Light as a Reactive Countermeasure to Sleep Inertia: Translating Laboratory Findings to the Field

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Fatigue Management and Mitigation: Perspectives for Safety and Reporting Webinar

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What is sleep inertia?

Impaired alertness and cognition upon waking

Proactive countermeasures

- Avoid prior sleep loss
- Avoid waking near circadian low
- Keep naps short

Often unviable

Reactive countermeasures

Field deployable, rapid acting

Photo source: Powerpoint

Light

- Phase shifting; acute alerting effects
- Less effective during the day
- Previous research during daytime sleep inertia (SI) periods unsuccessful (Santhi et al., 2013; Hayashi et al., 2003)

Could light at night be effective for SI?

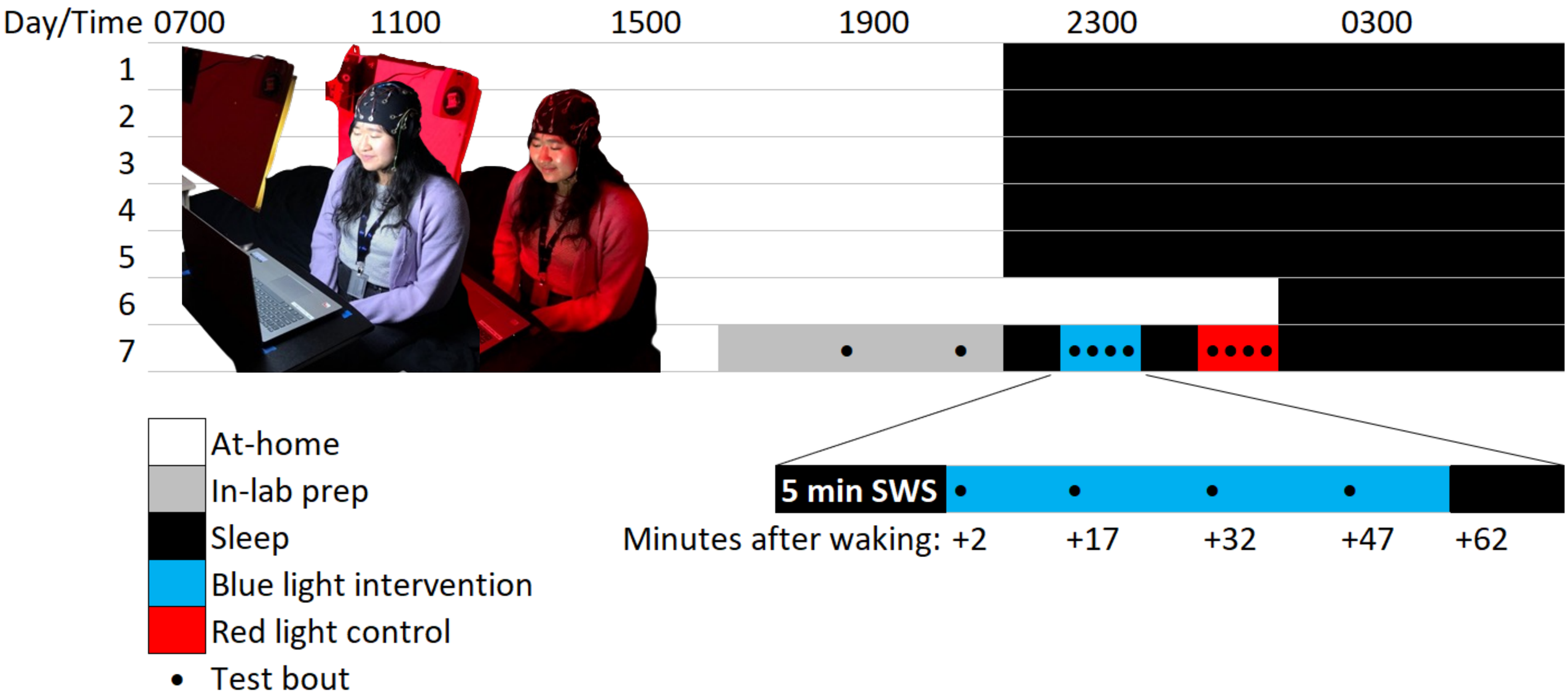
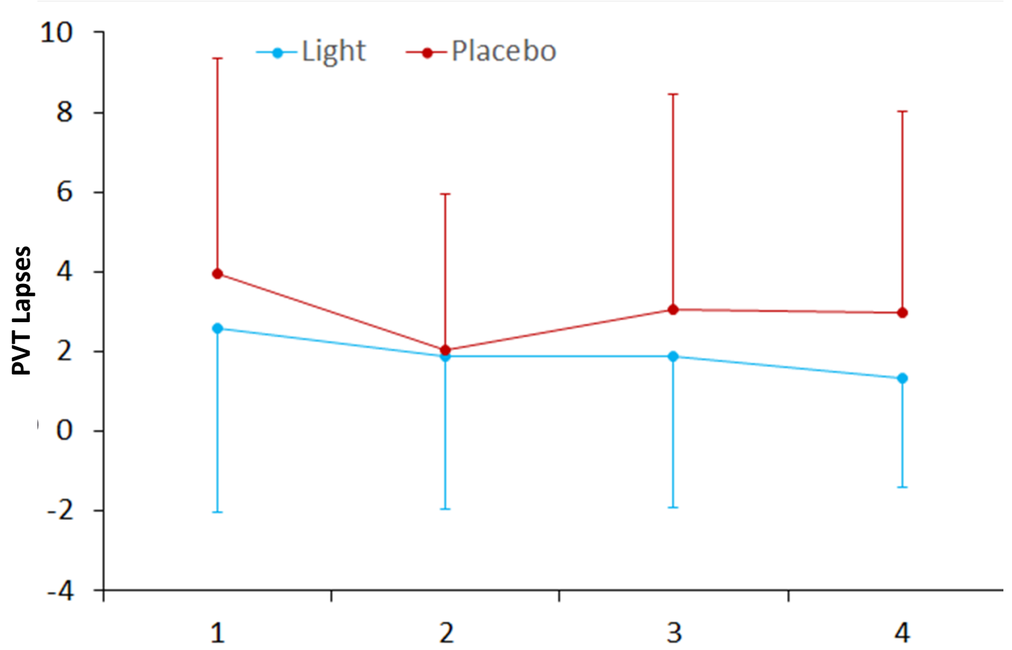


