UNIVERSITY of SOPRON
Faculty of Wood Engineering and Creative Industries
Department of Basic Sciences

PhD review

Developmental Gait Biomechanics and Task-Specific Plantar Loading in Children: Implications for Sensory Processing Disorder and Balance

by

Wei Liu

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Wei Liu's doctoral work was submitted at the University of Pannonia Doctoral School of Chemical Engineering and Material Sciences in 2026.

The comparison of the contents between the draft dissertation for the pre-defense and the final version for the official defense reveals several key enhancements. While the theoretical background, specific measurement values, and the core scientific claims of the hypotheses remain identical, the final version incorporates significant structural, methodological, and analytical expansions designed to strengthen the rigor and the theoretical synthesis of the research.

The first major content addition occurs in the materials and methods section on page 45, where a completely new subsection titled 2.1.1 Rationale for cohort composition and between-group comparability has been inserted. In this section, the author provides the theoretical justification for restricting the clinical sensory processing disorder cohort to boys only, explaining that this design isolates the effects of the sensory processing disorder from sex-related baseline variability. The subsection also explicitly clarifies that the study architecture aims to evaluate specific limb-role patterns within each distinct cohort rather than conducting direct statistical cross-comparisons between the three groups, thereby enhancing the internal validity of the study.

The second content update is located in the statistical analysis subsection on page 52. The final version introduces a critical paragraph addressing the limitations of the sample size for the sensory processing disorder subgroup. The author openly acknowledges that the small sample size of six participants limits the overall statistical power of the inferential tests, particularly during the highly variable turning conditions. Consequently, the text states that the findings for this clinical subgroup should be

interpreted as a tightly controlled cohort comparison rather than a population-level estimate, shifting the analytical focus toward the temporal consistency and biomechanical coherence of the phase-specific differences across the stance phase.

The third significant expansion involves the addition of three comprehensive summary tables at the beginning of the lower-limb kinematics and kinetics section on page 68. These new tables, labeled Table 3.4.1, Table 3.4.2, and Table 3.4.3, systematically organize the primary empirical findings for each of the three cohorts. They explicitly map the biomechanical variables, the specific locomotor tasks, the exact direction of the limb asymmetries or group differences, the precise percentage intervals of the stance phase identified by the one-dimensional statistical parametric mapping continuum, and the core neuromechanical conclusions.

The fourth set of additions consists of multiple new synthesis paragraphs inserted at the ends of major sections on pages 75, 77, 85, 86, and 89. These paragraphs interpret the empirical data within a broader sensorimotor and physiological framework. For the typically developing children, the text establishes that mild asymmetry represents normal physiological lateralization and a functional division of labor between support and propulsion rather than coordination deficits. For the clinical subgroup, the new synthesis explains that the midfoot-dominant loading and restricted foot modulation observed during running reflect a sensory-driven stability compensation, where the child trades propulsive efficiency for a broader base of support to manage noisy intrinsic feedback. For the adolescent athletes, the text clarifies that the extensive joint-level asymmetries during turning tasks represent necessary mechanical adaptations driven by inside-outside limb-role separation and training-induced kinetic specialization.

The fifth major contribution of the final version is the insertion of a completely new conceptual matrix on pages 89 and 90, titled Table 4.4.1 Comparative synthesis of asymmetry mechanisms across cohorts. This table provides a comprehensive cross-cohort synthesis that categorizes the underlying physiological causes behind the left-right mechanical differences. It systematically demonstrates how identical surface-level biomechanical asymmetries stem from three entirely different pathways: expected developmental laterality in healthy children, adaptive compensation in children with sensory integration difficulties, and functional specialization in trained youth athletes.

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Regarding the official thesis points chapter, a rigorous page-by-page comparison confirms that the actual scientific content, the numerical intervals, the statistical significance values, and the findings of the three primary thesis points remain completely identical word for word. However, two technical adjustments were made within this section to ensure consistency with the rest of the updated document. First, due to the tightening and structural compression of the text layout, the entire chapter has been shifted from page 88 of the pre-defense draft to page 96 of the final dissertation. Second, the embedded image labels and figure references within the text of the thesis points have been updated and renumbered to accurately correspond to the revised figure numbers of the main text.

The final content addition appears within the limitation statements on page 92. A dedicated subsection titled Small SPD subgroup size has been introduced to strengthen the methodological transparency of the dissertation. The author notes that non-significant results in the clinical comparison must be treated with caution and cannot be used as definitive evidence of equivalence between the groups, and the text explicitly outlines recommendations for future studies to recruit larger, phenotypically characterized sensory processing cohorts to confirm the external validity of these dynamic adaptations.

I find all 3 theses acceptable.

Summary

I conclude that the PhD dissertation of Wei Liu has scientific merit. I propose to give the PhD degree for Wei Liu.

2026. 05. 28.

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