
The Effect of Fading-In Light Transitions to Induce Micro-Refresh on Intellectual Work

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Research Background



Importance of improving
intellectual productivity

Studies emphasizing the importance of breaks

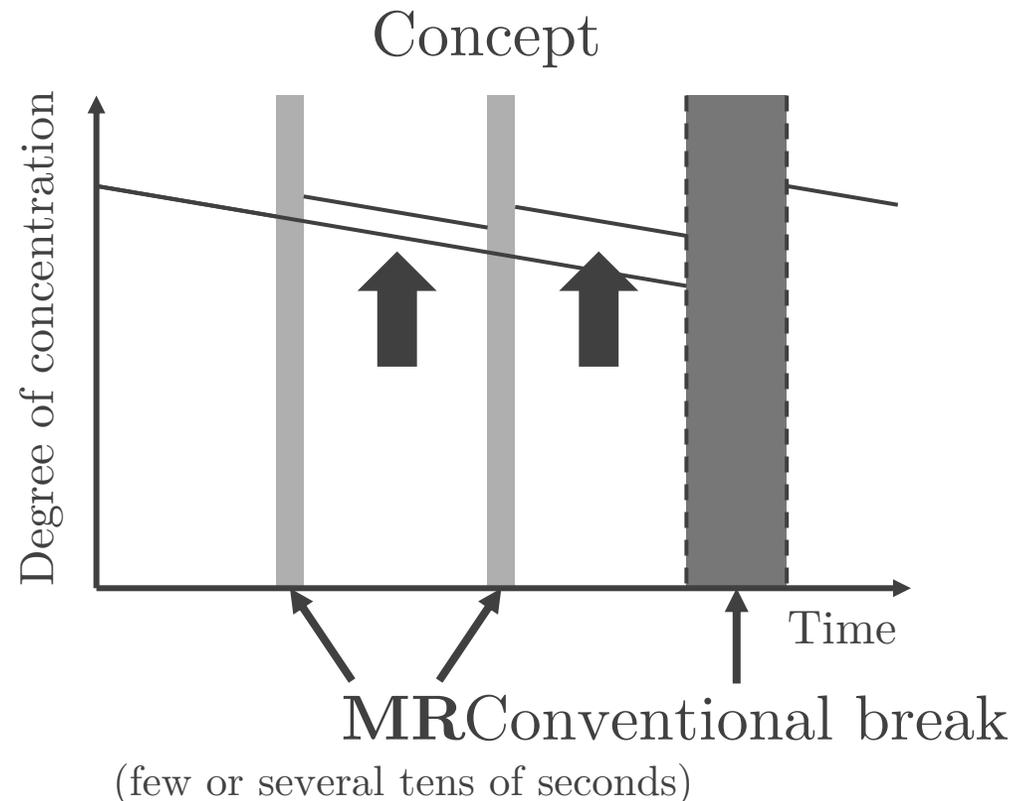
- 10-min. break during an hour of work
(Lim & Kwok, 2016)
- exposure to natural stimuli
(Kristin et al., 2016)
- 5 min/30 min or 10 min/1 h break
(Kopardekar & Mital, 1994; Balci & Aghazadeh, 2003)



Research Gap & Aim

Micro-Refresh (MR)

(Dianita et al., 2024; Kitayama et al., 2023)



Not yet fully understood about

- effects and mechanism of action
- stimuli that effectively induce MR

Research Aim

Explore whether lighting changes can contribute to promoting MR and improving intellectual productivity

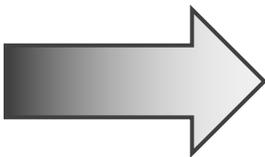


Lighting Environments

Work period



Task & ambient lighting
enhancing intellectual concentration
and immersion (Obayashi et al., 2016)


Fading-in
(reduce glare)

