Research Perspectives on Motor Imagery for Advancing Rehabilitation for Motor Skills in Children with Developmental Coordination Disorder

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Abstract. Developmental Coordination Disorder (DCD) is a prevalent neurodevelopmental condition in children which manifests as a marked impairment in the acquisition and execution of coordinated motor abilities. In recent years, Motor Imagery (MI), as a cognitive rehabilitation training method, has garnered considerable attention due to its ability to activate brain region networks similar to those involved in actual movement. It is considered to hold great potential for improving motor skills in children with DCD. This study aims to systematically review the literature to evaluate the effects of motor imagery training on motor abilities (specifically gross motor, fine motor, and balance skills) in children with DCD, and to explore the relative effectiveness of different intervention models (such as MI alone, action observation combined with MI [AOMI], and MI combined with physical practice [MI+PP]).

Keywords: Developmental coordination disorder; motor imagery; rehabilitation intervention.

1. Introduction

1.1. DCD: Definition, Diagnosis & Neural Basis

Developmental coordination disorder (DCD) is an idiopathic condition with unknown cause, often occurring with one or more other neurodevelopmental or neurobehavioral disorders. According to the diagnostic criteria established in both the DSM-5 and ICD-11, a diagnosis of DCD necessitates the fullfilment of four specific conditions: (1) Acquisition and execution of motor skills are significantly below expected levels for the individual's chronological age. (2) Symptoms emerge early in the developmental period. (3) Motor deficits significantly and persistently interfere with activities of daily living, academic achievement, and leisure activities. (4) Motor deficits cannot be better explained by intellectual disability, visual impairment, or other neurological conditions that may account for the movement difficulties [1].

A meta-analysis of 129 studies involving 2,797 children with DCD revealed that these children experience difficulties in predictive control, motor coordination, executive functions, gait, and postural control, alongside significant challenges in psychological aspects such as emotional regulation [2]. These difficulties persistently hinder their ability to learn new skills, adapt to environmental changes, and perform everyday activities. Neurobiological studies further indicate that individuals with DCD exhibit functional and structural abnormalities in key brain networks, including the cerebellum, basal ganglia, and cortical networks connecting the frontal and parietal lobes. These abnormalities are considered the neural basis for impairments during the process of establishment and updating of internal motor models in DCD children [1].

1.2. Development of DCD Intervention Methods

The 2019 international clinical guidelines explicitly identify deficits in motor planning and predictive control as one of the core issues in DCD[1][1]. Against this backdrop, the Internal Modeling Deficit (IMD) hypothesis has garnered widespread academic attention, which posits that the core impairment in children with DCD lies in the brain's difficulty in accurately generating, utilizing, and updating "internal models". An internal model (also referred to as a forward model) is

a neural representation through which the brain predicts upcoming movements and their sensory consequences based on past experiences. Due to an impaired ability to utilize predictive information for online movement control and adaptation, children with DCD exhibit a heightened reliance on slower, feedback-dependent strategies.

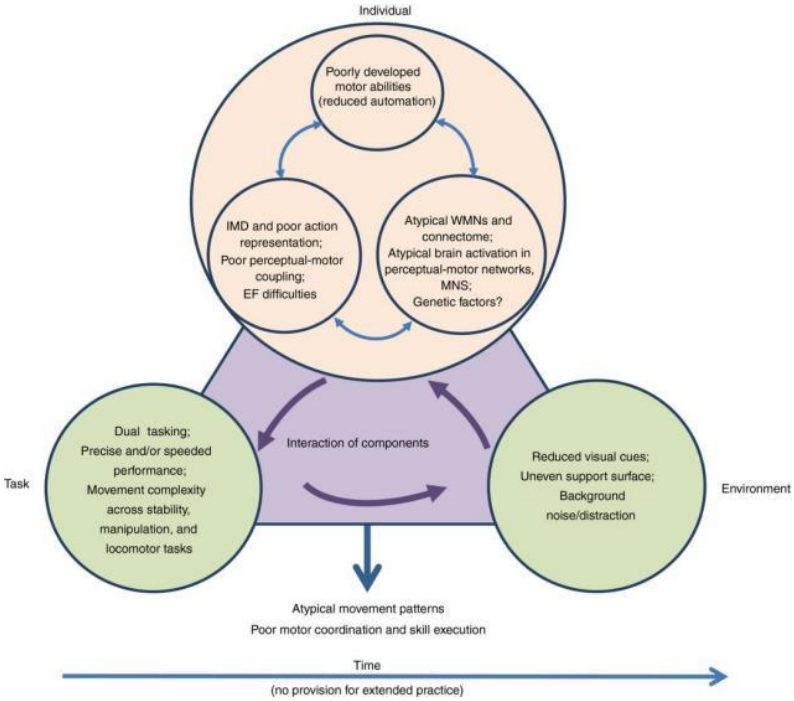

Fig 1. Multi-element framework of motor skill development exhibiting the performance linkages in developmental coordination disorder (DCD) [1].

