Longitudinal associations between screen time, bedtime and daytime sleepiness among adolescents: A three-wave panel study

Michał Tkaczyk[1], Albert J. Ksinan[2], & David Smahel[1]

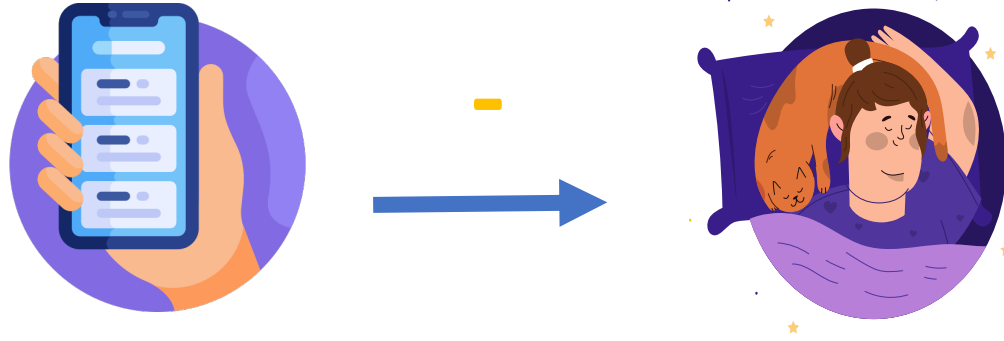[1]Interdisciplinary Research Team On Internet And Society, MUNI

[2] RECETOX, MUNI

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MINISTRY OF EDUCATION, YOUTH AND SPORTS

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Screentime and adolescent sleep

(for review see Hale & Guan, 2015; Lund et al., 2021)

Limitations of prior longitudinal research

- conflating between- and within-person variance in the observed variable (e.g., Tavernier & Willoughby, 2014)

- more theory-based evidence needed

- omission of potential moderators (e.g., sleep-related interventions) and subsequent sleep-related outcomes (e.g., daytime sleepiness)

Research questions

RQ1: What are the reciprocal between- and within-person associations between screen time, bedtime, and daytime sleepiness among adolescents?

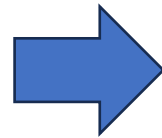**RQ2:** Are those associations different for younger and older adolescents?

RQ3: Does restricting screen time 1 hour before sleep make any difference?

Daytime sleepiness

Daytime sleepiness: a common direct consequence of insufficient sleep duration and poor sleep quality (Hansen et al., 2017)
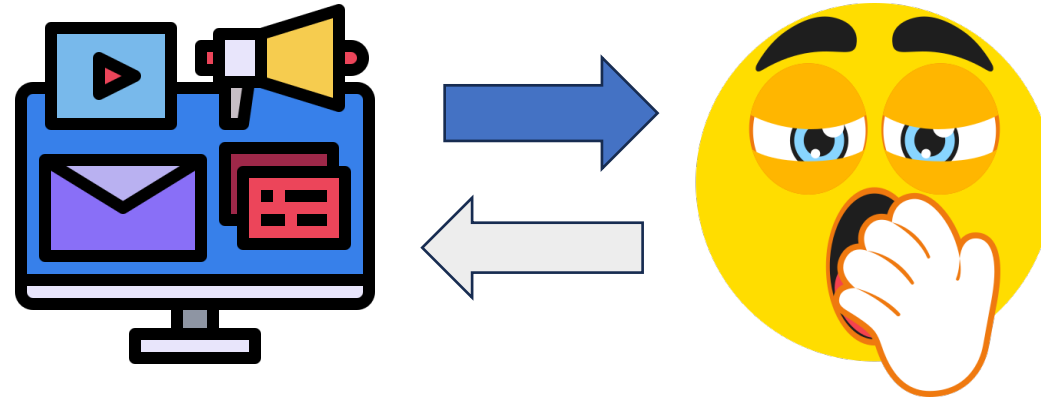
7.8 - 55.8%
(Pereira et al., 2010)

