

Editorial: Factors that affect the motor learning process

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ABBREVIATIONS

ADHD	Attention deficit hyperactivity disorder
GSA	Game Sense Approach
LD	Learning Disorder
TGMD-2	Test of Gross Motor Development-2
WM	Working memory

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ABSTRACT

This editorial introduces the Brazilian Journal of Motor Behavior special issue on “Factors that affect the motor learning process”, which brings together seven studies examining how motor learning is shaped by interacting constraints across cognitive resources, practice organization, task structure, and learner characteristics. The papers collectively show that manipulating cognitive engagement (e.g., acute working-memory stimulation) does not necessarily enhance learning of complex skills and may transiently disrupt early performance, whereas practice organization (random versus constant schedules) can meaningfully influence learning expressed in transfer. In parallel, the issue highlights that greater practice volume can improve performance without necessarily changing global perceived competence, and that structuring practice to preserve functionally meaningful components of complex techniques can yield more robust outcomes at retention. The final contributions extend these questions to populations with distinct developmental or neurological profiles, emphasizing that interventions may simultaneously target cognitive and fine-motor outcomes, that fundamental motor skill competence differs under standardized assessment in attention deficit hyperactivity disorder, and that augmented feedback can improve performance without producing retention when removed in cerebellar dysfunction. Together, the studies reinforce that motor learning is multifactorial and that conclusions depend on how constraints are manipulated and how learning is evaluated (practice performance vs. transfer/retention), providing convergent directions for future research and applied practice.

KEYWORDS: Motor learning | Practice organization | Perceptual-cognitive-motor constraint | Augmented feedback | Special populations

FACTORS THAT AFFECT MOTOR LEARNING

Motor learning is shaped by interacting constraints that operate at multiple levels, including cognitive resources, practice structure, and learner characteristics. The present special issue brings together seven studies that address these constraints from complementary perspectives, spanning laboratory-like paradigms and ecologically grounded skills, and extending the discussion to populations with distinctive developmental or neurological profiles.

One line of work in this issue asks whether transiently increasing cognitive engagement before practice can facilitate the learning of complex skills. Given that working memory (WM) supports problem solving and error correction early in learning, and prior work has suggested benefits of WM stimulation in relatively simple tasks, Macedo et al. ¹ tested the hypothesis that acute WM stimulation before random practice could optimize learning in a more complex motor skill (golf putting). Motor learning occurred in both groups, but acute WM stimulation did not enhance learning. It was associated with an initial performance impairment during early acquisition, suggesting that the WM stimulation, as implemented, did not translate into improved motor learning and may have transiently disrupted early performance.

Practice organization is another recurring theme in motor learning research, and it is revisited here in the context of a complex aiming skill. In golf putting, Ferreira et al. ² compared random and constant practice schedules while also probing mental effort via pupil dilation. The main result highlighted by the authors was that the random practice group showed superior transfer performance, consistent with the idea that practice scheduling can shape learning outcomes. In turn, groups did not differ regarding pupil dilation, suggesting that mental effort was not related to better motor learning in the random group.

Beyond cognitive demands and scheduling, the special issue also addressed a practical assumption that frequently guides coaching and instruction: that increasing practice volume should translate not only into better performance, but also into more positive self-beliefs. Amadio et al. ³ built from this premise while noting that the available evidence was limited and not always consistent. In novices practicing the tennis forehand, performance improved with practice (with an advantage for the higher-volume condition late in acquisition), yet global perceived competence did not change, suggesting that short-term performance gains may not automatically generalize to broader self-perceptions within the tested scope and timeframe.

The question of how practice should be structured becomes especially consequential when skills are complex and embedded in interactive environments. Gomes et al. ⁴ noted that judo projection techniques in matches are open skills in dynamic contexts. Yet traditional teaching often began with simplified, closed-skill-like drills (e.g., uchikomi), potentially weakening correspondence between practice and competitive demands. Against this background, they tested whether practice schedules that better preserve technique organization, including whole practice with pre-kuzushi, would improve learning of tai otoshi. Although all groups improved global technique and kuzushi movement patterns, only the whole-practice group achieved reliable gains in actual opponent unbalancing (actual kuzushi) that persisted into retention, supporting the value of aligning practice with combat-relevant demands.

The final set of papers broadened the scope to populations where learning-relevant constraints may be expressed differently and where intervention and assessment have additional clinical or educational relevance.

In children with Learning Disorder (LD), Ghasemian and Mohammadzadeh ⁵ emphasized that LD is often accompanied by executive-function difficulties, particularly in working memory, and that fine motor skill delays can further constrain classroom performance and learning. They evaluated whether sensory-motor integration exercises embedded in a Game Sense Approach (GSA) can jointly target these constraints. Their results indicated that the GSA intervention yields working memory improvements (vs. control) and greater gains in specific fine motor domains (e.g., response speed, upper-limb agility, visual-motor control) compared with both a goal-oriented exercise group and control, supporting GSA as a promising framework for integrated cognitive-motor benefits in this population.

A related developmental question was addressed by Fernandes et al. ⁶, who focused on whether fundamental motor skill competence of children with attention deficit hyperactivity disorder (ADHD) differs from that of children with typical development. Using the Test of Gross Motor Development-2 (TGMD-2), a standardized assessment framework, they reported poorer locomotor and object control performance in the ADHD group than in typically developing peers, along with a qualitative distribution that classified all children with ADHD in lower categories. These findings strengthen the descriptive evidence based on fundamental motor skill profiles in ADHD using a widely adopted instrument.

Finally, Giangiardini, de Freitas, and Alouche ⁷ examined a clinically central distinction: when does augmented feedback improve performance versus support learning? In individuals with cerebellar dysfunction, practicing aiming movements, additional visual feedback produced immediate performance benefits, but these benefits did not persist once feedback was withdrawn, indicating no retention of gains under the study's conditions. This result reinforces the need to interpret feedback-driven improvements cautiously in rehabilitation, explicitly separating short-term assistance from durable learning.

Collectively, the studies in this special issue indicate that “factors that affect the motor learning process” are multifactorial and can operate through distinct pathways. Cognitive-resource manipulations may not reliably enhance learning in complex skills and can even transiently impair early performance, whereas practice organization and task-representative structure can shape what is retained and transferred. At the same time, increases in practice volume can improve motor competence without necessarily shifting perceived competence, and work in special populations highlights how cognitive, developmental, and neurological constraints reshape the relationship between practice performance and retained capability. We hope this collection encourages continued refinement of both theory and methodology to better capture how cognitive, task, practice, and learner constraints jointly determine motor learning trajectories.

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