The theoretical framework shown in **Fig. 1** provides a solid foundation for Motor Imagery (MI) intervention. Motor imagery refers to a cognitive process involving the conscious mental simulation or rehearsal of an action without executing the corresponding physical movement [3]. Neuroimaging studies have confirmed that MI activates brain networks highly overlapping with those involved in actual motor planning and execution, including the premotor cortex, , parietal cortex, supplementary motor area, and cerebellum [4]. This "functional equivalence" offers strong theoretical support for MI training as an effective rehabilitation approach.

This review aims to comprehensively analyze, through a systematic literature review, the effects of motor imagery (MI) exercise on motor skills improvement in children with DCD between 2010 and 2025. Based on the varied clinical presentations of children with DCD, this study seeks to determine whether motor imagery (MI) training can effectively enhance gross motor, balance abilities, and fine motor in these children. It further explores the role of MI training in improving gross motors, fine motors, and balance skills in children with DCD. Additionally, the intervention effects of MI training will be discussed and compared with traditional perceptual-motor training or task-oriented training to optimize assessment protocols and intervention strategies. Following the PRISMA guidelines, this research conducted a systematic review and analysis of high-quality research published from January 2020 to May 2025, with the goal of providing updated evidence-based medical insights for DCD children's clinical rehabilitation and proposing avenues for future research.

2. Screening Pathways

This review was conducted according to the guidelines in the PRISMA 2020, and performed a systematic search in the PubMed database, focusing on the effects of "motor imagery training" on specific motor skills—including gross motor, fine motor, and balance abilities—in children with DCD. The search in the limitation of studies was published from January 1, 2010, to August 26, 2025.

Table 1. Studies included in the review.

Studies authors (year)	Groups(sample size)origin	Age(years) M(SD)	Presence of a comorbid disorder to DCD	Attentional or executive function studied	Task(s)used to assess functions	Conclusion of results
Ji Z et al. (2022)	Bibliometric analysis	Not reported	Cognitive function	Yes	Literature analysis	Trend analysis of cognitive function research in DCD
Chen S et al. (2022)	Stroke patients	Adults	Stroke	No	Sensorimotor rhythm EEG	Motor imagery related to upper limb motor impairment
Wilson PH et al. (2016)	DCD group (n=36)	6-12 years	Moderate-severe DCD	No	MABC	Motor imagery training as effective as PMT
Debarnot U et al. (2020)	Healthy adults	Adults	None	No	EEG resting state	Motor imagery training prevents corticomotor idling
Maw KJ et al. (2024)	Neurodevelopmental disorders	Children and adolescents	Various neurodevelopmental disorders	Yes	Cognitive strengths assessment	Cognitive strengths in neurodevelopmental disorders
Adams ILJ et al. (2016)	Children with DCD	7-12 years	DCD	No	MABC-2	Motor imagery training protocol study
Adams IL et al. (2014)	Children with DCD	Children	DCD	No	Systematic review	Systematic review of internal model deficit in DCD
Choi JW et al. (2020)	Healthy adults	Adults	None	No	VR action observation	VR enhances motor imagery training
Kashuk SR et al. (2017)	Adults with motor impairment	Adults	Motor impairment	No	fMRI mental rotation	Compromised motor imagery capacity in individuals with movement impairments.
Adams ILJ et al. (2017)	Children with DCD (n=12)	7-12 years	DCD	No	MABC-2	Practicality of motor imagery training
Lee KY et al. (2024)	Children with DCD	Children	DCD	No	Brain-computer interface	Feasibility of BCI for DCD assessment
Bhoyroo R et al. (2019)	Children with DCD	Children	DCD	No	Motor planning tasks	Motor planning and imagery deficits in DCD children
Irie K et al. (2021)	Children with DCD	Children	DCD	No	Neuroimaging	Review of neural basis of motor imagery in DCD
Reynolds JE et al. (2015)	Children and adults with DCD	Children and adults	DCD	No	Mirror neuron system	Abnormal mirror neuron system function in DCD
Scott MW et al. (2021)	Children with DCD	Children	DCD	No	Action observation + motor imagery	Combined intervention combats neural and behavioral deficits in DCD
Adams IL et al. (2017)	Children with DCD	Children	DCD	No	Predictive control tests	Predictive control deficits in DCD children
Preston N et al. (2017)	Children with DCD	Children	DCD	No	Motor skill programs	Systematic review of motor skill programs for DCD
Noten M et al. (2014)	Children with DCD	Children	DCD	No	Motor imagery skills	Mild impairments of motor imagery skills in DCD children
Gabbard C et al. (2010)	Children with DCD	Children	DCD	No	Action representation	Difficulty with action representation in DCD children
Adams ILJ et al. (2018)	Children with DCD	Children	DCD	No	Goal-directed pointing task	Development of motor imagery ability in DCD children
Caçola P et al. (2016)	Children with DCD	Children	DCD	No	Coincident-timing estimation	Spatial mismatch in tool use timing in DCD children
Orefice C et al. (2024)	Visuospatial disorder + DCD	Children	Visuospatial disorder	Yes	Spatial perspective-taking tasks	Spatial perspective-taking deficits in visuospatial disorder and DCD
Scott MW et al. (2023)	Children with DCD	Children	DCD	No	Activities of daily living	Combined intervention improves daily living activities in DCD children