MR period

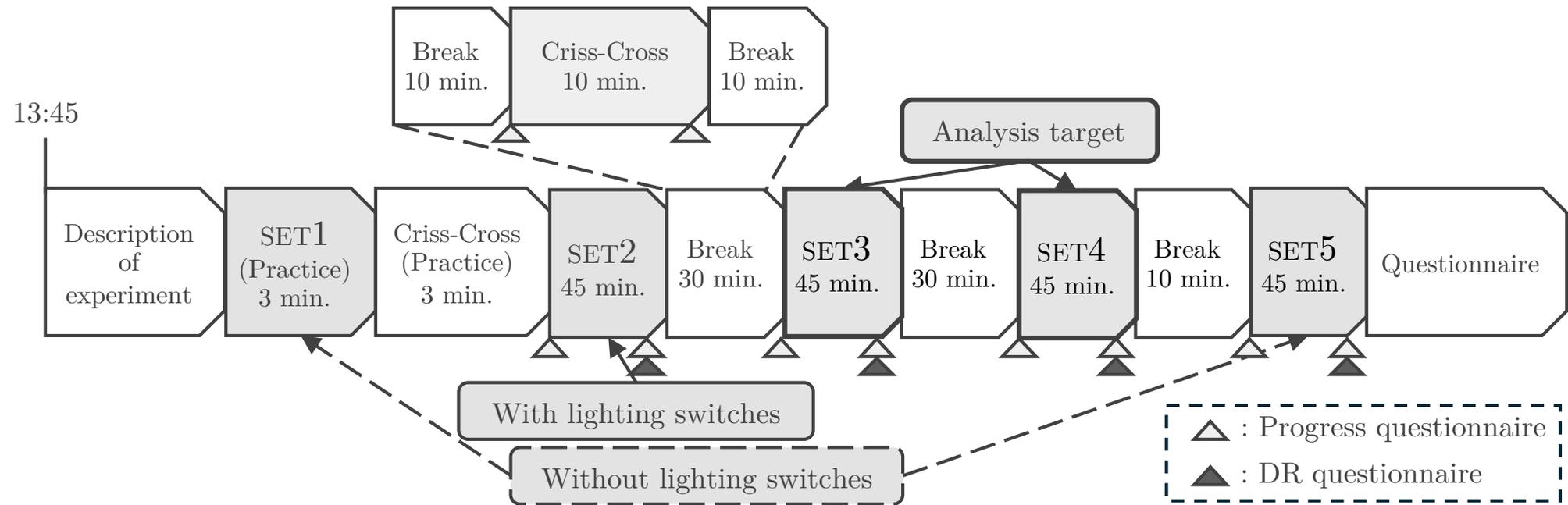


High-intensity lighting
improving vitality and
physiological arousal (Smolders et al., 2012)



Experimental Design

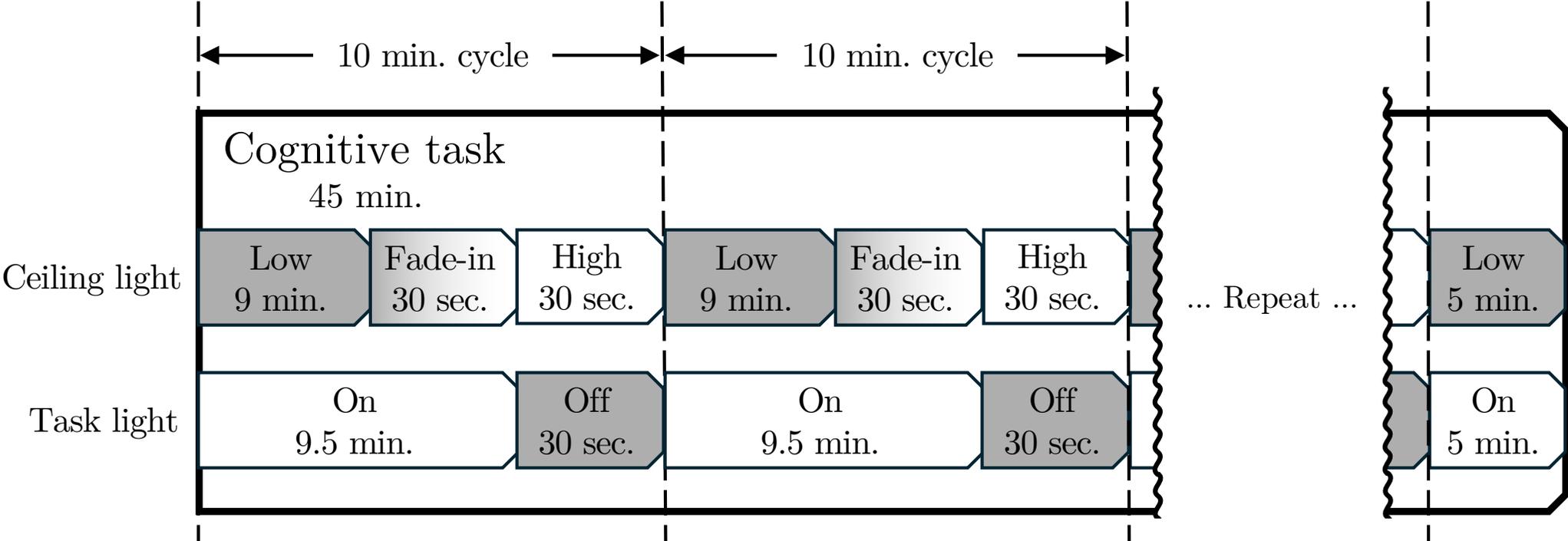
- Verify whether the switching designed to induce MR contributes to maintaining the intellectual concentration
- 7 Kyoto University students participated
- Conducted several comparison task (Ueda et al., 2016) SETs



