

Time of day X chronotype effects on adolescent's emotional states*

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Introduction

- Puberty induces a shift in the circadian rhythms' phase⁽¹⁾. Chronotype influences behaviour and performance throughout the day^(2,3), with psychobehavioural variables such as emotional states (ES) exhibiting circadian rhythmicity⁽⁴⁾. However, the interaction time of day X chronotype remains marginally explored, particularly in adolescence.
- We investigated potential interactive effects of chronotype and time of day on adolescent's ES, hypothesizing that morning-types reveal a better mood in the early hours and evening-types experience it later in the day. We further probed it while controlling for sleep (quantity and quality) and psychopathological symptoms (PS) due to its links with mood and ES.

Methods

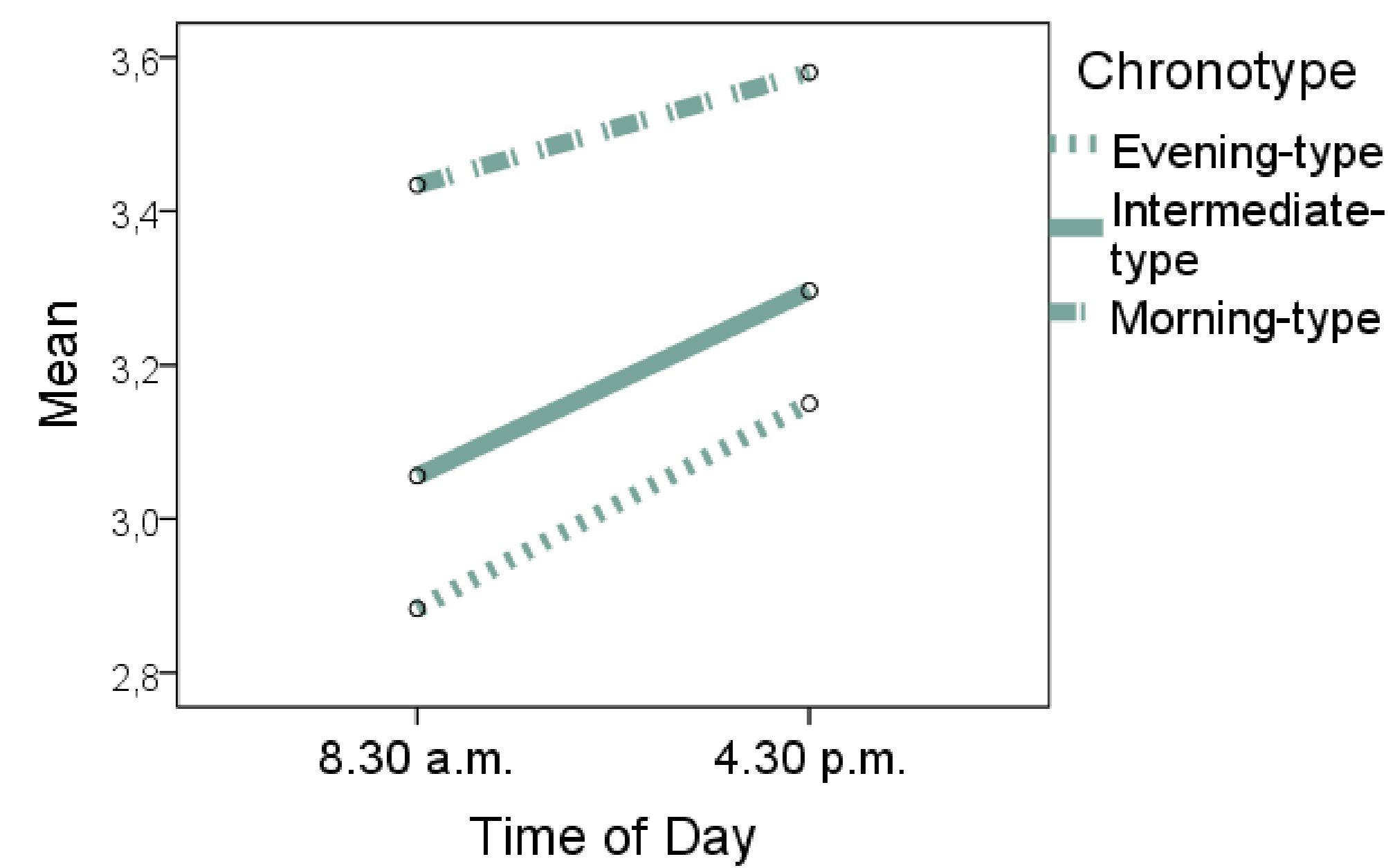
- One hundred ninety 8th-graders (53.7% males; mean age 13.47±.70) completed a two-part protocol: part one probing chronotype (CSM), sleep (BaSIQS), and PS (SDQ); part two targeting four measures of ES [momentary mood (FS), positive and negative affect (EAPNC), and anxiety-state (STAIC-S)] while manipulating time of day (first and last hours of the school day – 8.30 am and 4.30 pm).
- Potential confounders were considered, namely PS and sleep-related variables (sleep length, perceived sufficient sleep, and sleep quality).