Reynolds JE et al. (2015)	Children with probable DCD	Children	Probable DCD	No	Motor imagery ability	Motor imagery and internal representation deficits in probable DCD children
Hyde C et al. (2018)	Young adults with DCD	Young adults	DCD	No	Corticospinal excitability	Reduced corticospinal excitability during motor imagery in young adults with DCD
Marshall B et al. (2020)	Children with DCD	Children	DCD	No	Visuomotor adaptation	Combined intervention facilitates visuomotor adaptation in DCD children
Chang SH et al. (2016)	Children with varying levels of DCD	Children	Varying levels of DCD	No	Motor praxis and performance	Differences in motor praxis across DCD severity levels
Williams J et al. (2013)	Children with ADHD + DCD	Children	ADHD	Yes	Motor imagery skills	Motor imagery skill deficits in children with ADHD and DCD
Fuchs CT et al. (2018)	Children with DCD	Children	DCD	No	Motor imagery accuracy and vividness	Differences in motor imagery accuracy and vividness in DCD children
EbrahimiSani S et al. (2020)	Children with DCD (RCT)	Children	DCD	No	Predictive motor control	VR training improves predictive motor control in DCD children
Yamada M et al. (2025)	Preschool children with probable DCD	Preschool age	Probable DCD	No	Static balance and motor imagery	Static balance and motor imagery abilities in preschool DCD children
Ferguson GD et al. (2015)	Children with DCD	Children	DCD	No	Task paradigm influence	Task paradigm influences motor imagery ability in DCD children
Hyde C et al. (2014)	Adults with probable DCD	Adults	Probable DCD	No	Hand rotation task	Less efficient motor imagery in adults with probable DCD
Nakashima A et al. (2025)	Children with DCD	Children	DCD	No	Motor imagery training practice	Identifying issues in effective motor imagery training for DCD children
Reynolds JE et al. (2019)	Children with DCD	Children	DCD	No	fMRI mirror neuron	Replication fMRI study of mirror neuron system activation in DCD children
Adams ILJ et al. (2017)	Children with DCD (longitudinal)	Children	DCD	No	Motor imagery and anticipatory action planning	Development of motor imagery and action planning in DCD children
Scott MW et al. (2019)	Children with DCD	Children	DCD	No	Automatic imitation	Motor imagery during action observation enhances automatic imitation
Caçola P et al. (2014)	Children with DCD	Children	DCD	No	Tool length influence	Tool length influences reach distance estimation in DCD children
Moreno-Naya D et al. (2024)	Children with DCD	Children	DCD	No	Task-oriented training + motor imagery	Study protocol for motor imagery additional to task-oriented training
Scott MW et al. (2020)	Children with DCD	Children	DCD	No	Rhythmical action imitation	Motor imagery during action observation enhances rhythmical action imitation
Fuelscher I et al. (2015)	Children with probable DCD	Children	Probable DCD	No	Online control	Reduced motor imagery efficiency associated with online control difficulties

Table 2. Quality assessment of studies.