Lighting Change

SET
45 min.

with lighting switches:



Measurements

CTR (Concentration Time Ratio, %)

- indicator to quantitatively evaluate intellectual concentration calculated from the answer time data of cognitive task

Subjective fatigue and concentration levels

- conducted questionnaire before and after each SET
- uses a Visual Analog Scale with integer values ranging from 0 to 100

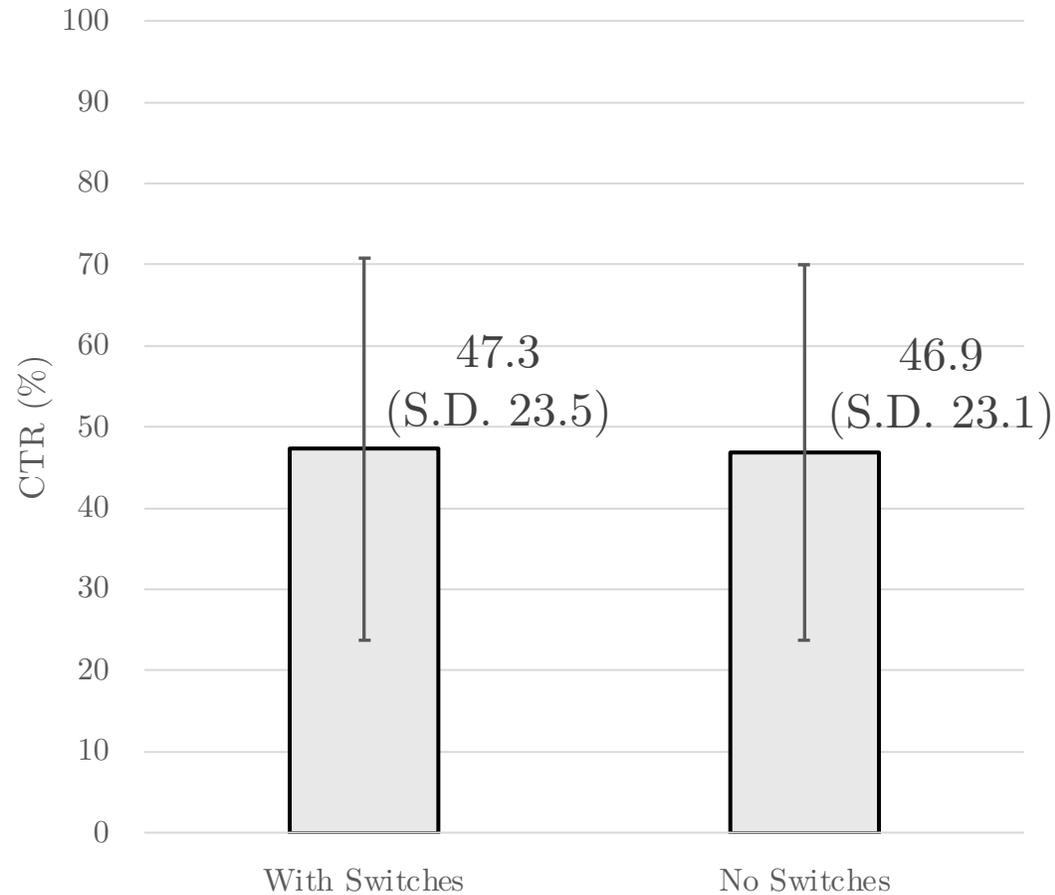
Subjective detachment and refreshment levels

