



Autonomic Imbalance as an Organizing Principle of Mental Functioning and Development:

A Developmental Extension of the Somato-Psychic Pathway



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CORE PROPOSITION

Within the SPP, autonomic imbalance is conceptualized as a **state-dependent regulatory condition** that may function as an **organizing constraint** on mental functioning and development, **rather than as a direct, unitary cause of symptoms**.

BACKGROUND AND OBJECTIVE(S)

- The **Somato-Psychic Pathway (SPP)** provides an etiological framework linking somatic structural-functional disturbance to altered autonomic regulation and higher-order functional outcomes.

- Autonomic imbalance is conceptualized as a **state-dependent organizing constraint** rather than a direct cause of individual symptoms.

- Reduced **availability, flexibility, or proportionality** of appropriate autonomic responses may influence attention, affect regulation, sleep, and adaptive behavior across development.

OBJECTIVE

To examine whether age-stratified functional patterns are consistent with an organizing role of autonomic imbalance within the SPP framework.

STUDY PARTICIPANTS & SETTING

Retrospective routine-care observations from children aged 2-12 years evaluated at a tertiary pediatric neurodevelopmental referral center were analyzed in two age strata.

AGE 2-6 YEARS
n = 94

AGE 6-12 YEARS
n = 42

Cohort inclusion required clinically salient, robust, and reproducible findings.

MATERIALS/METHODS

COHORT INCLUSION

Inclusion required clinically salient, robust, and reproducible evidence of axial structural-functional dysregulation and autonomic imbalance on neurological, postural, kinesiological, and reflex-based examination.

COHORT EXCLUSION

Exclusion criteria were age outside 2-12 years, an identified organic neurological lesion, psychosis, or a progressive degenerative disease.

AUTONOMIC ASSESSMENT

Autonomic regulation was assessed clinically from pupillary light responses, cutaneous autonomic reflexes, clinically observed changes in heart rate during examination and recovery, and relevant autonomic history (sleep, thermoregulation, sweating, gastrointestinal, and cardiorespiratory reactivity). Interpretation emphasized the availability, flexibility, proportionality, and recovery of context-appropriate responses.

Autonomic state was assessed clinically; no direct instrumental autonomic quantification was performed.

FUNCTIONAL OUTCOMES

Parent-report outcomes comprised inattention and hyperactivity (ADHD Rating Scale-IV - Parent Report, ages 2-6; SNAP-IV, ages 6-12), sleep disturbance (Children's Sleep Habits Questionnaire [CSHQ]), and RCADS domains: separation anxiety, social phobia, generalized anxiety, panic disorder, obsessive-compulsive symptoms, depressive symptoms, and overall anxiety.