Photo source: C. Hilditch

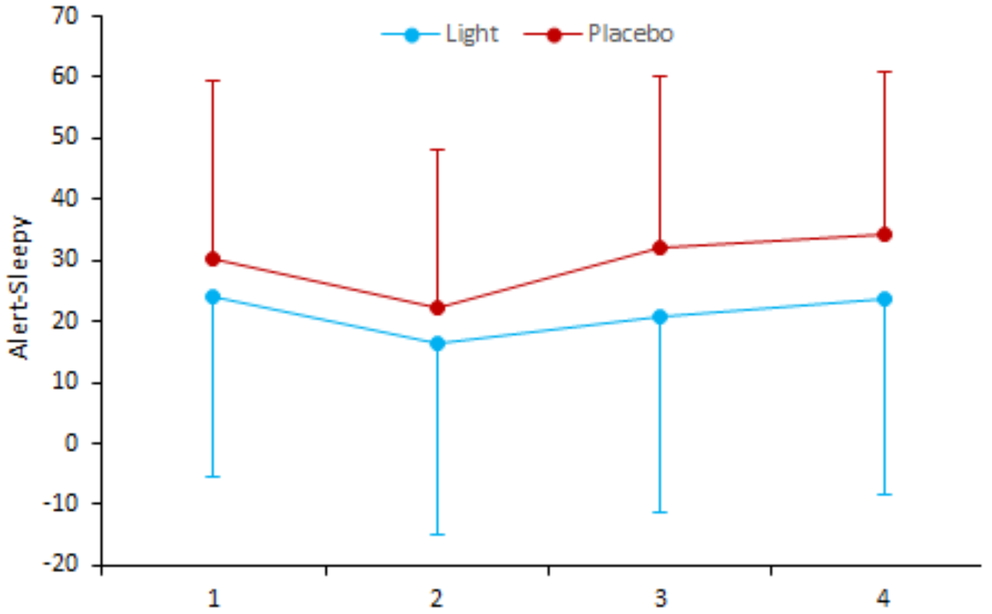
Results

Improved performance, alertness, & mood following SWS

Lapses



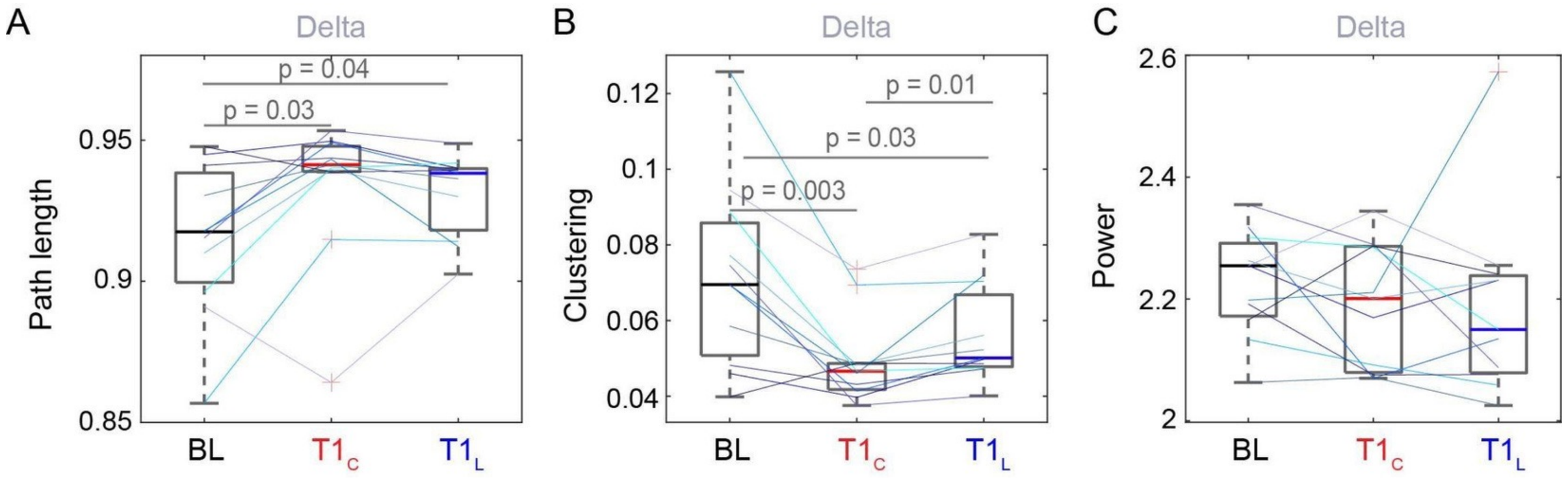
Sleepiness



Hilditch et al., 2022 *J Sleep Res*

Neural mechanism

- Path length increases; clustering decreases after waking in delta band
- Light ameliorates these changes
- Does not appear to act on power



Hilditch / Bansal et al., 2022 *Network NeuroSci*

Translational Aim:

To test the efficacy of exposure to a blue-enriched light upon waking from sleep at night to improve alertness, mood, and cognitive performance in an at-home setting

