functional connectivity between auditory and motor brain regions, such as the auditory cortex and premotor areas. In other words, instrumental practice enhances the ability to perceive musical sounds, while auditory perception itself can activate motor-related neural circuits (Gruhn, 2025).

Active participation in music-making—whether through singing or instrumental performance—enables the brain to construct internal models of action and sensory feedback that anticipate and predict the auditory consequences of motor commands. During practice, musicians rely on this auditory feedback loop to continuously monitor expected sounds in real time, allowing for the detection and correction of performance errors (Brown & Palmer, 2012; Luciani et al., 2022).

As their skills develop, musicians progressively consolidate and refine audio–motor associations, shifting from reliance on real-time feedback toward the use of feedforward mechanisms. Indeed, more experienced performers can mentally anticipate the auditory outcomes of their actions, thereby reducing their dependence on continuous auditory monitoring during performance.

The various neurocognitive components involved in musical performance—including tactile, bodily, sensory, and kinesthetic processes, as well as coordination, self-regulation, spatial and temporal organization, anticipatory mechanisms, imaginative and creative processing, and intersubjective and empathic engagement—contribute to defining the quality and structure of musical learning itself. These processes are reflected in key musical parameters such as tempo, rhythm, intervals and intervallic relationships, melodic successions and sequences, thematic cells and development, harmony, and agogics (Zaatar et al., 2024).

It is also important to note that active musical practice, by contributing to the development and strengthening of neural circuits involved in spatial and temporal processing, fosters a greater sensitivity to the formal and structural dimensions of musical experience, including abstract reasoning and logical–mathematical relationships (Tezer et al., 2016).

#### 5.1.1 From Experiential Learning to the Acquisition of Linguistic Elements

It is evident that, for students with specific learning disorders, these processes entail a range of challenges to be addressed, while at the same time offering significant opportunities for the development of expressive and cognitive potential.

The use of motor, gestural, and bodily mediation as a means of experiential understanding of musical organization—particularly of its hierarchical and structural dimensions—is a well-established approach, whose effectiveness has been demonstrated by major pedagogical traditions of the twentieth century, most notably those of Dalcroze and Orff (Abril, 2011).

The functional relationship between music and movement—understood in cognitive, communicative, expressive, and aesthetic terms—can therefore be regarded as methodologically and empirically grounded. There is also substantial evidence that musical performance requires the simultaneous engagement of multiple sensory modalities, including kinesthetic processes. From this perspective, integrating movement should be considered a fundamental component of institutional music education.

Nevertheless, educational practice continues to resist this view, often relying—explicitly or implicitly—on a Cartesian separation between body and mind. For this reason, it remains necessary to further investigate the relationship between movement and musical learning processes, to clarify its pedagogical role, and to develop a critical awareness of how movement is implemented in music education, both in general and special education contexts (Juntunen, 2020).

In perceptual and cognitive terms, this implies experiencing musical structure at a macro level, that is, in terms of functional qualities and formal articulations that reveal different hierarchical layers. It involves the ability to perceive, identify, and ultimately recognize the various functions of musical material—such as creating tension, resolving, transitioning, or linking—while also grasping the expressive significance of pauses, phrases, sections, and larger formal units. This form of experiential understanding precedes and lays the foundation for the acquisition of linguistic, lexical, and stylistic elements.

Engaging with music—whether in formal or informal contexts, and more broadly learning to sing or play an instrument—offers significant opportunities for cognitive development and for the refinement of both specific and transversal skills. This line of inquiry, although relatively recent in its current formulation, is rooted in earlier theoretical frameworks on motor and musical learning dating back to the 1950s. It aligns contemporary conceptions of sensorimotor integration with current theories inspired by embodied cognition (Reybrouck & Schiavio, 2024).

In theoretical and practical approaches to music education for students with learning disorders, the aim is to implement holistic processes of perception and cognition of sound and musical information. This entails promoting a fundamentally constructivist approach based on discovery and recognition, fostering connections and relationships within shared auditory experience. In this context, understanding evolves from playful, manipulative engagement to more reflective operations such as comparison, contrast, and organization.

### 5.1.2 Mediated Learning and Cognitive Modifiability

This involves gradually developing an adaptive, internalized understanding of music as discourse and as thought articulated on a large scale. Within this framework, writing and reading music emerge not so much as the decoding of a predefined syntax, but rather as the discovery of its generative structures (Portowitz et al., 2009).