- negative school-related outcomes (e.g., Drake et al., 2011)
- lowered health-related quality of life (Gustafsson et al., 2016)
- sedentary behavior (Kim et al., 2020),
- mood disorders (Lofthouse et al., 2009)
- depressive symptoms and anxiety (Moore et al., 2009)

Screen time and daytime sleepiness

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Displacement hypothesis (ST → DS)

prolonged screen time → postponed bedtime → sleep restriction → a worsened daytime sleepiness

Coping tool / sleep aid (DS → BT)
People seek out media as a means of coping with their sleep problems (Tavernier & Willoughby, 2014; Eggermont & Van den Bulck, 2006)

Physical activity path
Daytime sleepiness → lower PA level → more screen time (Malheiros et al. 2020)
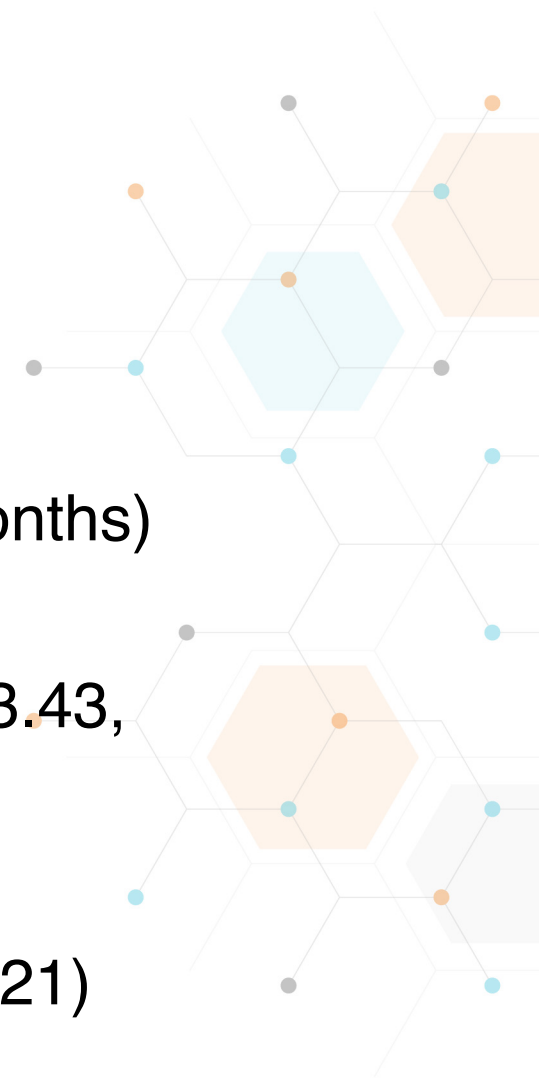
Methods

Study design

3-wave cross-sectional panel study (Wave 1 – June 2021, 6 months)

Sample

Czech adolescents (N=2,500 at Wave 1), aged 11-16, M_{age} = 13.43, 50% girl, N=1,102 at Wave 3

Analysis

RI-CLPM with the multigroup extension (Mulder & Hamaker, 2021)

Measures

Total screen time on a typical school day
"How much time (hours and minutes) do you spend doing the following activities during a regular school day?" [hh:mm]

Total Screen Time = PC or Notebook + Cell phone or Tablet + TV

ICT use before sleep at Wave 1
"*How long before going to sleep do you usually stop using all devices with a screen, i.e. phone, tablet, computer, television***?"** [hh:mm]

Bedtime on a typical school day
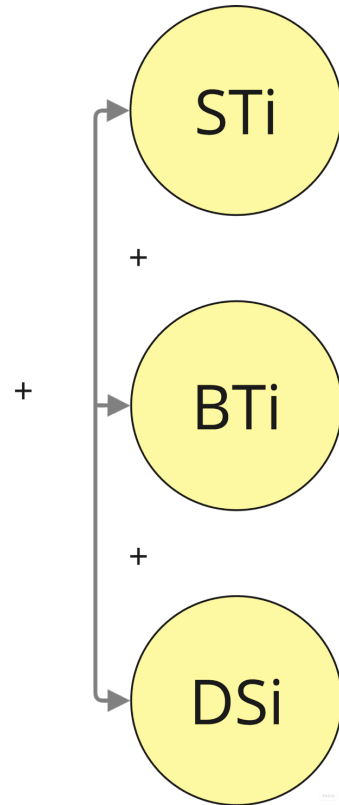*"When do you usually go to bed before schooldays?"* [hh:mm]