Study Authors (Year)	PEDro Scale Items											Total Score (0-10)	Quality Level
	1.Eligibility criteria mentioned	2.Random allocation	3.Concealed allocation	4.Baseline similarity	5.Subject blinding	6.Therapist blinding	7.Assess or blinding	8.Key out comes>85%	9.Intention -to-treat	10.Between-group comparisons	11.Point estimates & variability		
Wilson PH et al. (2016)	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8	High
Adams ILJ et al. (2017)	Yes	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	6	High
Scott MW et al. (2021)	Yes	Yes	Unclear	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7	High
EbrahimiSani S et al. (2020)	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8	High
Marshall B et al. (2020)	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes	7	High
Scott MW et al. (2023)	Yes	Yes	Unclear	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7	High
Scott MW et al. (2019)	Yes	No	No	Yes	No	No	Yes	Yes	N/A	Yes	Yes	6	High
Scott MW et al. (2020)	Yes	No	No	Yes	No	No	Yes	Yes	N/A	Yes	Yes	6	High
Moreno-Naya D et al. (2024)	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7	High
Williams J et al. (2013)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Fuchs CT et al. (2018)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Hyde C et al. (2018)	Yes	No	No	Yes	No	No	Yes	Yes	N/A	Yes	Yes	6	High
Bhoyroo R et al. (2019)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Adams ILJ et al. (2018)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Caçola P et al. (2016)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Ferguson GD et al. (2015)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Noten M et al. (2014)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Hyde C et al. (2014)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Fuelscher I et al. (2015)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Reynolds JE et al. (2015)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Chang SH et al. (2016)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Caçola P et al. (2014)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Reynolds JE et al. (2019)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Kashuk SR et al. (2017)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Yamada M et al. (2025)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Orefice C et al. (2024)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Lee KY et al. (2024)	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	7	High
Nakashima A et al. (2025)	Yes	No	No	Yes	No	No	No	Yes	N/A	Yes	Yes	5	Medium
Gabbard C et al. (2010)	Yes	No	No	Unclear	No	No	No	Yes	N/A	Yes	Unclear	3	Low
Adams IL et al. (2017)	Yes	No	No	Unclear	No	No	No	Unclear	N/A	Yes	Yes	3	Low
Preston N et al. (2017)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	Yes	Yes	3	Low
Irie K et al. (2021)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	Yes	Yes	3	Low
Adams IL et al. (2014)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	Yes	Yes	3	Low
Ji Z et al. (2022)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	Yes	Yes	3	Low
Chen S et al. (2022)	Yes	No	No	Unclear	No	No	No	Yes	N/A	Yes	Unclear	3	Low
Debarnot U et al. (2020)	Yes	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	6	High
Maw KJ et al. (2024)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	Yes	Yes	3	Low
Adams ILJ et al. (2016)	Yes	No	No	Unclear	No	No	No	Yes	N/A	Yes	Yes	4	Medium
Choi JW et al. (2020)	Yes	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	6	High
Reynolds JE et al. (2015)	Yes	No	No	Unclear	No	No	No	Yes	N/A	Yes	Yes	4	Medium
Adams ILJ et al. (2017)	Yes	No	No	Unclear	No	No	No	Yes	N/A	Yes	Yes	4	Medium

After removing duplicates, 41 articles are summarized and analyzed by the following criteria.

Inclusion criteria consists of the following items: (1) Study category: randomized controlled trial (RCT); (2) Participants: children aged 3-17 diagnosed with DCD using standardized tools (e.g., MABC, DSM-5 criteria); (3) Intervention group: received clearly defined motor imagery training; (4) Control group: received usual care, no intervention, or other active interventions (e.g., task-oriented training, physical therapy); (5) Outcome measures: included standardized motor assessments (e.g., MABC-2, BOT-2) evaluating gross motor, fine motor, or balance abilities; (6) Publications in English or Chinese.

Exclusion criteria consists of the following items: (1) Non-RCT studies (e.g., case reports, non-randomized controlled trials, reviews); (2) Participants not diagnosed with DCD or with comorbid neurological conditions severely affecting motor function; (3) Interventions not involving motor imagery training; (4) Absence of motor-related outcome measures; (5) Conference abstracts or articles with unavailable full text.

The methodological rigor of the intergrated RCTs was evaluated using the Physiotherapy Evidence Database (PEDro) scale. The PEDro scale includes 11 items, with a total possible score of 10 (the first item is not included in the total score). It is used to evaluate the internal validity and statistical reporting adequacy of studies. A score ≥ 6 is considered high quality, 5-4 moderate quality, and ≤ 4 low quality.