- conducted questionnaire after each SET
- uses a 5-point Likert scale

Post-experiment questionnaire



Results: CTR

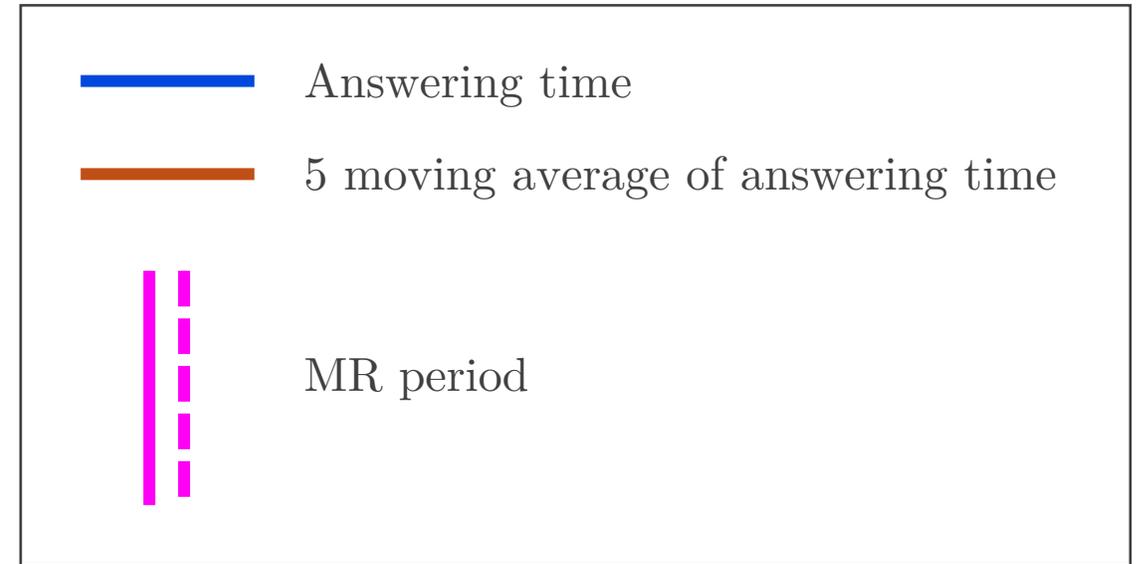
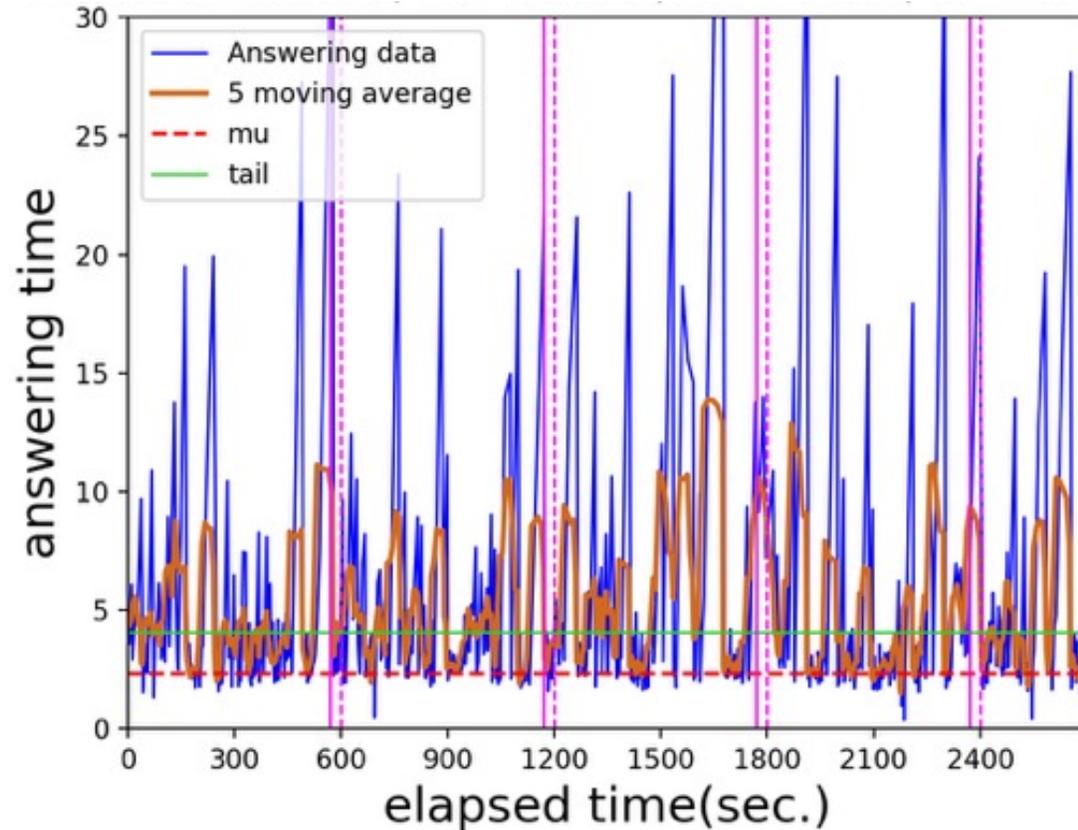