Daytime Sleepiness
The Pediatric Daytime Sleepiness Scale (5 items) [Drake et al., 2003]
e.g., *"You are tired and grumpy during the day"* (1-never – 5-very often)

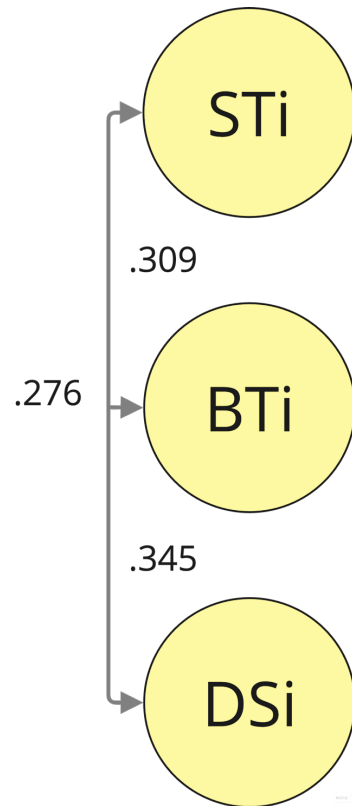# Results: Between-person effects

STi

BTi

DSi

ECREA 2024

Results: Between-person effects

STi

.309

.276 BTi

.345

DSi

$X^2(9) = 12.73$, *p* = .175, CFI = 0.999, RMSEA = .013, TLI = .997

Results: Within-person effects

Maksniemi et al. (2022)
