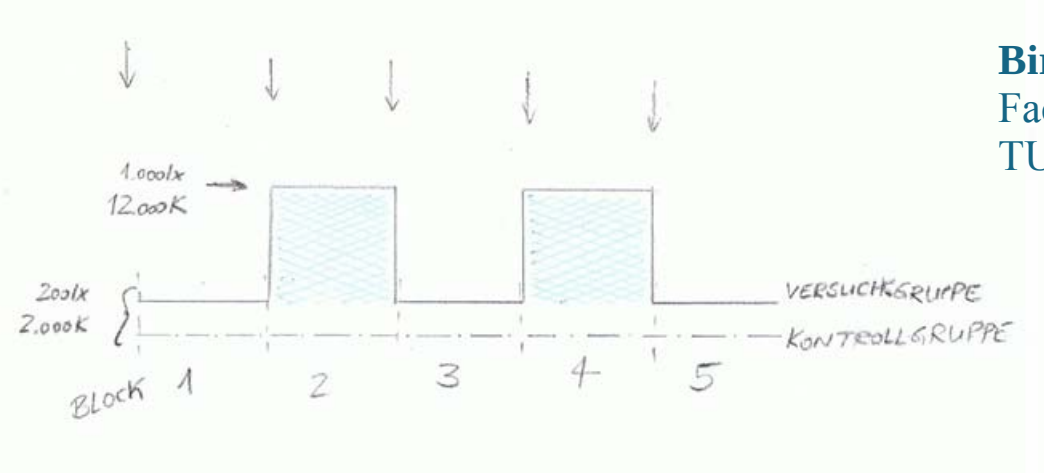
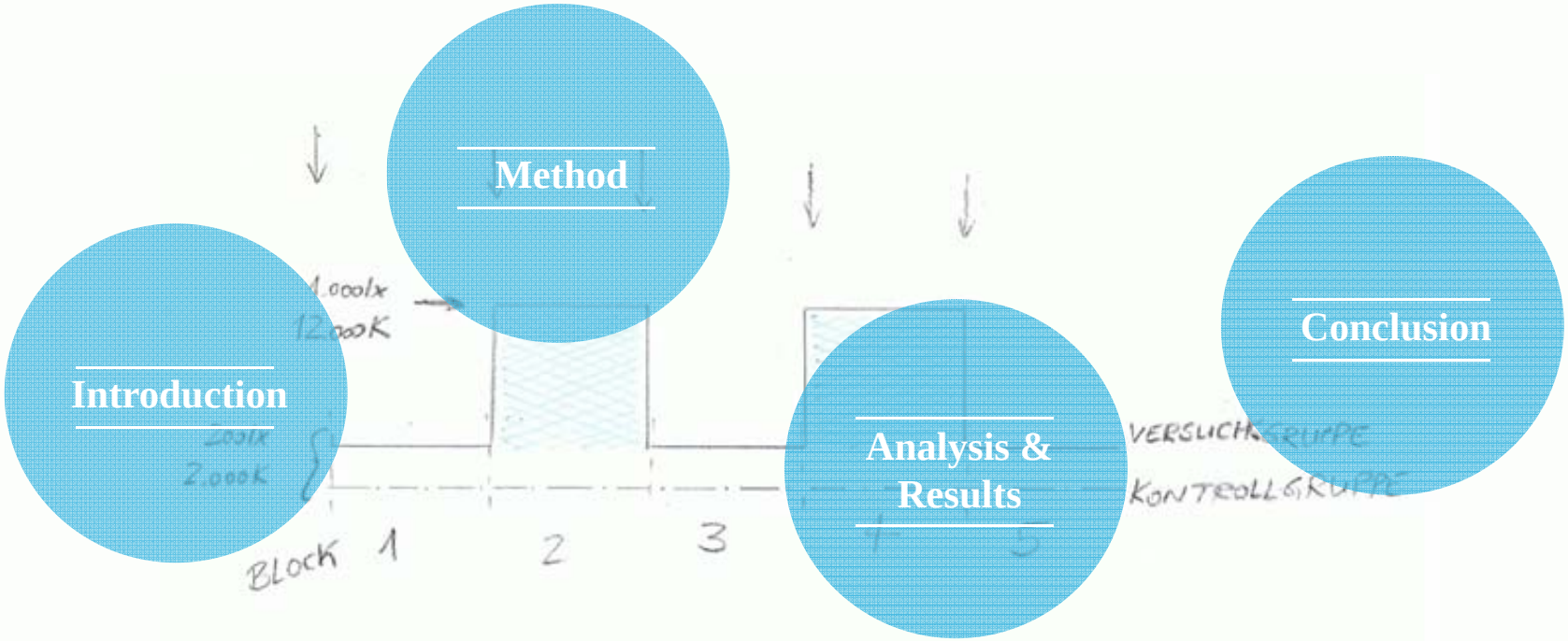
Lux Junior | 09. September 2017

