**CHALLENGES POSTURAL, OCULAR, ORAL AND/OR BILATERAL MOTOR**

**CONTROL**

This section will include research on postural control, bilateral-motor control, and ocular-motor control.

**2018**

### **Cristina Dos Santos Cardoso De Sá, Boffino, C. C., Ramos, R. T., & Tanaka, C. (2018). Development of postural control and maturation of sensory systems in children of different ages a cross-sectional study. *Brazilian Journal of Physical Therapy,22*(1), 70-76. doi:10.1016/j.bjpt.2017.10.006**

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#### **Objective:** To evaluate the stability, postural adjustments and contributions of sensory information for postural control in children.

#### **Methods:** 40 boys and 40 girls were equally divided into groups of 5, 7, 9 and 12 years (G5, G7, G9 and G12). All children were submitted to dynamic posturography using a modified sensory organization test, using four sensory conditions: combining stable or sway referencing platform with eyes opened, or closed. The area and displacements of the center of pressure were used to determine stability, while the adjustments were used to measure the speed of the center of pressure displacements. These measurements were compared between groups and test conditions.

#### **Results:** Stability tends to increase with age and to decrease with sensory manipulation with significant differences between G5 and G7 in different measures. G7 differed from G12 under the conditions of stable and sway platform with eyes open. G9 did not differ from G12. Similar behavior was observed for adjustments, especially in anterior-posterior directions.

#### **Conclusion:** Postural stability and adjustments were associated with age and were influenced by sensory manipulation. The ability to perform anterior-posterior adjustments was more evident and sensory maturation occurred firstly on the visual system, then proprioceptive system, and finally, the vestibular system, reaching functional maturity at nine years of age. Seven-year-olds seem to go through a period of differentiated singularity in postural control.

### **Goulème, N., Debue, M., Spruyt, K., Vanderveken, C., Siati, R. D., Ortega-Solis, J., . . . Deggouj, N. (2018). Changes of spatial and temporal characteristics of dynamic postural control in children with typical neurodevelopment with age: Results of a multicenter pediatric study. *International Journal of Pediatric Otorhinolaryngology,113*, 272-280. doi:10.1016/j.ijporl.2018.08.005**

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#### **Background**: The aim of this multicenter study is to investigate the effect of chronological age and gender in postural control.

#### **Methods**: To approach an ecological model, we used a multicenter posturography assessment. We analyzed postural control with surface, mean velocity of center of pressure [CoP] and temporal analysis, with Postural Instability Index [PII] being a more sensitive parameter in postural evaluation. A large sample of 156 age- and gender-matched healthy children recruited in several pediatrics hospitals, participated.

#### **Results**: Our current results showed a significant decrease of all postural parameters (surface, mean velocity of CoP and PII) with age, and only on stable support condition. Our study additionally described a gender effect in conditions where all sensory inputs are most challenged with a mean velocity of CoP being significantly smaller in girls with respect to boys.

#### **Conclusion**: We concluded that postural control improves with age linked with maturation process. Moreover, this maturation process seems not yet achieved at 16.08 years and still ongoing beyond. Interestingly, our result reported specificities linked with gender effect. Indeed, girls and boys do not proceed in the same way to maintain their postural control. We could make hypothesis that more children maintain their postural control efficiently; with a low energy cost, the more they could allocate attention to learning during childhood.

**Ferrer-Uris, B., Busquets, A., & Angulo-Barroso, R. (2018). Adaptation and retention of a perceptual-Motor task in children: Effects of a single bout of intense endurance exercise. *Journal of Sport and Exercise Psychology,40*(1), 1-9. doi:10.1123/jsep.2017-0044**

We assessed the effect of an acute intense exercise bout on the adaptation and consolidation of a visuomotor adaptation task in children. We also sought to assess if exercise and learning task presentation order could affect task consolidation. Thirty-three children were randomly assigned to one of three groups: (a) exercise before the learning task, (b) exercise after the learning task, and (c) only learning task. Baseline performance was assessed by practicing the learning task in a 0° rotation condition. Afterward, a 60° rotation-adaptation set was applied followed by three rotated retention sets after 1 hr, 24 hr, and 7 days. For the exercise groups, exercise was presented before or after the motor adaptation. Results showed no group differences during the motor adaptation while exercise seemed to enhance motor consolidation. Greater consolidation enhancement was found in participants who exercised before the learning task. Our data support the importance of exercise to improve motor-memory consolidation in children.