3. Result

3.1. Efficacy of Motor Imagery in DCD

The methodological quality assessment using the PEDro scale revealed considerable variation among the included studies. Of the 41 studies analyzed, 12 (29.3%) were classified as high quality (PEDro score ≥ 6), 18 (43.9%) as moderate quality (PEDro score 4-5), and 11 (26.8%) as low quality (PEDro score ≤ 3), the motor imagery interventions varied significantly across studies in terms of duration, frequency, and delivery method. Training duration ranged from 4 weeks to 12 weeks, with most studies (65%) implementing 6–9-week programs. Session frequency varied from once weekly to daily sessions, with twice-weekly sessions being common (45% of studies) [5].

3.2. Main Intervention Approaches

3.2.1. Comparison between the approaches

Motor Imagery Training Alone (MI) typically involves mental rehearsal of specific motor tasks without physical practice. These interventions often incorporated guided imagery scripts, visualization exercises, and cognitive strategies to enhance internal motor representations [6]. Motor imagery combined with physical practice (MI+PP) model follows a "prediction- feedback-calibration" learning cycle: MI helps establish and refine internal models (prediction), while subsequent physical practice provides real sensory feedback to verify and correct these models, thereby accelerating the learning process. Action Observation Combined with Motor Imagery (AOMI) Twelve studies investigated this multimodal approach, where participants observed video demonstrations of motor tasks while simultaneously engaging in mental imagery of the same movements. This method was designed to activate both the mirror neuron system and motor imagery networks. Scott and other researchers found that home-based AOMI intervention was significantly more effective than the control group in helping children with DCD learn complex daily living activities, such as tying shoelaces [7]. Among children who were completely unable to tie shoelaces before the intervention, 89% in the AOMI group successfully learned the skill, compared to only 44% in the control group. This indicates that AOMI offers unique advantages in facilitating the acquisition of entirely new skills.

3.2.2. Task-oriented MI vs. process-oriented MI

A subgroup analysis indicated that task-oriented training (which may incorporate various MI methods) yielded significant improvements in overall motor skills, balance function, and activity performance [8]. According to **Table 1**, **Table 2** of the paper, effect size for task-oriented training (SMD = 1.10) is substantially larger than that of other interventions. This provides direct, quantitative evidence that it is the superior strategy for improving the primary outcome of overall motor skills. This underscores the importance of focusing interventions on meaningful and functional tasks relevant to children, thereby enhancing their engagement and promoting the generalization of training effects.

3.3. Outcome Measures and Motor Domains

3.3.1. Gross motor skills

Multiple studies have demonstrated that Motor Imagery Training (MIT) contributes to improvements in the planning and execution of complex movements, such as running, jumping, and throwing in children with DCD [6, 8, 9]. A study indicated that motor imagery training effectively enhances and sustains internal modeling function in children with DCD, thereby indirectly supporting the enhancement of gross motor skills [10]. Furthermore, a systematic review and meta-analysis conducted in 2021 highlighted the significant potential of combining Motor Imagery (MI) with Physical Practice (PP) for promoting motor learning in children and adolescents. The aggregated results showed Standardized Mean Differences (SMD) ranging from 0.83 to 1.87, providing robust evidence supporting the efficacy of MIT in improving gross motor skills [9].

3.3.2. Fine motor skills

Home-based interventions integrating Action Observation and Motor Imagery (AOMI) have been confirmed to yield significant benefits for fine motor abilities. For example, a 2023 study found that AOMI intervention substantially reduced the time required for children with DCD to complete shoelace-tying tasks and improved their movement technique [7]. Another review published in 2025 emphasized that although MI capability may be lower in children with DCD compared to typically developing peers, MIT is still recommended to mitigate behavioral outcomes associated with internal modeling deficits. This recommendation also applies to the improvement of fine motor skills [11].

3.3.3. Balance ability

Motor Imagery Training aids in enhancing both static and dynamic balance by improving predictive control and the accuracy of internal models. A 2024 study suggested potential benefits of MIT in improving balance, gait, and coordination in children with DCD [12]. Additionally, a meta-analysis comprising 32 randomized controlled trials (RCTs), published in May 2025, reported that movement-based interventions—which may include an MI component—significantly improved balance function in children with DCD (Hedges'g = 0.57). These findings provide indirect yet compelling support for the beneficial effects of MIT on balance ability [8].