Group	ID	Improved CTR
1	2	-11.7
	4	10.8
	6	7.4
2	3	5.9
	5	-2.6
	7	-13.8
	8	7.0
Average		0.4

- The average CTR was slightly higher with changes
- **4 participants** exhibited an improvement in CTR
- **Variation** among participants



Results: Comparison Task



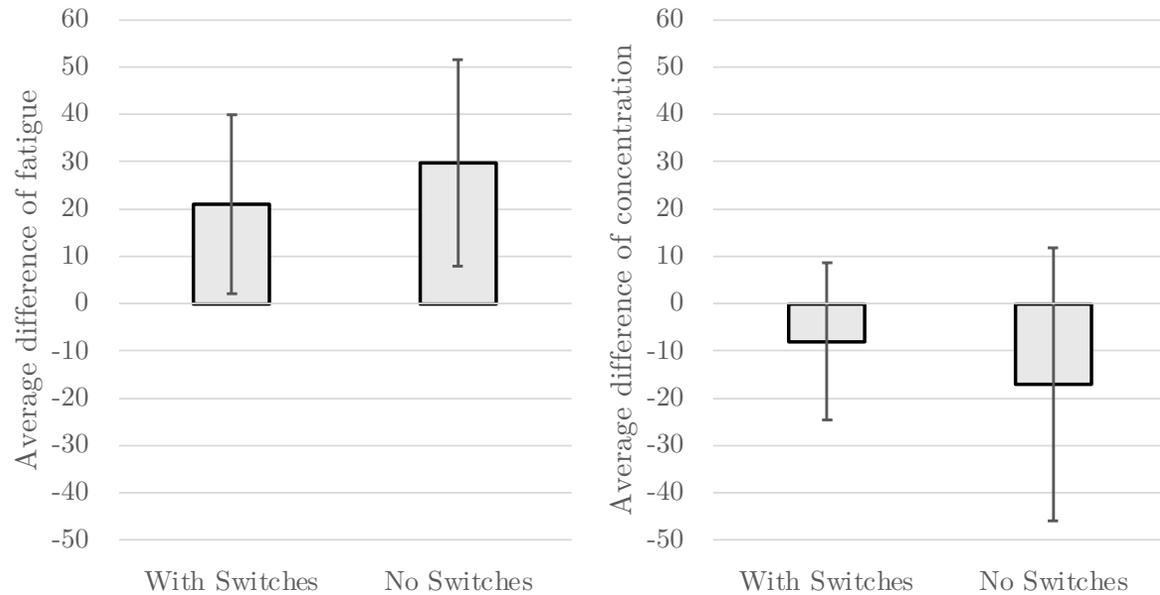
- Some participants **continued to answer** without pausing, even during the designated micro-refresh periods