“Can dynamic light changes of light level and spectral power distribution improve alertness and well-being?”

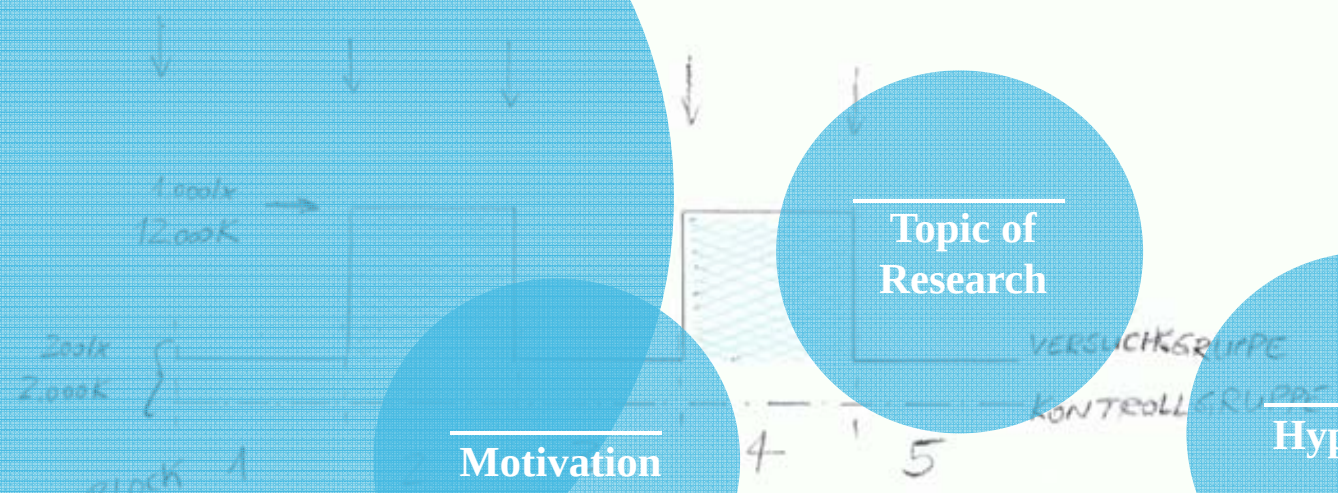


Birte Saathoff, Inga Rothert
Fachgebiet Lichttechnik
TU Berlin

Technische Universität Berlin



Introduction

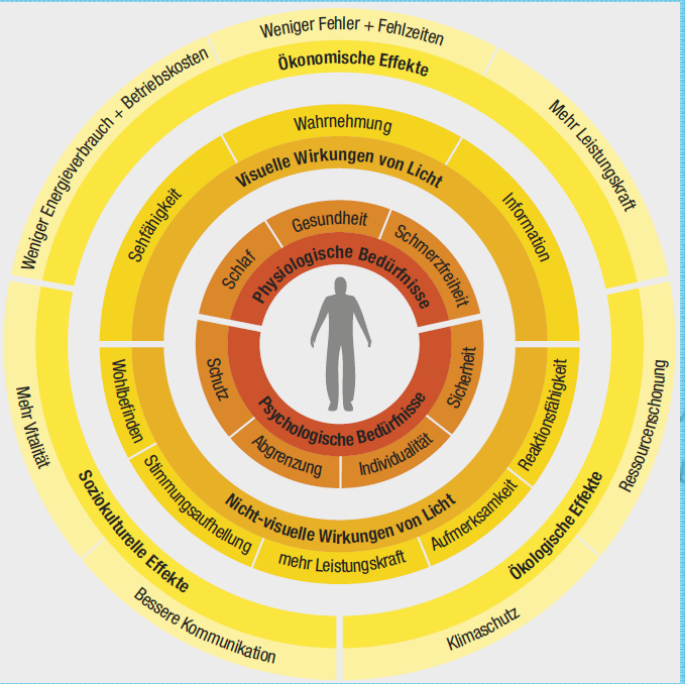


Motivation

Topic of Research

Hypothesis

Motivation



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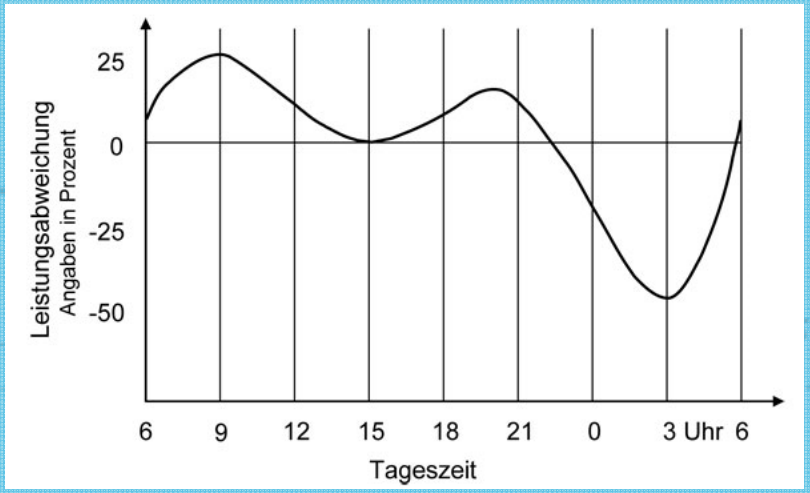
Motivation



Circadian Physiological Performance Rate
(Hildebrandt et.al, 1998)

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Motivation

Effects of light on alertness	