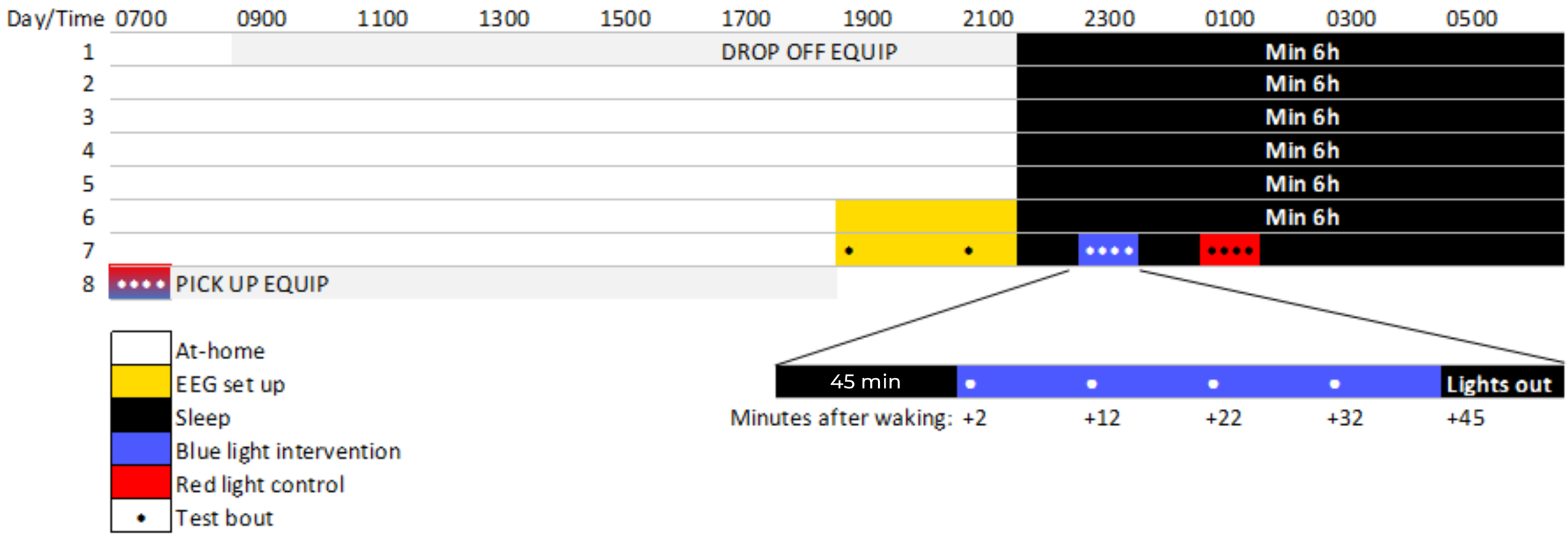
Participants

N = 36 completed (*n* = 2 excluded)

- 18 Female
- 26.2 ± 5.9 (18-40) years
- General Health Questionnaire, psychiatric questionnaires (e.g., BDI, STAI)
- Min. 6h time-in-bed; bedtime 9am-3am

One-week at-home study

- Nights 1-7: Actiwatch, sleep diary
- Night 6: EEG habituation, set up equipment, practice tests
- Night 7: BL, intervention, testing, EEG



Translation to the field

Photo source: C. Hilditch, Cerebra, Lucimed

Photo source: C. Hilditch

Outcome measures

- Psychomotor Vigilance Task (PVT)
- Descending Subtraction Task (DST)
- Karolinska Sleepiness Scale (KSS)
- Mood (visual analog scales)

Analysis

- Mixed-effects models
- Fixed effects: Condition, Test, C*T
- Random effect: Participant
- Covariates: Order, Sex, Baseline, Prior sleep