In this educational approach, the key term is *cognitive modifiability*, a pedagogical concept that aligns with the Mediated Learning Experience (MLE), in which interaction with sound material helps students with SLD, as well as others, develop musical thinking through a deeper structural understanding, thereby improving their overall cognitive flexibility (Tzuriel, 2013).

In teaching music reading, the focus shifts from following prescriptive rules (i.e., playing exactly what is written) to exploring generative principles, allowing students to move beyond such constraints.

In the early stages of music learning (reading and performing), holistic mediation methods may lead to slower processing of musical material due to interference among the different cognitive processes involved, compared to simple notational decoding.

In fact, beginners' tendency to focus attention, remember, process, and retain information more effectively (the congruence effect) emerges precisely when unexpected elements occur that are incongruent with their expectations.

This induces a progressive internal selection and processing of the musical experience (reading and playing), resulting in greater performance fluency. Essentially, holistic effects are associated with increased, rather than reduced, selective attention.

This accumulation of contextual information may temporarily slow performance or reading. At more advanced stages of learning, holistic processing becomes substantially integrated with analytical cognitive processes, significantly improving both executive fluency and expressive and interpretative dynamics (Wong & Gauthier, 2010).

## 5.2 Textual and Contextual Deconstruction Strategies

Implementing deconstruction strategies in music learning involves systematically developing an approach that breaks down musical material into its constituent parts in order to understand how it functions. This may seem at odds with a holistic conception of musical experience and interpretation. In practice, however, this methodology begins precisely with a holistic appropriation of the musical piece in question—a form of sensorial, perceptual, and cognitive assimilation that results in an embodied internalization.

Only then does the process of decomposition take place, through the analysis and identification of formal structures, phrases, timbral and tempo-related aspects, and the interaction between melody and harmonic texture.

The very criteria of deconstruction emerge during disassembly, through performance-based explorations and the transposition of holistic perceptions into hierarchically related musical elements. In deconstructivist terms, the relationships between signs in music exist in a state of constant functional and semantic flux. The meaning produced by the signs themselves is continuously reshaped through their dynamic interaction with other signs or texts.

More specifically, musical practice, as an existential and experiential phenomenon, generates and organizes signs and texts according to criteria of binary opposition, such as internal vs. external, empirical vs. theoretical, and form vs. content (Scherzinger, 2005; Dyndhal, 2008).

This is because, as previously discussed, interaction with musical material (listening, reading, performing) entails an embodied and enactive approach that engages with and seeks to make sense of the inscription of thought in musical form.

When addressing SLD issues in music, it can be particularly effective to invert hierarchical relationships within the musical material. This supports the development of critical thinking and enables alternative interpretations of the traditional hierarchies among musical elements. In this way, analysis and interpretation, for example, may initially focus on rhythmic, intonational, and expressive aspects, thereby fostering a more comprehensive functional understanding of melodic structures and of the harmonic and functional relationships among different parts.

### 5.2.1 A Multifocal Cognitive Dimension

The multifocal cognitive dimension of musical material implies that *hypertextual decoding cannot occur in a linear and causal manner*, as in a simple denotative relationship between notation and performance.

*Transposition is both quantitative and qualitative*, requiring musical material to be processed analytically, discretely, and syntactically, while at the same time—and perhaps even more importantly—analogically and expressively.

This perspective outlines *a nonlinear approach to musical analysis and performance*, rooted in post-structuralist and semiotic music theory (Maeder & Reybrouck, 2015; Sanna, 2025). The underlying idea is that music cannot be understood simply by moving from notation to performance in a one-to-one causal relationship.

Rather, it presupposes a multifocal cognitive dimension in which listeners and performers process music simultaneously through multiple, sometimes contradictory, lenses (Overy & Molnar-Szakacs, 2009; Nijs et al., 2023).

Once deconstructed, musical hypertext reveals a network of relationships among sonic-musical actions situated within a culturally defined context. In this context, in turn, it must also be deconstructed to fully understand its linguistic and lexical hierarchies.

In educational terms, this entails moving from a schematic representation of the overall form to an analysis of melodic and harmonic progressions, reflecting a shift from superficial recognition to deep structural understanding.