static	**dynamic**
High light level (Smolders, Kort 2014, Cajochen 2007) Higher short wavelength rate (Keis et al. 2014, Shamsul et al. 2013, Mills et al. 2007)	Short dynamic changes in light (Chang et al. 2012)

Topic of Research

Can dynamic light changes of light level and spectral power distribution improve alertness and well-being during the physiological afternoon sleepiness?

Control Variables:

Room Temperature, Concentration of CO2
Experience with concentration tests
Age, sicknesses …

Independent Variables:

Light level
Spectral power distribution

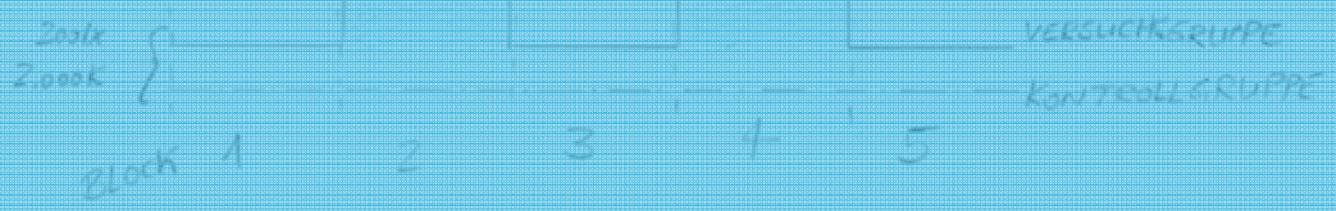
Experiment

Dependent Variables:

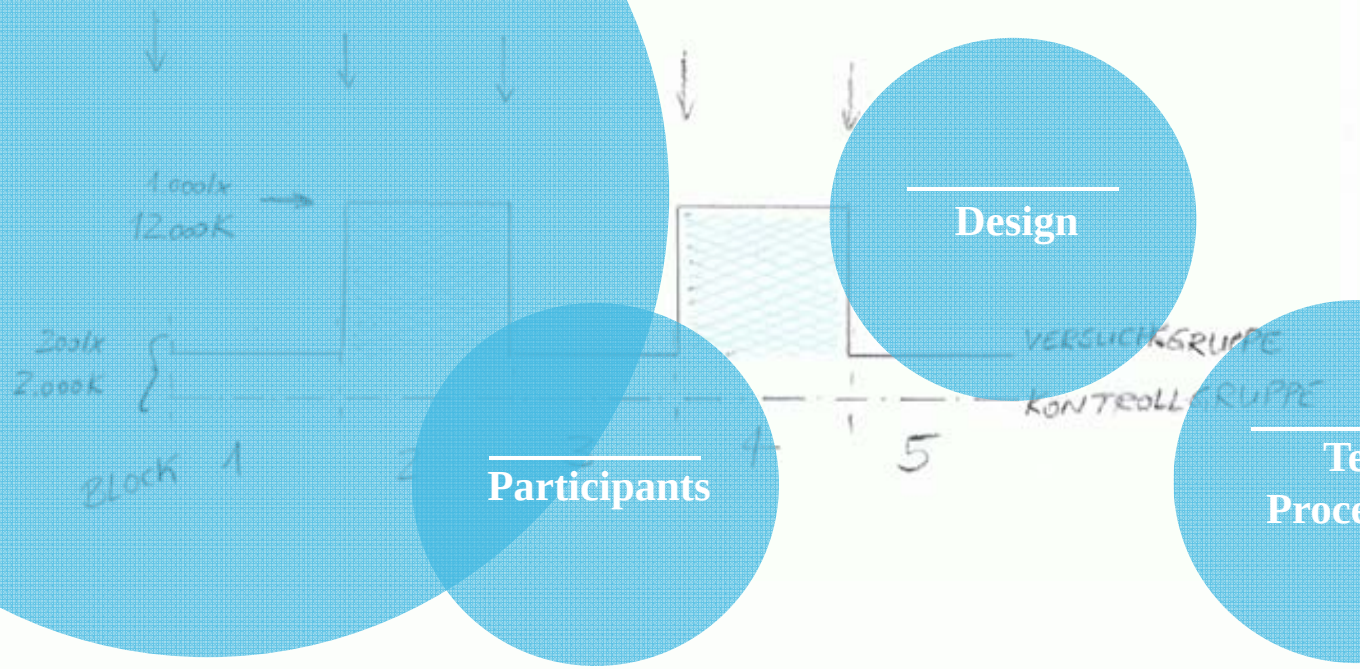
Alertness
Well-being

Hypothesis

Dynamic light changes of light level as well as spectral power distribution can improve alertness and well-being during the physiological afternoon sleepiness.