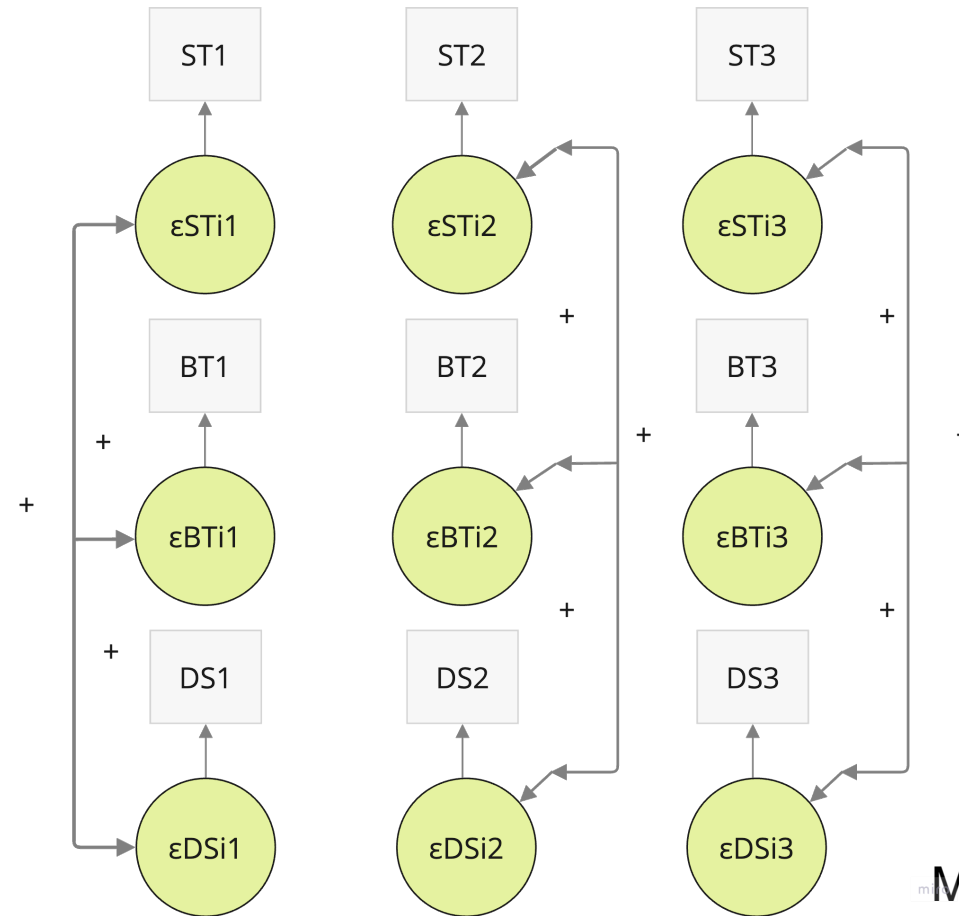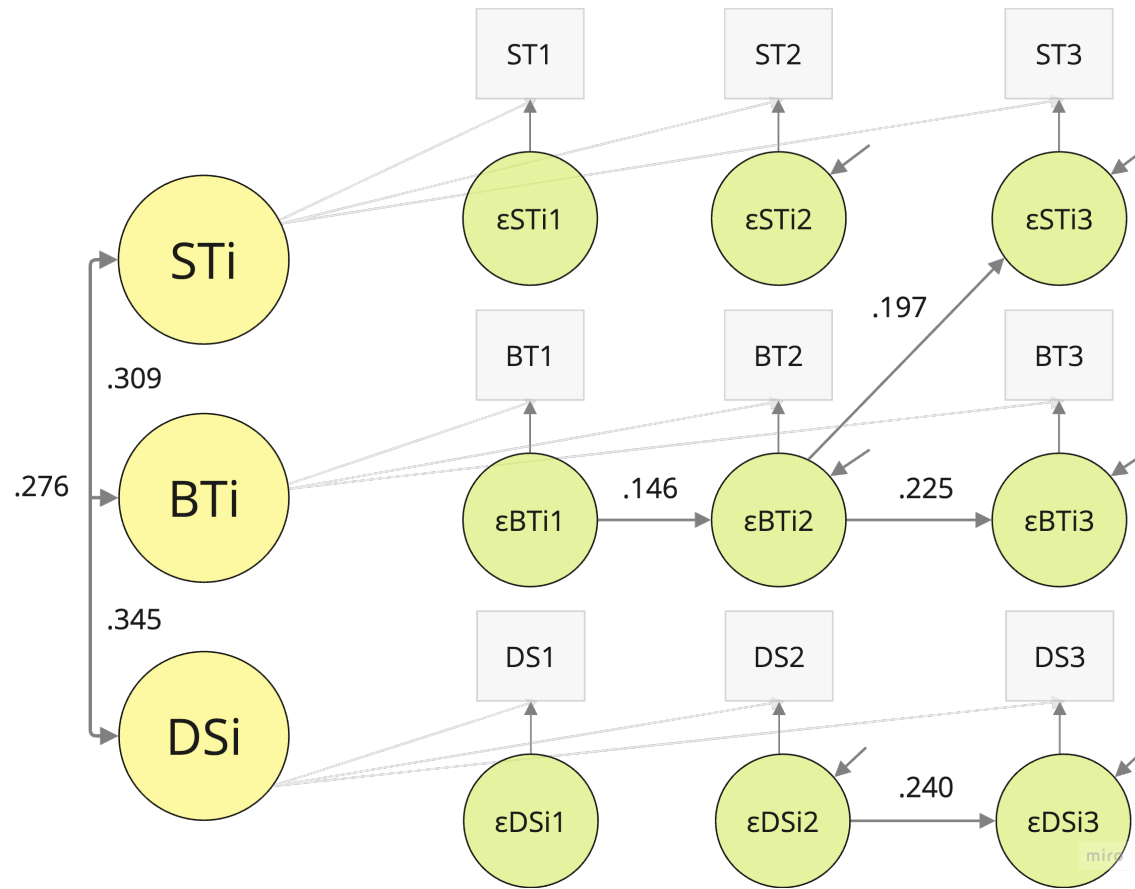
Results: Within-person effects
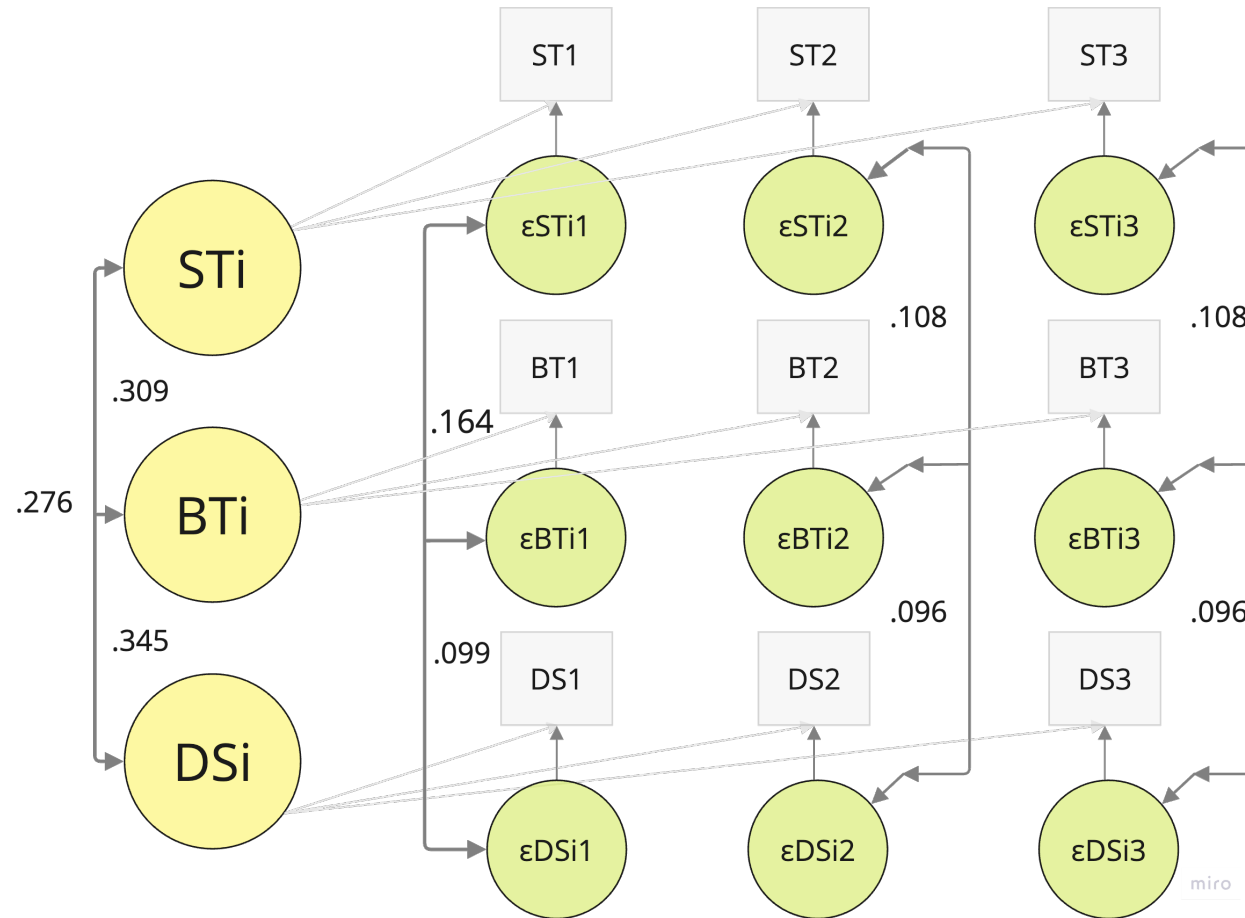
$X^2(9) = 12.73$, $p = .175$, CFI = 0.999, RMSEA = .013, TLI = .997