It also involves recognizing intervals, modes, and scales as specific identifying elements that enable a deeper grasp of structural, theoretical, and technical aspects (including performance and interpretation).

At the same time, this pedagogical transition allows students with SLD to understand how a piece functions, rather than merely its structure, thereby facilitating improvements in performance, interpretation, and memorization.

The complexity of reading and performing music arises precisely from the need to manage multiple sources of information simultaneously and, consequently, to integrate different cognitive processes in real time.

**5.2.2 Overcoming the Paradox of Reductionist Analysis**

A widely used strategy—one that involves examining a limited number of elements at a time, or even a single aspect of the musical material—is known as analytical reduction or reductionist analysis.

For example, this may include separating the interpretation of the melodic sequence from that of the rhythmic structure, engaging in distinct readings and interpretations, and then focusing on tactile and kinesthetic dimensions by identifying gestural patterns and phrasing.

Returning to the musical material in its entirety occurs through the progressive integration of these heterogeneous experiences. The aim is to develop formal and expressive awareness as emergent qualities arising from a diversified exploration of the sonic material.

At first glance, this approach may appear unproblematic. However, paradoxically, it prefigures the process in terms of its intended outcome. In essence, it initiates a form of goal-oriented planning in which the procedure determines the process, rather than the reverse. The desired outcome is identified, broken down into actionable steps, and organized into a roadmap that only subsequently assumes the characteristics of a strategy.

This perspective reflects a form of teleological determinism in planning, whereby the end (objective) dictates the means (procedure/process).

By contrast, in strategic planning, the final objective (the "what") informs the pathway (the "how"). This distinction highlights how a clear definition of objectives serves as the primary driver of subsequent action, at both the organizational and individual levels.

Therefore, key elements such as the evaluation of alternative hypotheses, the problematization of learning outcomes, and the verification of the effectiveness of the actions undertaken are often missing.

Integrating hypothesis testing, problem solving, and the evaluation of instructional effectiveness represents a crucial shift from passive instruction to adaptive, evidence-based teaching. These components, often overlooked in favor of mere content transmission, are essential for fostering deeper reasoning and ensuring that pedagogical interventions produce meaningful and measurable outcomes.

Under conditions of typical neurocognitive development, such educational approaches may nonetheless demonstrate some effectiveness in short-term learning, functioning as useful shortcuts by incorporating procedural aspects of operant conditioning.

In the context of learning disorders, however, it becomes necessary to implement iterative cycles of cognitive reinforcement, preferably combined with metacognitive monitoring and ongoing verification.

### 5.2.3 The Common Ontology of Shared Learning

The methodological perspective of progressively achieving formal and expressive awareness of a piece of music must therefore entail a genuinely embodied and enactive educational practice that incorporates intersubjective exchange of experiences. In this context, awareness corresponds to internal and socially shared mirroring processes that enable the *emergence of a common ontology among group members* (Metzinger & Gallese, 2003).

An *integrative pedagogical framework* identifies music education as an active, physical experience, rather than a purely intellectual or passive one. It emphasizes the importance of engaging the body in order to understand musical structure, rhythm, and emotion.

This perspective aligns with enactive approaches, which hold that musical understanding develops through sensorimotor interaction (Henley, 2025).

In this sense, musical learning is fundamentally social: it takes the form of an intersubjective exchange of experiences involving various modes of interaction, including ensemble performance, improvisational contexts and practices, and, more broadly, all situations in which participants share and reflect upon their experiences.

We propose to develop an educational approach that grounds its pedagogical potential and effectiveness in teaching activities that explicitly engage the cognitive dimension of the mirror neuron system. Such educational contexts include situations in which learners observe and listen to others, or even imagine their actions. These mirroring processes activate neural pathways similar to those involved in the actual execution of the action, thereby facilitating empathic understanding and coordination.

Through these shared interactions, performers develop a common, nonverbal understanding of the structure and intent of the musical work, giving rise to a shared—albeit temporary—ontology and a unified sense of musical meaning.

### 5.3 Metacognitive Strategies

In academic music education, as in other fields, students are rarely confronted with tasks and assignments that are insufficiently complex relative to their level of study and learning. For this reason, it is essential to explicitly assess students' understanding of task requirements. This fosters active inquiry into information, objectives, and processes, thereby reducing potential misunderstandings and conceptual, terminological, and procedural ambiguities.