Table 1. Sample's distribution by chronotype and gender.

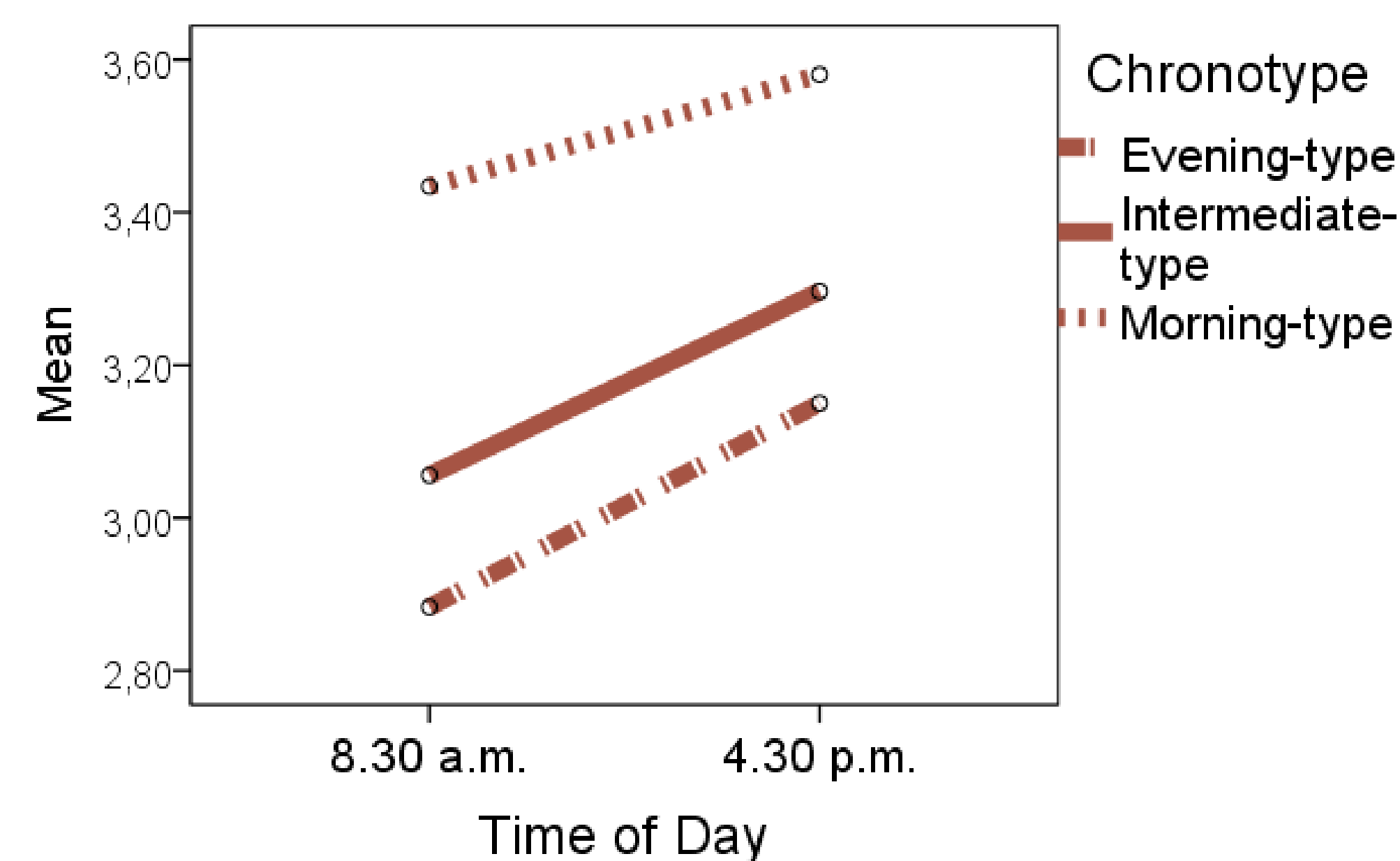
Chronotype	Females	Males	Total
	N	N	N
Evening-types	20	24	44
Intermediate-types	48	57	105
Morning-types	20	21	41

* Full-length paper of the present work: Bettencourt, C., Tomé, B., Pires, L., Leitão, J. A., & Gomes, A. A. (2020). Emotional states in adolescents: Time of day X chronotype effects while controlling for psychopathological symptoms and sleep variables. *Biological Rhythm Research*, 1-22. DOI: 10.1080/09291016.2020.1783489