Results

No differences in sleep between conditions

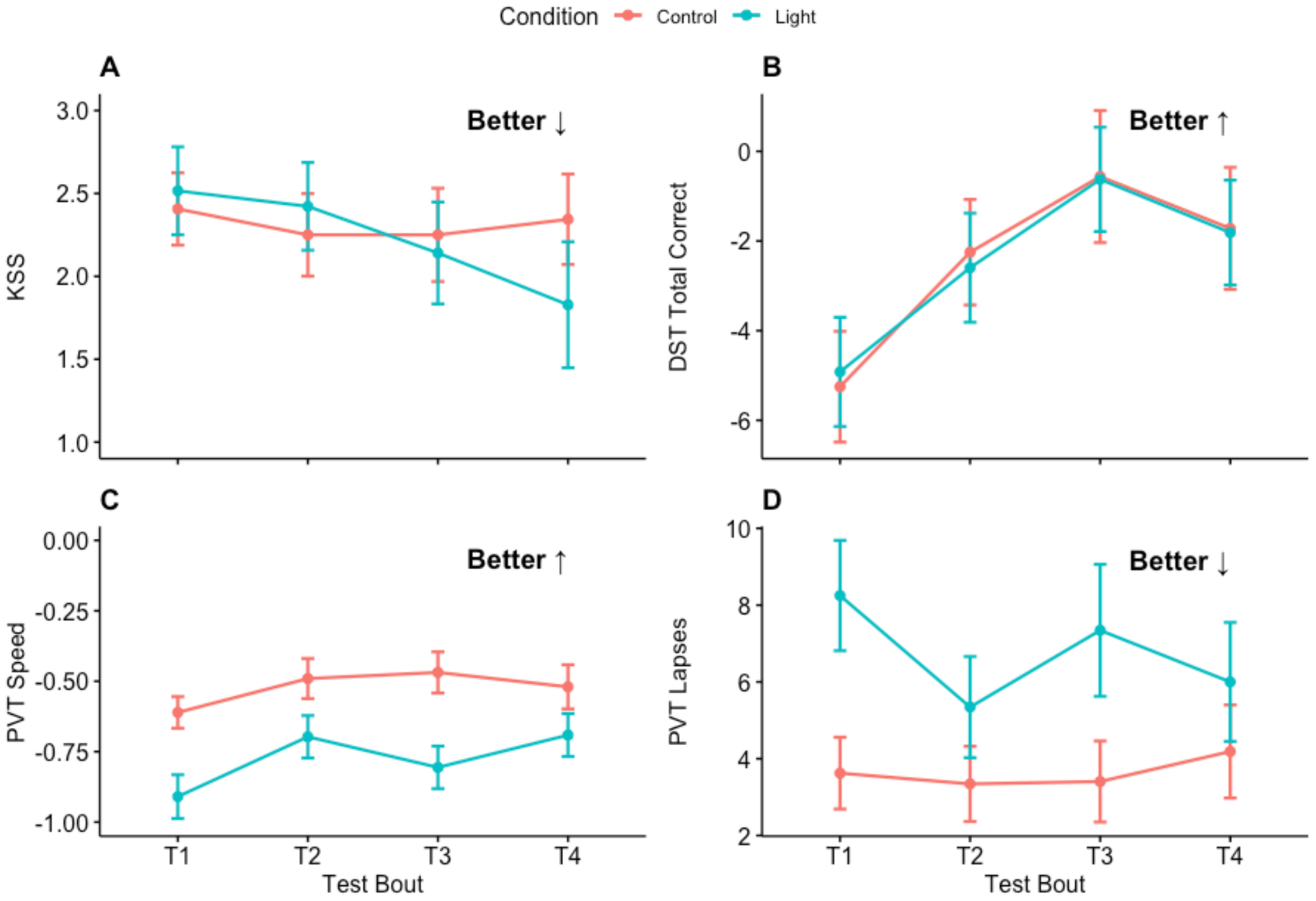
Sleep stage at wake-up

	Light	Control
N1	6	4
N2	7	9
N3	19	18
REM	1	1