In this sense, when engaging with a new exercise, study task, or musical piece, it can be highly useful to promote self-reflective questioning about the activity itself, encouraging students not simply to provide answers, but rather to interrogate the objectives of the musical task.

In particular, for students with Specific Learning Disorders (SLD), it can be crucial to structure activities and the use of musical materials by dividing tasks into manageable units according to different modalities of decoding and memorization (visual, auditory, tactile, kinesthetic, ideational, imaginative, etc.).

An initial phase of guided self-reflective feedback should gradually give way to greater student autonomy, in which adopting a metacognitive approach enables learners to become increasingly self-regulated. Subsequently, it becomes essential to address long-term task management, which involves planning and organizing phases of study and learning, as well as identifying potential weaknesses or gaps that require attention.

During these teaching phases, students with SLD may experience cognitive overload. The causes of these episodes of fatigue and processing difficulty are multifactorial, including previously unaddressed theoretical and/or practical gaps that may resurface and become a source of anxiety and stress. Similarly, interactions with peers can become challenging, particularly when students are confronted with large amounts of information or tasks that require sustained effort.

#### 5.3.1 Support the Organization and Functioning of Working Memory

In these situations, the use of memorization techniques (visual, motor, imaginative, etc.) is often highly effective, as is the use of physical supports (e.g., concept maps) or digital tools (dedicated software). The development of metacognitive processes in music also involves multiple, simultaneous levels of perception and formal recognition. This includes identifying the global characteristics of a musical structure while also recognizing the distinct functionality of its component parts, particularly when rhythmic and melodic structures undergo progressive transformation within a piece.

It further entails determining the expressive and functional meaning of a given thematic core or harmonic passage, while maintaining an active relationship with its initial formulation and subsequent transformations over time.

It also involves identifying expressive analogies and structural patterns across multiple occurrences. This contributes to increased cognitive flexibility and perceptual stability, leading to improved decoding and understanding of musical reading and analysis. The enhancement of these abilities—such as identification, recognition, temporal extension, and the executive or creative use of information—clearly reflects *a more efficient organization and functioning of working memory.*

Just as in linguistic and verbal learning, instructional contexts present numerous tasks that place significant demands on working memory, ranging from text comprehension, which is often assumed to be already acquired, to more complex tasks. Similarly, understanding a musical hypertext requires a form of holistic anticipation of the expressive and executive "meaning" of the material. Without this, music reading becomes a hesitant progression through a dense network of possible interpretations and combinations.

Essentially, musical working memory must integrate contextual and previously learned instructions related to various rhythmic and melodic passages. Anticipating performance requires mental simulation and comparison to reduce reliance on trial-and-error (Pozenatto, 2020; Yang & Lo, 2024).

More often than not, the phrase to be performed is internally constructed in terms of sound and expression, as a form of active formulation of musical thought. This involves learning to think not merely in terms of "sound units," whether simple or complex, but in terms of meaningful phrasing.

Finally, although musical working memory is a specialized, multicomponent system developed to manage, update, and store musical information in real time, it is significantly challenged when musicians attempt to recall—or rather reconfigure—the details of a piece within a broader narrative structure, whether in performance or improvisation. This cognitive mechanism enables performers to transform structural elements (such as notes and rhythm) into interpretative or spontaneous actions, making extensive use of executive functions to inhibit habitual responses and maintain task-focused attention.

### 5.3.2 Self-Regulation and Self-Directed Mastery in Music

All of this leads to the *promotion of self-discipline* through personal motivational processes aimed at achieving pre-established or mutually agreed goals, such as completing tasks even when they appear irrelevant or unengaging (Pintrich & Zusho, 2002).

In both musical and academic contexts, learning to play an instrument alone or in a group fosters processes and behaviors that support self-discipline and the development of *strategies that enhance self-regulation* (Kirk et al., 1993; McPherson & Renwick, 2000; Oreck, Baum, & McCartney, 1999).

*Self-regulation in music*—often characterized by a "think before you act" or "stop–think–act" approach—is a crucial cognitive and behavioral skill. This approach facilitates the transition from impulsive, error-prone performance to reflective and self-directed mastery. Among the useful tools is the use of reflection sheets, which help students evaluate their behaviors and musical choices.