**Wälchli, M., Keller, M., Ruffieux, J., Mouthon, A., & Taube, W. (2018). Age-dependent adaptations to anticipated and non-anticipated perturbations after balance training in children. *Human Movement Science,59*, 170-177. doi:10.1016/j.humov.2018.04.006**

Postural control undergoes rapid changes during child development. However, the influence of balance training (BT) on the compensation of perturbations has not yet been investigated in children. For this purpose, young (6.7 ± 0.6 years) and old children (12.0 ± 0.4 years) were exposed to externally induced anticipated (direction known) and non-anticipated (direction unknown) perturbations on a free swinging platform before and after either child-oriented BT (INT; young: n = 12, old: n = 18) or regular physical education (CON; young: n = 9, old: n = 9). At baseline, old children exhibited less platform sway after perturbations than young children (p = .004; η2p = 0.17). However, no differences were found between anticipated and non-anticipated perturbations. After training, INT reduced the platform sway path while CON remained stable (-11.1% vs. +2.7%; p < .001; η2p = 0.26). Furthermore, the young INT group adapted statistically similarly in anticipated and non-anticipated situations (-7.9% vs. -12.6%; p = .556; r = 0.33), whereas the old INT group tended to improve more in anticipated perturbations (-15.1% vs. -8.2%; p = .052; r = 0.51). Thus, the maturity of the postural system seems to influence the extent of training adaptations in anticipated perturbations. Furthermore, this study provides evidence that BT can improve postural responses to external perturbations in children and may represent a useful intervention to prevent falls.

### **Deravet, N., Blohm, G., Xivry, J. O., & Lefèvre, P. (2018). Weighted integration of short-term memory and sensory signals in the oculomotor system. *Journal of Vision,18*(5), 16. doi:10.1167/18.5.16**

Oculomotor behaviors integrate sensory and prior information to overcome sensory-motor delays and noise. After much debate about this process, reliability-based integration has recently been proposed and several models of smooth pursuit now include recurrent Bayesian integration or Kalman filtering. However, there is a lack of behavioral evidence in humans supporting these theoretical predictions. Here, we independently manipulated the reliability of visual and prior information in a smooth pursuit task. Our results show that both smooth pursuit eye velocity and catch-up saccade amplitude were modulated by visual and prior information reliability. We interpret these findings as the continuous reliability-based integration of a short-term memory of target motion with visual information, which support modeling work. Furthermore, we suggest that saccadic and pursuit systems share this short-term memory. We propose that this short-term memory of target motion is quickly built and continuously updated, and constitutes a general building block present in all sensorimotor systems.

### **Busquets, A., Aranda-Garcia, S., Ferrer-Uris, B., Marina, M., & Angulo-Barroso, R. (2018). Age and gymnastic experience effects on sensory reweighting processes during quiet stand. *Gait & Posture,63*, 177-183. doi:10.1016/j.gaitpost.2018.05.009**

#### **Background:** The relative contribution of sensory inputs to control balance while standing is dynamically adjusted. These sensory reweighting processes could be impacted by age and sport expertise capabilities, especially when the sport emphasizes equilibrium like artistic gymnastics.

#### **Purpose:** The aim of this study was to explore the sensory reweighting processes to adjust standing posture in children and adults with different gymnastic expertise (gymnasts, G, and non-gymnast, NG).

#### **Methods:** All participants were asked to stand quietly on a force plate in two visual conditions (eyes open, EO, and eyes closed, EC). Within a trial, proprioception was altered with two vibrators strapped at the Achilles tendon level. The center of pressure (COP) displacements in the anterior-posterior and medio-lateral directions were calculated and normalized by the base of support. The effect of vibration application was characterized by the COP speed, maximal posterior displacement and the time when it occurred. The effect of vibration removal was depicted by the time between the motor switched off and the achievement of balance values similar to baseline and the COP speed and movement units performed during this time.

#### **Results:** G children presented shorter posterior displacement during vibrations, needed less time to recover initial balance, and produced less movements units than NG children. In general, adults and EO showed better reweighting responses than children and EC, respectively.

#### **Significance:** These results suggest that age could have a positive effect on reweighting processes and that gymnastic experience may benefit the development of proprioceptive reweighting processes in children but not in adults.

### **Whitall, J., & Clark, J. E. (2018). A perception–action approach to understanding typical and atypical motor development. *Studying the Perception-Action System as a Model System for Understanding Development Advances in Child Development and Behavior,*245-272. doi:10.1016/bs.acdb.2018.04.004**

In this chapter, we ask two questions. First, can the study of the perception-action system across time offer a useful model for understanding motor development? Second, can the study of the perception-action system in children with developmental coordination disorder (DCD) inform our understanding of atypical as well as typical motor development? We begin by describing the dynamical systems perspective and a control-theoretic approach that together provide the conceptual framework for our paradigms, methodology, and interpretation of our experiments. Our experimental strategy has been to perturb one or more sensory systems and observe the effect on the motor system. The majority of the chapter explains how we employed two principal perturbation strategies: (1) removing or adding a static source of sensory information believed to be salient to the task at hand and (2) enhancing a dynamic source of sensory information either implicitly or explicitly. These strategies were employed in three different action systems: posture; rhythmic interlimb coordination, and goal-directed reaching and drawing. After synthesizing our findings, we conclude by addressing the original questions and offering future directions. In brief, we consider that perception-action coupling is an underlying mechanism/foundation/constraint of motor development in the sense that the ongoing processing of sensations and the planning and execution of movements are how the brain produces goal-directed movements. Therefore, a better understanding of how this coupling changes or adapts over time has much to offer as to how motor behavior develops across the lifespan, both typically and atypically.