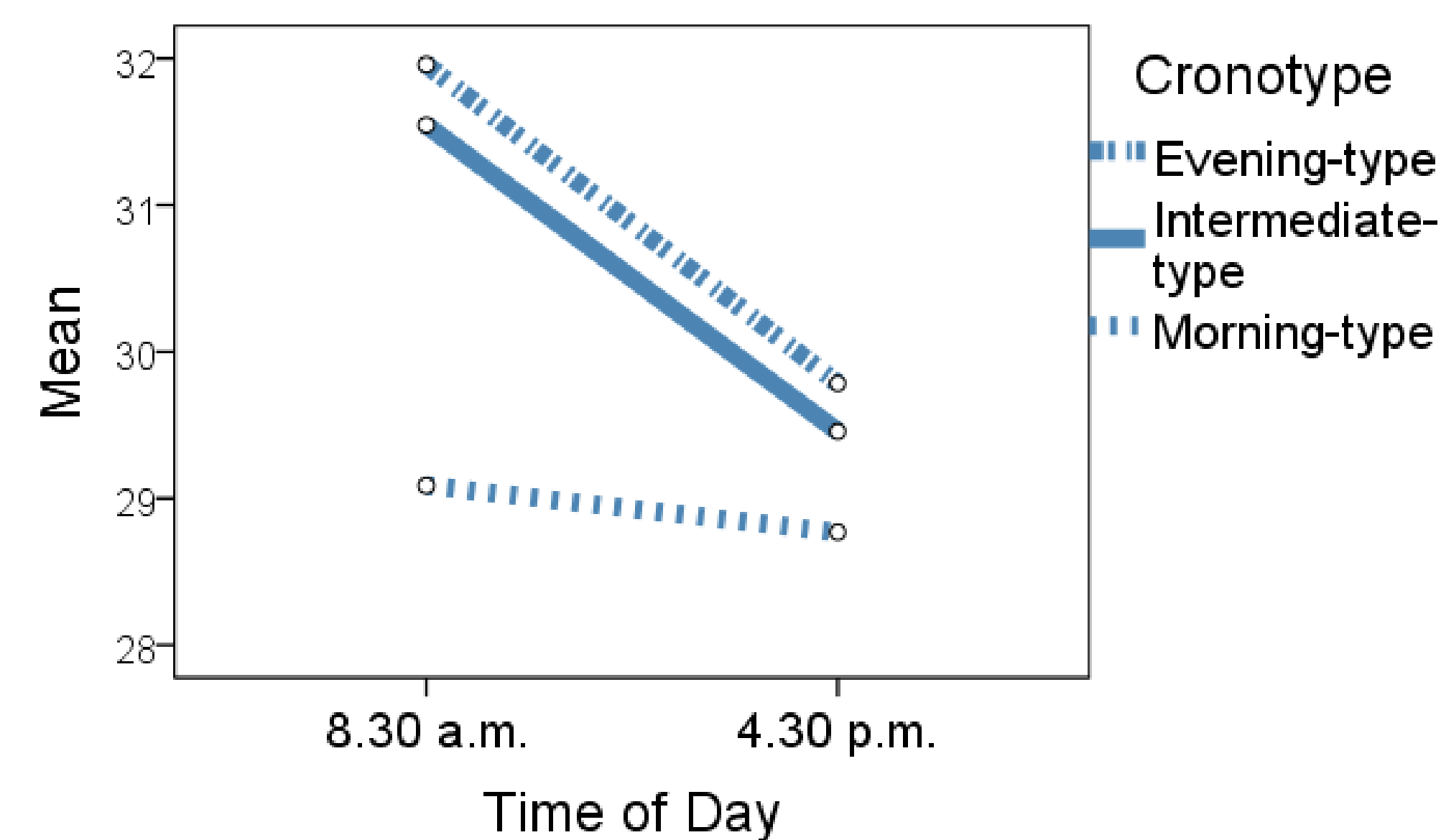
Momentary Mood



Positive Affect



Anxiety-State



Results

- Despite the hypothesized interaction not reaching significance, consistent effects of time of day were uncovered on all ES' measures, except for negative affect. Momentary mood ($p < .001$, $\eta_p^2 = .125$) and positive affect ($p < .001$, $\eta_p^2 = .068$) raised from morning to afternoon and anxiety dropped ($p = .001$, $\eta_p^2 = .058$).
- Chronotype independently influenced all ES' measures, except for negative affect. Morning-types showed better momentary mood ($p = .043$, $\eta_p^2 = .033$), more positive affect ($p = .008$, $\eta_p^2 = .051$) and less anxiety ($p = .010$, $\eta_p^2 = .048$) than evening-types.
- Chronotype's effects on ES' measures seem to be influenced by sleep and/or PS: effects on momentary mood and anxiety-state become non-significant when controlling for sleep and PS, while effects on positive affect become non-significant when controlling for PS.

Discussion/Conclusions

- The absence of time of day X chronotype effects may result from the ES' circadian oscillations transversally observed in all chronotypes^(4,5,6).
- Overall, results showed increasing mood levels from the first to the last hours of the school day regardless of chronotype, i.e., both in morning- and evening-types. Chronotype and time of day exerted independent effects on adolescent's ES, although some associations between chronotype and ES seem to be affected by sleep and/or PS. Rather than being a pure influence of inherent circadian-related factors, the relationship between chronotype and ES may have been influenced by the significant variability amongst chronotypes in our study regarding sleep and PS.
- Both chronotype and time of day didn't impact negative affect. Negative affect doesn't appear to be closely tied to circadian preferences and exhibits no consistent diurnal pattern, possibly due to the reactive nature of its underlying processes, depending on more external factors^(6,7).

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