ANALYSIS

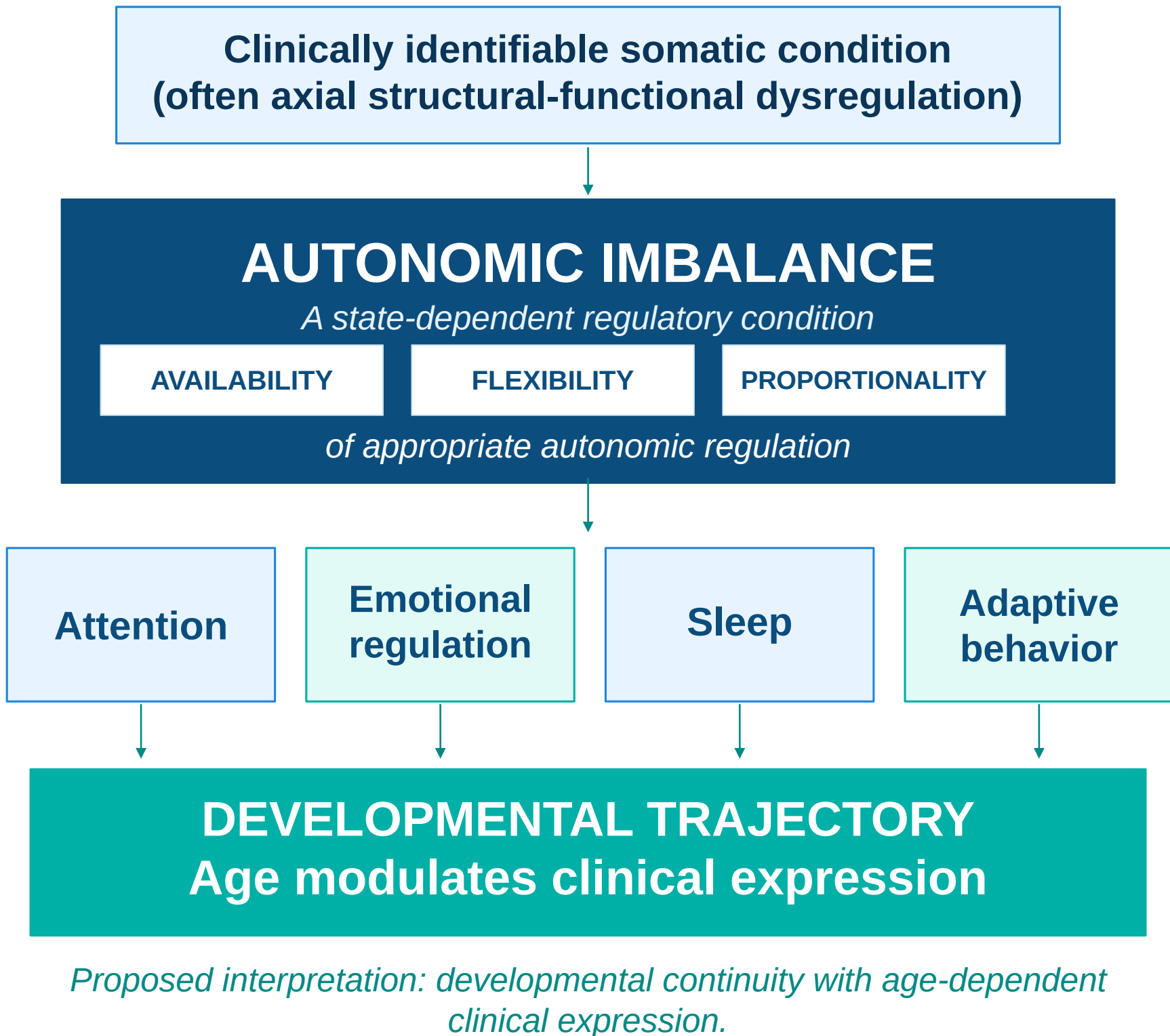
PRE and POST scores were compared within each age stratum using paired t-tests; Wilcoxon signed-rank tests were used when normality was not supported. Normality was assessed with the Shapiro-Wilk test. Two-sided $p < .05$ defined statistical significance. Effect sizes were reported as Cohen's d or rank-biserial correlation, as appropriate.

Analyses were interpreted as theory-concordant pattern evidence, not as a causal test of the proposed mechanism.

LEARNING OBJECTIVE

Describe the proposed role of autonomic imbalance as a developmental organizing constraint within the Somato-Psychic Pathway framework.

