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Infographic

INFOGRAPHIC: Effects of stressful environmental context on learning, coordination, and motor action control

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ABBREVIATIONS

ANS	Autonomic Nervous System
BDNF	Brain-Derived Neurotrophic Factor
CNS	Central Nervous System
SEC	Stressful Environmental Context
SPNS	Somatic Peripheral Nervous System

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Self-confidence is essential for individual development. As children acquire motor skills, they interact with their environment and refine their abilities to meet environmental demands [1]. The resulting sense of competence promotes growth across behavioral domains, fostering expectations of success and engagement in play, games and sports. However, a Stressful Environmental Context (SEC) negatively influences development, particularly in psychosocial and motor areas. SEC is characterized by adverse social conditions, including negative interpersonal interactions, performance pressure from parents, teachers, or peers, highly competitive situations, and environments marked by bullying, insecurity, violence, or financial strain. Exposure to SEC is often related to learning and coordination difficulties, avoidance of physical activity, and low self-esteem [2].

Motor learning involves lasting improvements in motor task performance through practice. Initially, responses are variable and error-prone; with continued practice, movements become refined, energy expenditure decreases, and confidence increases. In the advanced stages, performance becomes efficient and automatic. Neurophysiologically, this process reflects brain reorganization and plasticity, emphasizing the integrated action of the cortico-striatal and cortico-cerebellar systems [3]. Thus, behavioral improvements and neural adaptations occur in parallel, reinforcing each other.

The Central Nervous System (CNS), Somatic Peripheral Nervous System (SPNS), and Autonomic Nervous System (ANS) operate in an integrated manner, ensuring flexibility, adaptation, and efficient execution of motor actions in response to environmental and task demands. Movement planning and execution rely on complex CNS interactions involving the primary, supplementary, premotor, and cingulate motor areas, as well as other structures, such as the cerebellum, basal ganglia, thalamus, parietal and prefrontal cortices, limbic system, and spinal cord. Visual and sensory areas also contribute to this process. The prefrontal cortex establishes the goals of an action, whereas the primary motor cortex executes movements via corticospinal neurons that connect to alpha motor neurons. In addition, Brain-Derived Neurotrophic Factor (BDNF) expression [4] and Diffuse Projection Modulatory Systems, such as the locus coeruleus and substantia nigra, regulate neuronal excitability through the diffuse release of noradrenaline and dopamine, influencing attention, learning, and motor control [5].

The ANS regulates vital body functions and directly contributes to motor performance. Its sympathetic and parasympathetic divisions act in an antagonistic yet complementary manner, promoting balance and adaptation to physiological and environmental demands. In SEC, the hypothalamic-pituitary-adrenal axis is activated, releasing cortisol, which affects brain areas related to motor control. Chronic cortisol exposure is associated with neuronal damage and coordination deficits. Evidence shows that BDNF expression and dopamine release are dysregulated in SEC, negatively affecting motor function and neural adaptation [2]. Effective motor control depends on proper synaptic activity, including neurotransmitter synthesis, release, and clearance, which are vital for motor learning and

performance.

Finally, skilled motor performance results from the interaction among organism, environment, and task constraints [1]. SEC-induced alterations affect this dynamic, modifying the organism's configuration and negatively impacting motor behavior. Although motor performance in SEC is a common challenge for developing children, some strategies can be adopted to prevent this condition from becoming chronic in schools, clubs, and academies. Raising awareness of how teachers and parents should behave in their interactions with children, as well as fostering healthy cooperation and understanding among classmates, are essential steps toward creating a supportive environment.

REFERENCES

1. Newell KM. Constraints on the development of coordination. In: Wade M, Whiting HTA, editors. *Motor development in children: aspects of coordination and control*. Dordrecht, Netherlands: Martinus Nijhoff; 1986, p. 341-360.
2. Martins LA, Schiavo A, Paz LV, Xavier LL, Mestriner RG. Neural underpinnings of fine motor skills under stress and anxiety: a review. *Physiol Behav* 2024;282:114593. Doi: 10.1016/j.physbeh.2024.114593
3. Doyon J, Benali H. Reorganization and plasticity in the adult brain during learning of motor skills. *Curr Opin Neurobiol* 2005;15(2):161-167. doi: 10.1016/j.conb.2005.03.004
4. Andreska T, Rauskolb S, Schukraft N, Lüningschrör P, Sasi M, Signoret-Genest J, et al. Induction of BDNF expression in layer II/III and layer V neurons of the motor cortex is essential for motor learning. *J Neurosci* 2020;40(33):6289-6308. doi: 10.1523/JNEUROSCI.0288-20.2020
5. Phillips CD, Hodge AT, Myers CC, Leventhal DK, Burgess CR. Striatal dopamine contributions to skilled motor learning. *J Neurosci* 2024;44(26):e0240242024. doi: 10.1523/JNEUROSCI.0240-24.2024

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