Result of task for ID6 under the lighting switch condition

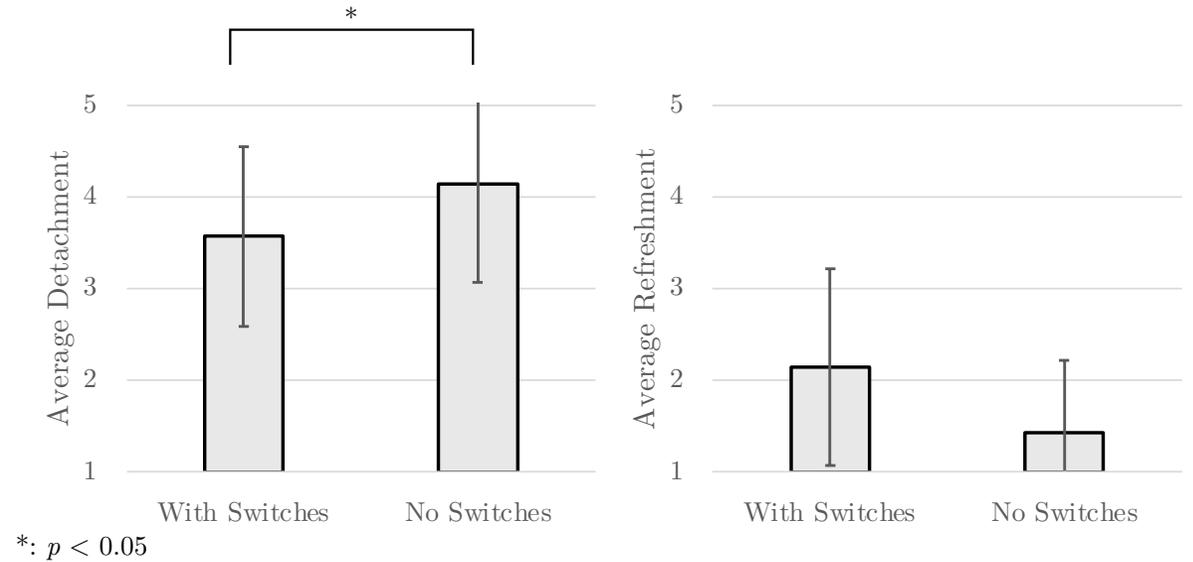


Results: Subjective Measurements

Fatigue and concentration levels



Detachment and refreshment levels



Results: Post-Experiment Questionnaire

Impressions of each SET

- ‘When there was no change, my concentration decreased halfway through’ (ID6)
- ‘felt my concentration increase when switching from brighter to darker’ (ID8)
- ‘I was able to maintain my concentration’ (without changing) (ID7)
- ‘When switched to darker, I thought the task was over and my mind wandered’ (ID5)

The lighting environment during the work period

- 6 participants gave a positive response

Refreshing feeling and comfort caused by the lighting changes

- 5 participants gave positive responses to both



Discussions & Future Work

Discussions

- Lighting switching may contribute to subjective refreshment and sustained concentration
- Work-period lighting was evaluated as conducive to concentration
- Lighting transitions did not hinder work

Limitation & Future Work

- Small sample size and large individual differences in CTR
→ Increase number of participants
- Some participants did not utilize MR periods as intended
→ Explicitly explain MR intention before experiments to encourage active use of MR periods
- Further validation of effects on concentration and refreshment