Results: Within-person effects

$X^2(9) = 12.73$, $p = .175$, CFI = 0.999, RMSEA = .013, TLI = .997

The role of age

Table 1 The effects of age on screen time, bedtime, and daytime sleepiness (RIs)

	11-13y	14-16y
Total screen time (hh:mm)	5:58	6:50
Bedtime (hh:mm)	9:34 PM	10:05 PM
Daytime sleepiness (1-5)	2.56	2.76

No effects of age neither for between- nor within-person associations between screen time, bedtime, and daytime sleepiness

The role of reducing screen time

Table 2 The effects of restricting screen time 1 hour before bedtime on screen time, bedtime, and daytime sleepiness (RIs)

	Not restricted	Restricted
Total screen time	6:31	6:05
Bedtime	9:56 PM	21:34 PM
Daytime sleepiness	2.70	2.56
RI_{ST} <-> RI_{DS}	.231***	.293***
RI_{ST} <-> RI_{BT}	.295***	.153
RI_{BT} <-> RI_{DS}	.345***	.200

No effects of screen time restriction in 1 hour before bedtime neither for between- nor within-person effects of screen time on bedtime and daytime sleepiness

Conclusions (preliminary)

- Total screen time was associated with later bedtime and higher daytime sleepiness (RIs, correlated change)

- Only a single cross-lagged effect was found (BT -> ST) - too large intervals between waves (?)

- Younger and older adolescents are equally vulnerable to adverse effects of screen time on bedtime and daytime sleepiness

- Restricting the screen time 1 hour before bedtime time could actually work

References

Drake, C., Nickel, C., Burduvali, E., Roth, T., Jefferson, C., & Badia, P. (2011). *Pediatric Daytime Sleepiness Scale* [Dataset]. https://doi.org/10.1037/t02761-000

Eggermont, S., & Van Den Bulck, J. (2006). Nodding off or switching off? The use of popular media as a sleep aid in secondary-school children. *Journal of Paediatrics and Child Health*, *42*(7–8), 428–433. https://doi.org/10.1111/j.1440-1754.2006.00892.x

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Medicine Reviews*, *21*, 50–58. https://doi.org/10.1016/j.smrv.2014.07.007

Hansen, S. L., Capener, D., & Daly, C. (2017). Adolescent Sleepiness: Causes and Consequences. *Pediatric Annals*, *46*(9). https://doi.org/10.3928/19382359-20170816-01

Lund, L., Sølvhøj, I. N., Danielsen, D., & Andersen, S. (2021). Electronic media use and sleep in children and adolescents in western countries: A systematic review. *BMC Public Health*, *21*(1), 1598. https://doi.org/10.1186/s12889-021-11640-9

Malheiros, L. E. A., Da Costa, B. G. G., Lopes, M. V. V., Chaput, J.-P., & Silva, K. S. (2021). Association between physical activity, screen time activities, diet patterns and daytime sleepiness in a sample of Brazilian adolescents. *Sleep Medicine*, *78*, 1–6. https://doi.org/10.1016/j.sleep.2020.12.004

Mulder, J. D., & Hamaker, E. L. (2021). Three Extensions of the Random Intercept Cross-Lagged Panel Model. *Structural Equation Modeling: A Multidisciplinary Journal*, *28*(4), 638–648. https://doi.org/10.1080/10705511.2020.1784738

Pereira, É. F., Teixeira, C. S., & Louzada, F. M. (2010). Sonolência diurna excessiva em adolescentes: Prevalência e fatores associados. *Revista Paulista de Pediatria*, *28*(1), 98–103. https://doi.org/10.1590/S0103-05822010000100015

Tavernier, R., & Willoughby, T. (2014). Sleep problems: Predictor or outcome of media use among emerging adults at university? *Journal of Sleep Research*, *23*(4), 389–396. https://doi.org/10.1111/jsr.12132

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Michal Tkaczyk, PhD
tkaczyk@fss.muni.cz
Interdisciplinary Research Team
on Internet and Society

Thank you for your attention!