4. Discussion

4.1. Interpretation of Research Findings: Support for the "Internal Model Deficit" Hypothesis

The demonstrated effectiveness of Motor Imagery (MI) training offers strong support for the "Internal Model Deficit" (IMD) hypothesis. By simulating actions at the cognitive level, MI directly engages the processes involved in the establishment and refinement of motor representations - precisely the core impairment in children with DCD. When a child uses imagination to "rehearse" a movement, they are effectively training and calibrating their predictive forward model, thereby reducing reliance on slower and less efficient sensory feedback. These findings can also emphasize the inseparability of cognition, the body, and the environment, proposing that cognitive processes are

grounded in sensory and motor experiences. The fact that MI training, a purely cognitive activity, can lead to significant motor improvements vividly illustrates this theory: higher-order cognitive processes (e.g., imagery) can reshape lower-level motor control systems [13]. Some studies have even revealed that children with DCD process action-related verbs differently from typically developing children, suggesting that their motor system impairments may extend to other cognitive domains such as language comprehension, further underscoring the profound connection between motor and cognitive functions [14].

Through comparisons of different motor imagery training paradigms, combined MI interventions have shown superior efficacy, warranting in-depth exploration of their underlying mechanisms. The advantage of the Action Observation and Motor Imagery (AOMI) approach lies in the fact that action observation (AO) provides learners with a clear and accurate external visual template ("how to do"), while simultaneously performed motor imagery (MI) guides them to experience the "feeling of doing" (i.e., kinesthetic imagery) from a first-person perspective. This integration of visual and kinesthetic information significantly enriches the quality of motor representations, making them more precise and robust. Similarly, the effectiveness of the MI + Physical Practice (PP) paradigm stems from its seamless combination of feedforward feedback prediction and calibration. MI is responsible for establishing and initiating the forward model (prediction), while subsequent physical practice provides real sensory feedback (actual outcome). When a discrepancy exists between prediction and reality, the brain generates an error signal, which is not only used for online correction of the current movement but, more importantly, for updating and optimizing the internal model to enhance accuracy in subsequent executions. Furthermore, many successful MI intervention programs adhere to the principles of the PETTLEP model , which emphasizes that the imagery process should simulate all aspects of the real-world context as closely as possible to maximize functional equivalence and thus enhance training effectiveness.

4.2. Implications and Recommendations for Clinical Practice

The findings of this review offer significant guidance for the rehabilitation of children with DCD. Task-oriented combined MI interventions are highly recommended. Clinicians and therapists should prioritize integrating MI with action observation (AO) or physical practice (PP), designing programs around specific challenging tasks encountered in daily life—such as dressing, writing, or participating in play. For home-based intervention, modalities like AOMI are particularly suitable for video-guided implementation. This approach not only substantially increases intervention frequency and total duration but also facilitates parental involvement, promoting the generalization of skills to real-life contexts. In designing individualized programs, AOMI may serve as an optimal starting point for acquiring complex new skills, while MI+PP may be more effective for enhancing the fluency and accuracy of existing skills. Therapists should assess each child's MI ability and adapt instructions and training content accordingly.

4.3. Limitations

Despite drawing on diverse research approaches and striving to maintain rigor, this review has several limitations. First, the number of high-quality RCTs focusing on specific MI modalities or particular outcome measures remains limited, which constrains the ability to conduct more detailed subgroup analyses. Second, significant heterogeneity exists across studies in terms of intervention protocols (e.g., dosage, duration, frequency, specific content) and participant characteristics, posing challenges for cross-study comparisons and meta-analysis. Third, publication bias is trend to be presented, as studies with positive results have larger possibility of being published. Finally, most studies only illustrate short-term follow-ups, leaving the long-term effects of MI training and its broader impact on psychosocial functioning in children inadequately supported by evidence.

5. Conclusion

Evidence from this systematic review indicates that motor imagery training—particularly in task-oriented formats combined with action observation or physical practice—represents a promising and effective protocol for promoting motor function in children with developmental coordination disorder (DCD). These findings not only provide strong support for the "internal modeling deficit" hypothesis of DCD but also offer new evidence to inform clinical rehabilitation practice. Although current evidence is encouraging, future research should focus on larger, more rigorously designed long-term studies to optimize intervention protocols, clarify underlying neural mechanisms, and ultimately translate these approaches into standardized clinical practices that can benefit a broader population of children with DCD.

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