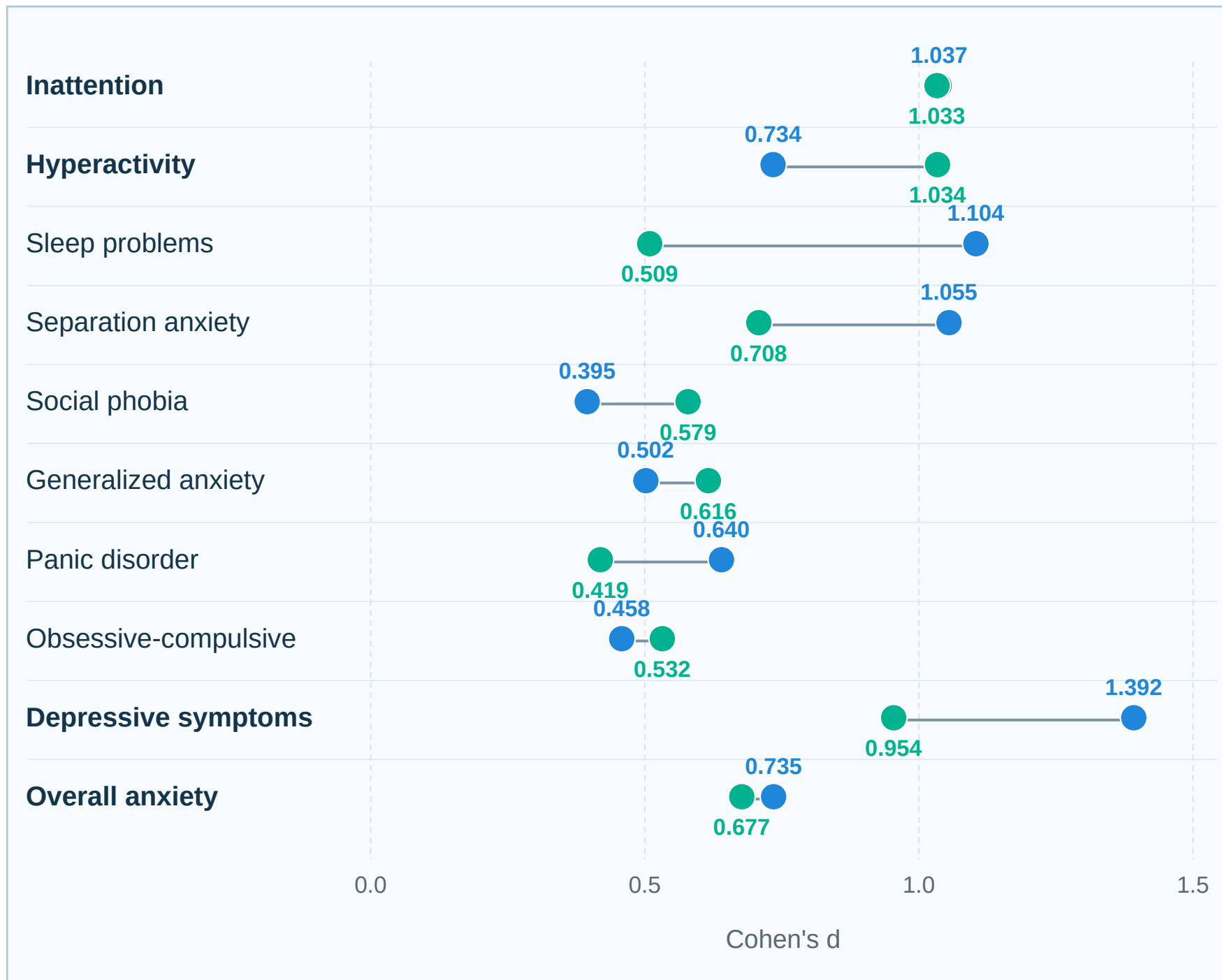
DEVELOPMENTAL ORGANIZING-CONSTRAINT MODEL



RESULTS

Across both age strata, pre-post changes were **directionally concordant across all assessed mental-functional domains**. Cohen's d ranged from **0.395 to 1.392**. Larger effects were more frequent in the younger cohort, although the relative domain profile differed by age.

ALL COHEN'S d ESTIMATES BY AGE STRATUM



EFFECT-SIZE RANGE

d = 0.395-1.392

across 20 age-stratified estimates

CROSS-STRATUM PATTERN

Larger effects in the younger cohort in 6/10 domains; strongest contrasts in sleep, separation anxiety, and depression.

