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## **Seasonal time constraints shape life history, physiology, and behaviour independently, and decouple a behavioural syndrome in a damselfly**

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### **Abstract:**

The integration of traits into ‘syndromes’ has been suggested as a useful framework to advance insights in trait responses to environmental stressors. Yet, how stressors shape the consistency (‘repeatability’) of traits and their covariation at the individual level remains debated. We studied how seasonal time constraints shape trait repeatability and integration of life-history, behavioural and physiology traits along a fast-slow continuum, using the ‘pace-of-life syndrome’ as a framework. We manipulated the photoperiod during the larval development of the damselfly *Ischnura elegans*, generating a time-relaxed early, a control, and a time-constrained late group. The photoperiod treatment did not seem to affect the voltinism of the larvae. As predicted, late-period larvae accelerated development and growth, yet this acceleration was no longer detectable for growth and metabolic rate during the final instar, possibly due to costs of the initial life-history acceleration. This warrants caution when interfering a species’ pace-of-life based on a specific developmental stage. The late-period larvae were as predicted more active (only during the later stages of the final instar) and bolder than the control larvae, but not different from the early-period larvae. Most studies on time constraints only compared late and control animals, thereby potentially wrongly concluding adaptive responses to time constraints. Activity, boldness and body mass were repeatable, while growth and metabolic rates were not. Notably, repeatabilities did not change under time constraints. There was no support for an overall trait integration in pace-of-life syndrome, yet activity and boldness covaried positively as expected. Importantly, this ‘behavioural syndrome’ was decoupled in the late-period larvae, which might be adaptive to enhance energy acquisition to fuel the accelerated development. Our results suggest that besides the predicted plastic acceleration of life-history, plastic changes in behavioural trait integration may also be important but overlooked aspect of responding to time constraints.

Keywords: behavioral syndromes, pace-of-life, personality, photoperiod, time stress, trait integration