Wake	1	2
TST (min)	34.3	30.5

Hilditch et al., under review

Results

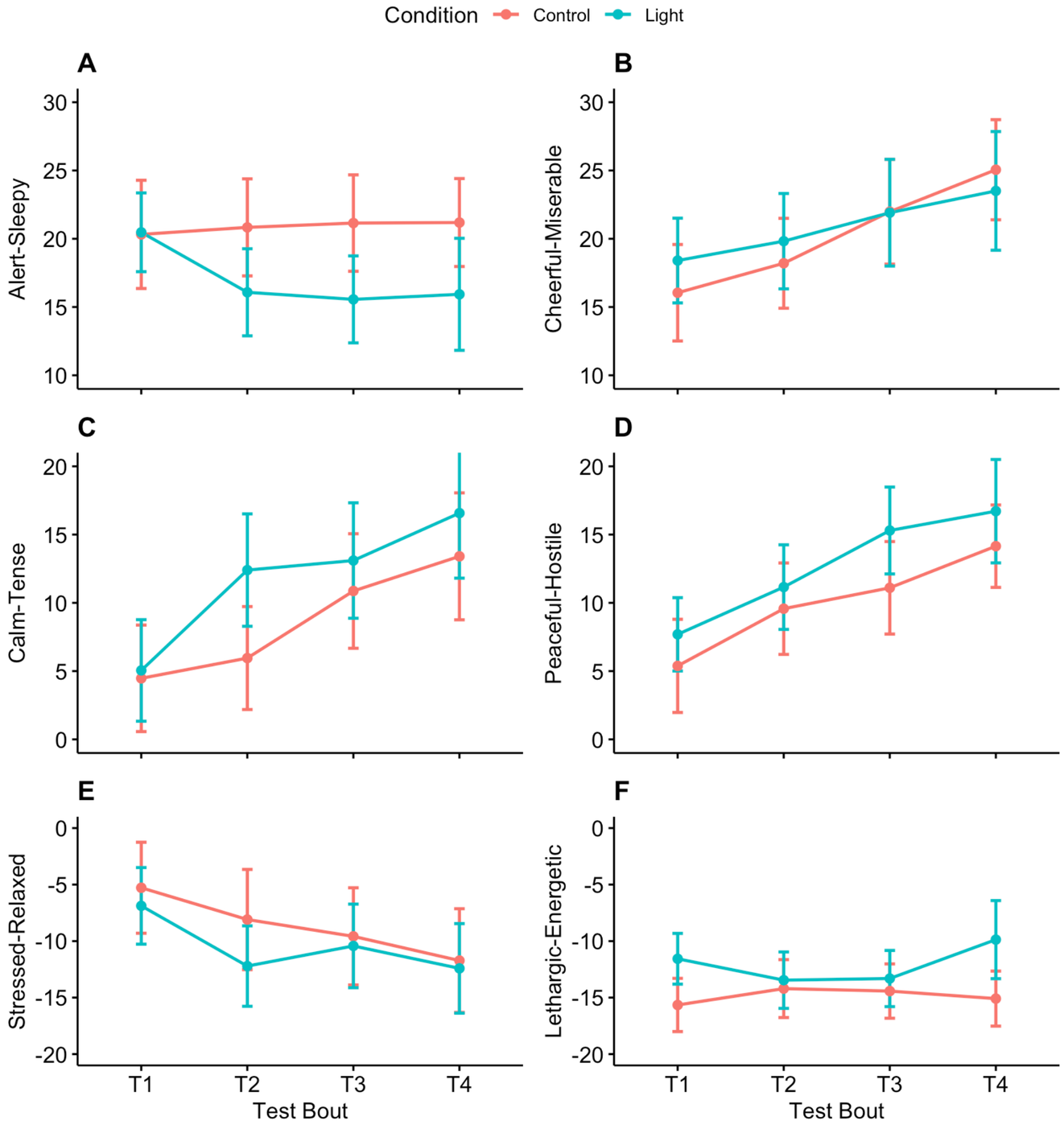
No difference or worse cognitive performance