DESCRIPTIVE LIMITATION

Descriptive, theory-concordant pre-post pattern; no inferential comparison between age strata.

DEVELOPMENTAL INTERPRETATION

CROSS-STRATUM CONSISTENCY

Directionally concordant change across all assessed domains was the dominant empirical pattern.

AGE-DEPENDENT EXPRESSION

Relative domain prominence varied by developmental stage without implying a different organizing principle.

INFERENCE NOT SUPPORTED

The design does not test causal autonomic mechanisms, comparative efficacy, or differential effects between age strata.

CONCLUSIONS / SIGNIFICANCE

- The age-stratified pattern is **consistent with - but does not establish** - a developmental organizing role of autonomic imbalance within the SPP.

- Reduced availability, flexibility, or proportionality may limit the capacity to generate a timely, context-appropriate autonomic response and to recover as demands change. This reduced regulatory flexibility may be expressed across attention, activation, sleep, affect regulation, and adaptive behavior, thereby acting as a **cross-domain developmental constraint**.

- Independent prospective infant evidence provides **convergent developmental support** for continuity from early regulation to later higher-order function.

Prospective studies incorporating direct autonomic measurement and longitudinal developmental follow-up are required.

INTERPRETIVE BOUNDARIES

CAUSAL INFERENCE IS NOT SUPPORTED

The data do not establish autonomic imbalance as a direct cause of symptoms.

AUTONOMIC STATE WAS NOT INSTRUMENTALLY QUANTIFIED

Autonomic regulation was assessed clinically through testable responses rather than direct physiological measurement.

RETROSPECTIVE PARENT-REPORT DESIGN

Outcomes were derived from retrospective routine-care parent reports without a prospective control group; causal attribution and between-cohort inference are limited.

THEORY-CONCORDANT PATTERN, NOT MECHANISM VALIDATION

The observations are interpreted as alignment with the proposed developmental framework, not as direct validation of its mechanism.

NEXT INVESTIGATION

Prospective cohort

Instrumented autonomic phenotyping

Longitudinal developmental outcomes

PRIMARY EMPIRICAL TEST

Test whether baseline autonomic measures and their change predict domain-specific developmental outcomes under controlled designs.

EXTERNAL DEVELOPMENTAL SUPPORT

Early self-regulation at 1 month predicted language development at 12 months.

This independent prospective finding is consistent with developmental continuity from early regulatory organization to later higher-order function.

DEVELOPMENTAL IMPLICATION

A common regulatory constraint may yield age-dependent clinical expression without requiring different underlying principles.

External support is convergent, not mechanistically confirmatory.

SELECTED REFERENCES

1. Zivny B. Somato-Psychic Pathway: A Universal Developmental Trajectory Linking Somatic Structural-Functional Integrity, Autonomic Regulation, and the Emergence of Mind. Front Integr Neurosci. 2026;20:1771123. doi:10.3389/fnint.2026.1771123

2. Zivny B. Persistent afferent bias as a mechanistic link between somatic disruption and autonomic dysregulation. Front Integr Neurosci. 2026;20:1848233. doi:10.3389/fnint.2026.1848233

3. Zivny B, Zivna V. Axial Block (AxB): A Position Paper on Definition, Terminology, and Pathophysiology. SPP Institute Position Papers, No. 1. 2026. doi:10.5281/zenodo.22050239

4. Zivna V, Sousa M, Sampaio A, Cruz S. Self-regulation at one month predicts language development at 12 months. Eur J Dev Psychol. 2025. doi:10.1080/17405629.2025.2607718

5. Porges SW. Polyvagal theory: Current status, clinical applications, and future directions. Clin Neuropsychiatry. 2025;22(3):169-184. doi:10.36131/cnforinteditore20250301

SPP FRAMEWORK & PUBLICATIONS

spp.institute

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