Method



Design

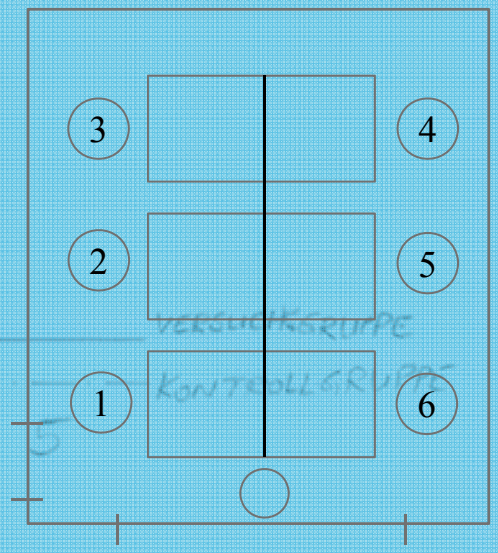
Participants

Test Procedure

Participants

- 61 Participants (32 female)
- age: 18 – 30 years (average age 24,5)
- 31 Part.: Experimental Group
- 30 Part.: Control Group

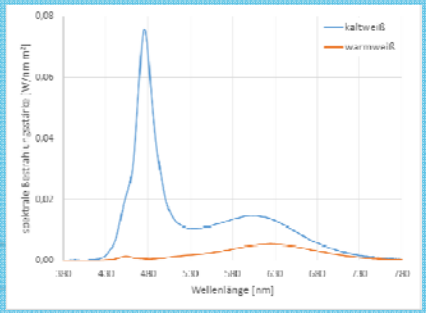
- duration: 9.00 – 9.45 am and 14.00 – 15.30 pm
- from Jan – March 2017
- max. 6 participants per experiment + test leader
- Randomly assigned to light scene and seat
- 20 € compensation for participation



Design – Experimental Setup

Lightscene	used for Control Group	used for Experimental Group	E_v	CCT	a_{mel}
Warm White	Yes	Yes	200 lx	2.200 K	0,29
Cold White	No	Yes	1.000 lx	12.000 K	1,59

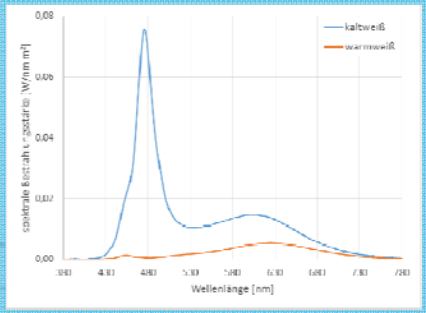
+ light signal



Design – Experimental Setup

Lights	mental up	a_{mel}
Warm W	es	0,29
Cold W	es	1,59

+ light signal



Design – Operationalisation

Independent Variable	Dependent Variable		Examination Method
Static vs. Dynamic Light Scene	Alertness		d2-R-Test, Auditive Go-NoGo-Test
	Well-being	Subjective sleepiness	Questionnaire (KSS)
		Subjective feeling of level of concentration, stress and motivation	Questionnaire

Design – Operationalisation

Independent Variable	Dependent Variable	
Static vs. Dynamic Light Scene	Alertness	
	Well-being	Subjective Subjective concentrat motivatio

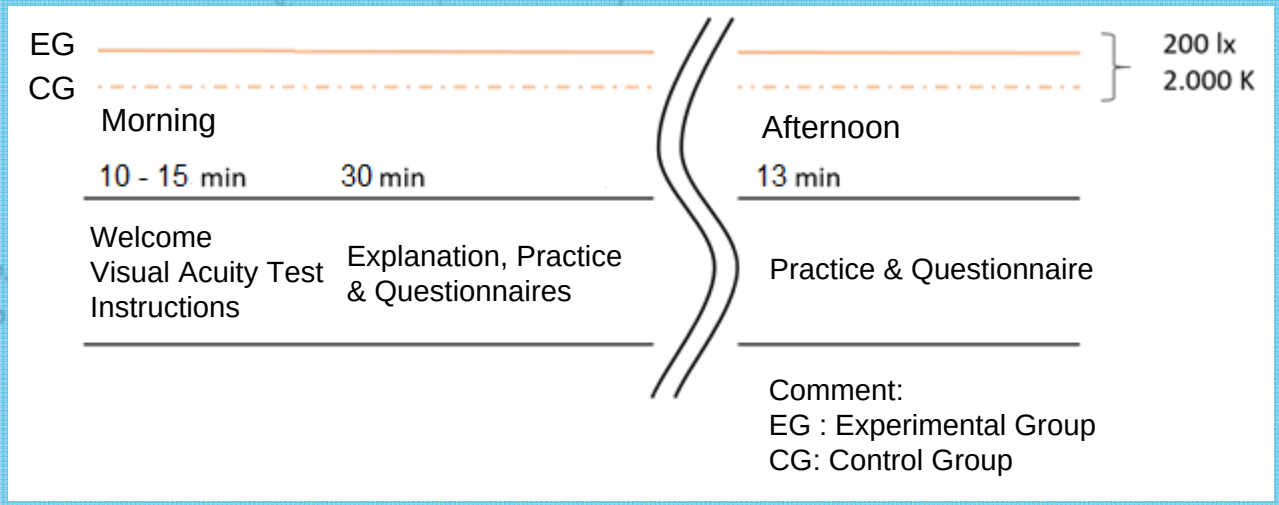
1. Wie fühlst du dich momentan?