Hilditch et al., under review

Results

Improved alertness and energy



Hilditch et al., under review

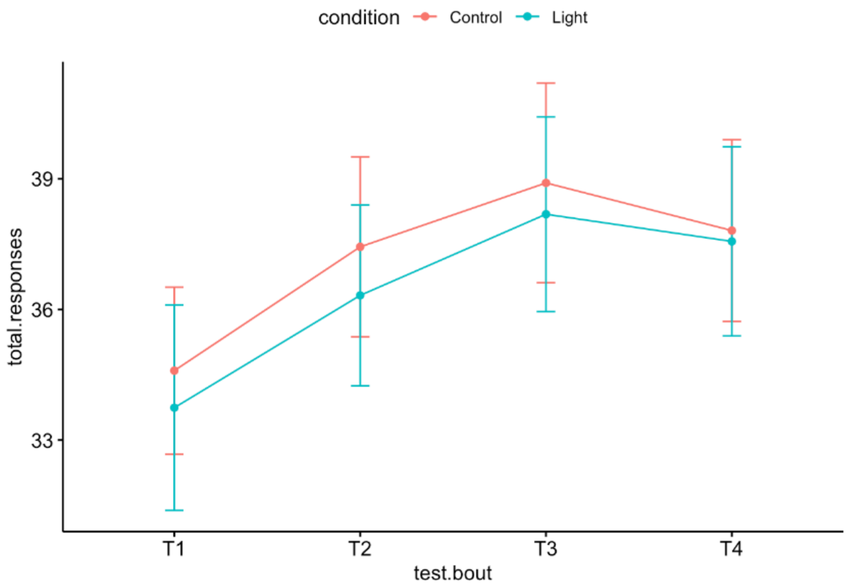
Results

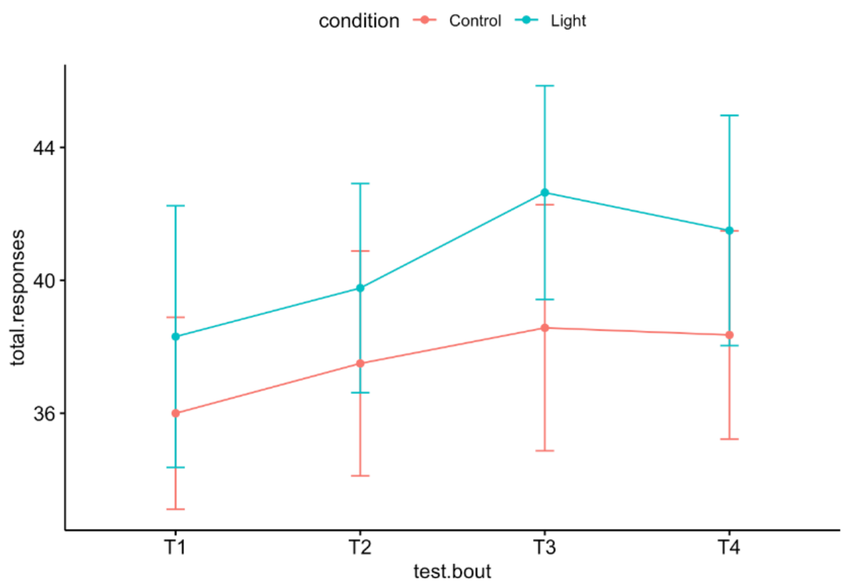
DST and mood improved with light after waking from N3