This is complemented by reflective practices such as collaborating with a tutor and systematically listening to and reviewing audio recordings of practice sessions to identify strengths, uncertainties, and areas for improvement.

It is also important to develop the habit of setting daily or weekly goals in order to maintain higher levels of concentration and motivation. Such practices promote structured, purposeful execution, shifting from a random, trial-and-error approach to intentional, goal-oriented behavior (Zarza-Alzugaray et al., 2025).

#### 5.3.3 Metacognitive Musical Practices

Implementing a metacognitive dimension in music learning and teaching requires the systematic integration of the theory of structural cognitive modifiability into everyday pedagogical practice (Portowitz & Klein, 2007; Portowitz et al., 2009).

Musical performance and listening can represent potentially beneficial activities for individuals with specific learning disorders, as they allow for the testing, calibration, and enhancement of cognitive functions, particularly when auditory processing engages multiple memory and attentional systems.

Active engagement with music strengthens neural connectivity, offering opportunities for experiential cognitive training that integrates auditory, motor, and cognitive domains. Agogic aspects (such as expression, rhythm, and dynamics) are particularly relevant, as they involve temporal processing, which may represent a challenge for individuals with dyslexia or other learning disorders.

Focusing on parametric dimensions such as pitch and rhythm, on the other hand, can support the development and monitoring of cognitive control and executive functions. It also contributes to refining auditory perception, with potential benefits for language processing, phoneme discrimination, and reading.

In short, the ability to integrate these elements simultaneously—maintaining tempo, regulating rhythm, and interpreting expressive features—constitutes a multisensory and sensorimotor experience that fosters the organization of coordination processes and the holistic understanding of musical experience.

Recognizing a musical theme without being misled by melodic, harmonic, or rhythmic variations requires the ability to maintain underlying patterns—that is, to identify them despite surface-level inconsistencies—while preserving a sense of formal identity and accommodating change. In cognitive terms, this enhances perceptual stability and precision.

Holistic perception involves processes of both analysis and synthesis, which are fundamental to the understanding of musical structures whose interrelations among components operate on a broader, multi-level scale.

Within this developmental process, perception is no longer primarily anchored to isolated episodes or focal experiences, but rather to a constructivist framework that suspends the search for immediate solutions in favor of identifying connections among parts, integrating them into larger units while still recognizing the formal and functional properties of each component.

The cognitive effort required to achieve precision and accuracy in the acquisition, processing, and production of information related to musical material becomes increasingly sustained and demanding. These functions are essential in music, particularly in performance, where they directly support attention and concentration.

#### 5.3.4 A Collaborative, Creative, Participatory, and Shared Educational Environment

Musical activity in collaborative, creative, or performance-based contexts—such as ensemble playing—encourages students with SLD to share responsibilities, take turns, and attend to others, facilitating a shift from individual frustration toward group-based self-regulation.

At the same time, structured and repetitive musical activities provide stable rhythmic and melodic patterns that support focused attention and may reduce anxiety through more effective emotional regulation. Indeed, active participation in music helps students with learning disorders develop greater impulse control, as their individual performance must adapt to the tempo and dynamics of the group (Carboni, 2025:8).

Through collaborative music-making, students learn to monitor their own performance and interpretation in relation to others, thereby strengthening self-assessment and fostering metacognitive skills.

The use of multiple representational modalities can help teachers understand and evaluate students with SLDs' musical learning styles, particularly in contexts where verbal expression is limited. Pedagogical approaches that promote the use of diverse representations offer students who struggle with fluent communication—both musical and verbal—the opportunity to express ideas through alternative modalities (e.g., graphic and kinesthetic notation, vocal and instrumental improvisation, and gestural or expressive engagement with sound material), ultimately supporting the organization and structuring of memory processes.

Music education for students with SLD should therefore be grounded in the integrated use of multiple sensory channels: kinesthetic, auditory, and visual. The integration of emotional, affective, and imaginative processes further enhances both procedural and declarative memory by engaging dopaminergic reward mechanisms (Tyng et al., 2017; Duszkiewicz et al., 2018).

## 6. Recommendations

It is considered important to further develop theoretical research, educational applications, and methodological reflection, particularly regarding the conception of music as an embodied and enactive hypertext.

