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Evolution of Perfetti's Neurocognitive Rehabilitation Theory: Implementation of "Comparison Between Actions" Paradigm in Pediatric Cerebral Palsy Treatment

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Relevance

"Perfetti's Neurocognitive Rehabilitation Theory" posits that the **quality** of recovery—whether spontaneous or driven by therapeutic intervention—depends on the specific cognitive processes engaged and the modality of their activation [1, 2]. This theoretical model has also been applied to the early developmental stages of infants, including the first days of life [3-5]. Adult and also pediatric patients with cerebral palsy undergoing neurocognitive rehabilitation frequently demonstrate compromised transfer of therapeutic gains from controlled clinical environments to functional activities of daily living. This phenomenon represents a significant limitation in current neurorehabilitation, where motor learning achieved during structured therapeutic interventions fails to generalize real-world motor performance. The discordance between exercise-induced neuroplasticity and functional motor competency indicates inadequate integration of sensorimotor learning with cognitive-behavioral adaptation mechanisms. Contemporary neurocognitive rehabilitation protocols require refinement to address this translational deficit between therapeutic motor acquisition and autonomous functional application in pediatric populations with spastic cerebral palsy.

Goal

To develop and validate an enhanced neurocognitive rehabilitation protocol incorporating systematic "Comparison Between Actions" methodology to facilitate superior transfer of sensorimotor learning from therapeutic contexts to functional motor performance in pediatric cerebral palsy patients.

Objectives

To integrate contemporary neurophysiological evidence regarding sensorimotor integration, comparative cognitive processing, and motor learning mechanisms into pediatric neurocognitive rehabilitation practice. To establish a three-phase intervention protocol systematically incorporating "action comparison" across clinical **observation**, therapeutic **exercise**, and outcome **evaluation** stages. To assess the efficacy of this enhanced protocol in improving motor function generalization, cognitive-motor integration, and autonomous motor problem-solving capabilities in children with spastic cerebral palsy compared to conventional neurocognitive rehabilitation approaches.

Materials and Methods

The intervention protocol "*Action Comparison*" integrates and reinterprets in rehabilitative way evidence from neuroplasticity research, sensorimotor integration studies, and comparative cognitive processing literature. Theoretical foundations include: reinterpretation of Piaget's sensorimotor developmental stages emphasizing assimilation and accommodation mechanisms; Anokhin's functional systems theory regarding goal-directed motor behavior organization; Gentner's structure-mapping theory of analogical reasoning, Murraky's contemporary multisensory integration mechanisms research; Vygotskji's concept of zone of proximal development; and recent neuroanatomical findings regarding cervical spinal interneuron connectivity patterns linking visual, vestibular, and somatosensory systems [6-12]. The three-phase protocol comprises: Phase I - **multidimensional observational** assessment introduces new instruments: three structured questionnaires to establish comprehensive functional baselines, incorporating first-person patient perspective, parents point of view and expectations, third-person therapist input in order to identify a *guide-action* which would become the objective of the intervention; Phase II - selective attention **exercise**, training with explicit awareness and implicit facilitation, targeting specific sensorimotor **themes** identified during assessment; and Phase III - This phase assessed the recovery of the quality of the *guide-action* and the extension of the new learning to novel motor tasks. Clinical implementation occurred across multiple pediatric rehabilitation centers including the Vygotskji Study Centre and Developmental Rehabilitation Centre.

Results

Clinical outcomes demonstrated significant improvements in functional motor performance across home, educational, and community environments compared to baseline measurements. Patients exhibited accelerated motor learning acquisition with enhanced retention of therapeutic gains at follow-up assessments. Notably, significant positive transfer effects were observed for untrained motor tasks, indicating development

of generalized motor problem-solving capabilities rather than task-specific motor improvements. Neuromotor recovery patterns demonstrated enhanced internalization of sensorimotor associations and in some cases with improved conscious awareness of the relationship between therapeutic exercises and target functional activities. The systematic integration of *comparative action* analysis facilitated superior cognitive-motor integration with measurable improvements in autonomous motor adaptation to novel environmental demands.

Conclusions

The "Comparison Between Actions" paradigm represents a significant advancement in pediatric neurocognitive rehabilitation by addressing the critical gap between therapeutic gains and functional application. The three-phase protocol adopting a systematic comparison process demonstrates a superior clinical efficacy in facilitating transfer of motor learning from structured therapeutic contexts (exercise) to functional motor performance in natural environments. This enhanced approach yields improved quality of functional motor execution, accelerated neuromotor recovery patterns, and development of autonomous motor problem-solving capabilities in pediatric patients with spastic cerebral palsy.

Recommendations

Implementation of the "Comparison Between Actions" protocol should be considered for integration into standard pediatric neurocognitive rehabilitation practice. Further research utilizing standardized assessment scales and neuroimaging techniques is recommended to quantify the clinical observations and establish evidence-based guidelines. Development of structured training programs for rehabilitation professionals for the in the systematic application of action comparison methodologies would facilitate broader adoption. Longitudinal studies are needed to assess long-term maintenance of functional improvements and transfer effects across different pediatric populations.

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Conflict of Interest Statement

The author declares no conflict of interest.

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