All

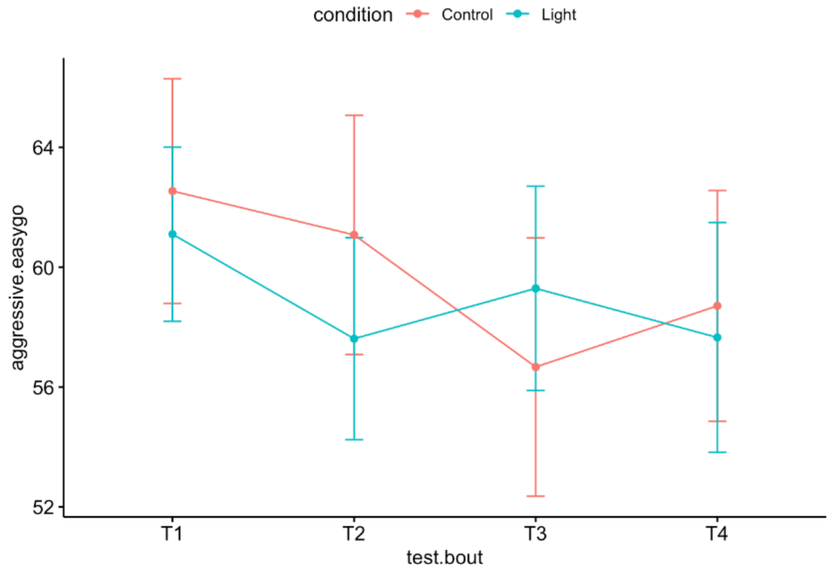
N3 only

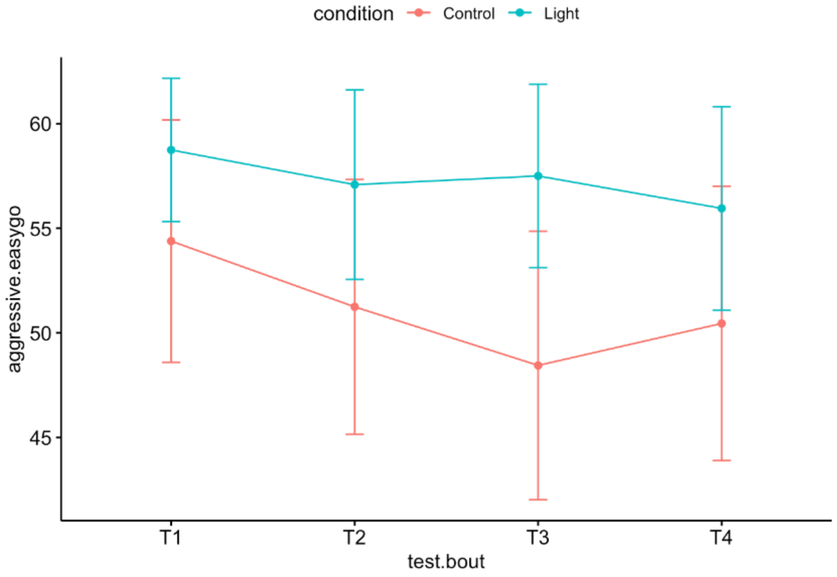
DST





MOOD

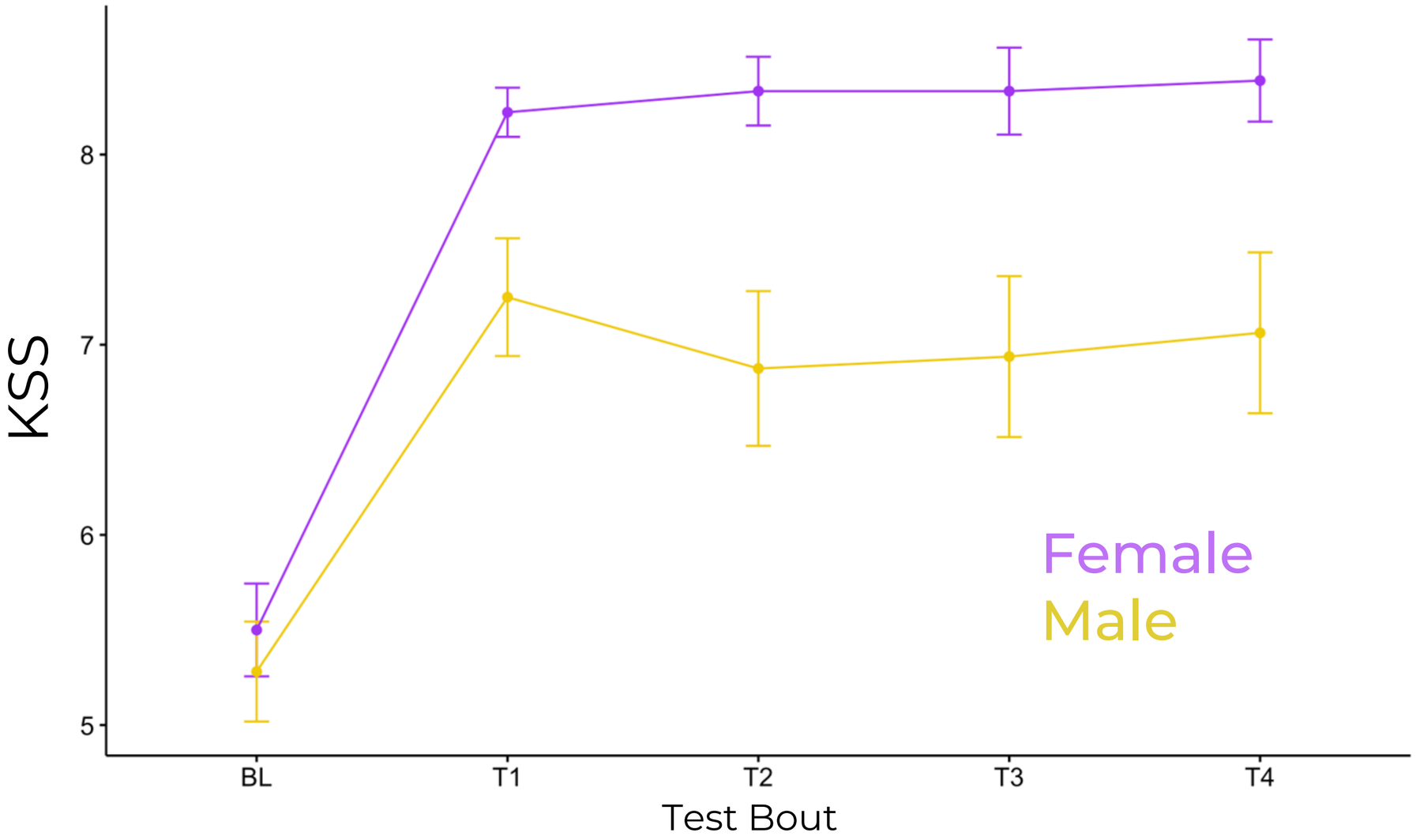




Hilditch et al., under review

Results

Females rated themselves as sleepier after waking

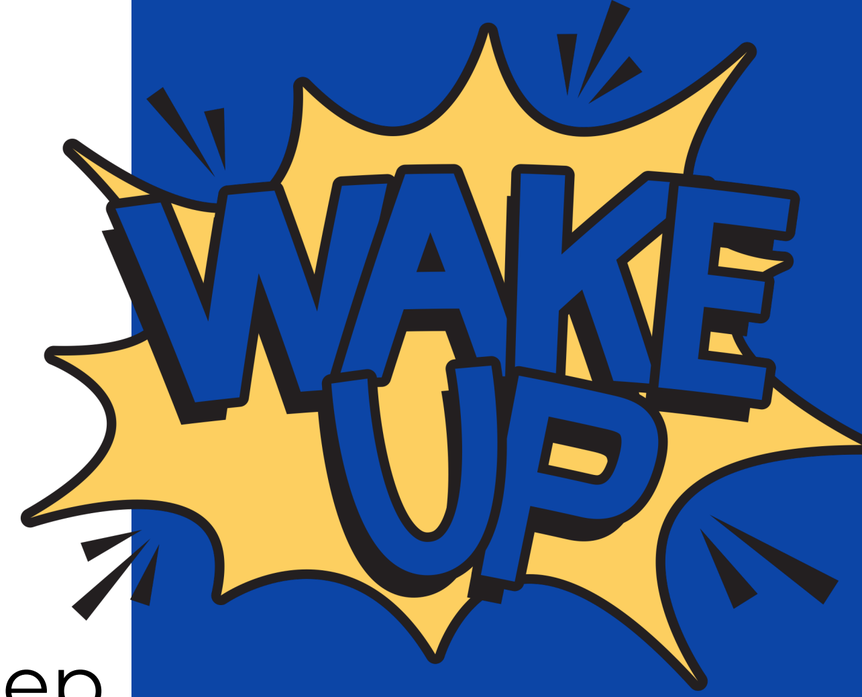


Hilditch et al., 2022 *Sleep Advances*

Discussion

- Light modestly improved working memory, alertness, and mood in an at-home setting, esp. when waking from deep sleep
- Sex differences in the perception of sleep inertia
- Light alters brain network connectivity

- Visual acuity, comfort?
- Different devices/exposures, sleep/wake scenarios, cognitive domains?



THANK YOU

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