Such developments may lead to new lines of research and innovative pedagogical approaches to address persistent institutional barriers to the education of individuals with specific learning disorders (SLD), thereby opening new perspectives for social and cultural development.

## 7. Conclusion

**1)** This work highlights the importance of designing educational and pedagogical contexts that foster the integration of emotional and motivational dimensions within teaching practices, including the selection and design of instruments, as well as the assessment of students' achievement and personal development.

In this perspective, research derived from musical practice in academic contexts should further clarify and substantiate the role of emotional dynamics in supporting the encoding and retrieval of semantically structured knowledge. At the same time, it is essential to consider the quality and coherence of individual approaches to musical study in relation to the psychological and physiological transformation of learning-related behaviors (Tyng et al., 2017).

**2)** Furthermore, particular attention should be given to the consolidation of memory processes, with the aim of enhancing both the accuracy and durability of acquired information. This involves stabilizing transient memory representations across working and long-term memory systems (Cotton & Ricker, 2022), as well as the systematic use of activities designed to promote periodic recall of learned material. Such practices engage students' retrieval abilities and support the reorganization of knowledge over time.

In short, this entails designing learning environments and activities that are constructive, active, intentional, relational, and authentic. Such music learning contexts activate multiple processes involving critical thinking, including the continuous exploration of the relationships among performance, expressive, and executive outcomes. Within this framework, learning is oriented toward process rather than the mere acquisition of techniques or isolated skills; musical material is not passively received, but becomes a space for intersubjective exchange and reflection; and learning situations are not homogenizing, but are designed to provide personally meaningful stimuli.

**3)** This approach also involves essential aspects such as continuity in the development of skills, abilities, and competencies. It requires reorganizing the cognitive schemas through which tasks are performed and information is processed, thereby restructuring procedural and cognitive processes. Within this framework, contextual information plays a fundamental role for students with SLD, which implies the need for clear, concise, and explicitly structured instructions.

Such a communicative approach is particularly effective for clarifying operational strategies and aligning them with expectations, especially when combined with modeling tasks. Modeling activities, in turn, carry important pedagogical implications for teachers: they require simplifying complex situations to highlight the most relevant aspects of the learning process. They also involve the use of mediating tools (visual, tactile, gestural, and motor) as representational and analytical supports for problem-solving and for the formulation of performance and interpretative hypotheses.

Finally, modeling includes processing new and feedback-based information, as well as continuous learning updates through interactive communication during the modeling process.

**4)** This leads to a redefinition of the learning setting, which must be adapted in terms of time, materials, and interactions, in order to make music education more responsive and effective.

In music education programs for students with SLD, this implies selecting targeted activities that align with different cognitive profiles and operate within the learner's zone of proximal development. In this sense, teaching should support students' cognitive potential in real time, guiding it toward its fullest expression within the constraints of the planned educational framework.

Reconsidering the context and approach to music learning for students with SLD in academic settings ultimately requires adopting evidence-based teaching strategies. Consequently, pedagogical methods and practices should be grounded in scientific and methodological research at all levels of education, from entry-level instruction to advanced musical training.

Within this perspective, pedagogical options should remain open and critically evaluated, with no assumptions taken for granted and no approaches excluded a priori.

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The author declares no conflicts of interest.

**About the Author**
Mauro Carboni's academic profile reflects an interdisciplinary integration of music, cognitive psychology, clinical pedagogy, and special education. From 2000 to 2014, he worked as a tenured researcher at the University of Rome "Foro Italico", where his research focused on special education and educational studies aimed at developing

inclusive processes. In particular, his work addressed empathic motor and gestural behaviors in inclusive learning contexts, as well as the design of virtual learning environments mediated by sensory and motor experiences. In 2014, after fifteen years of academic activity, he joined the Conservatory of Music in Perugia as Full Professor of Music Pedagogy, a position he held until October 31, 2025. He formally retired on November 1, 2025. From 2020 to 2025, he served as Delegate for Disabilities and Specific Learning Disorders at the "Morlacchi" Conservatory of Music in Perugia. In this institutional role, in addition to addressing individual student learning and inclusion needs, his aim was to bridge the gap between institutional academic expectations and the learning potential of students with cognitive and functional disabilities. To this end, he worked to strengthen accessibility criteria and promote more inclusive educational environments.

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