unwohl	○	○	○	○	○	○	○	wohl
unkonzentriert	○	○	○	○	○	○	○	konzentriert
interessiert	○	○	○	○	○	○	○	gelangweilt
nicht gestresst	○	○	○	○	○	○	○	gestresst
unruhig	○	○	○	○	○	○	○	ruhig
demotiviert	○	○	○	○	○	○	○	motiviert
erschöpft	○	○	○	○	○	○	○	munter

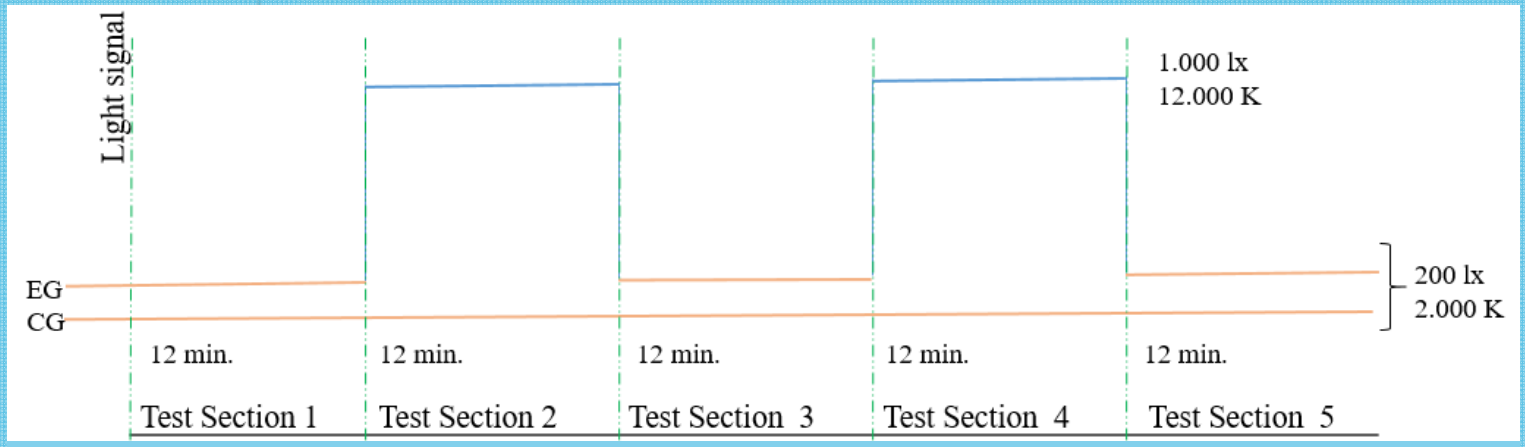
2. Bitte bewerte deine momentane Müdigkeit (Skala 1-9 !).

Extrem wach		Wach		Weder wach noch müde		Müde, aber keine Schwierigkeiten wach zu bleiben		Extrem müde, mit dem Schlaf kämpfend
1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

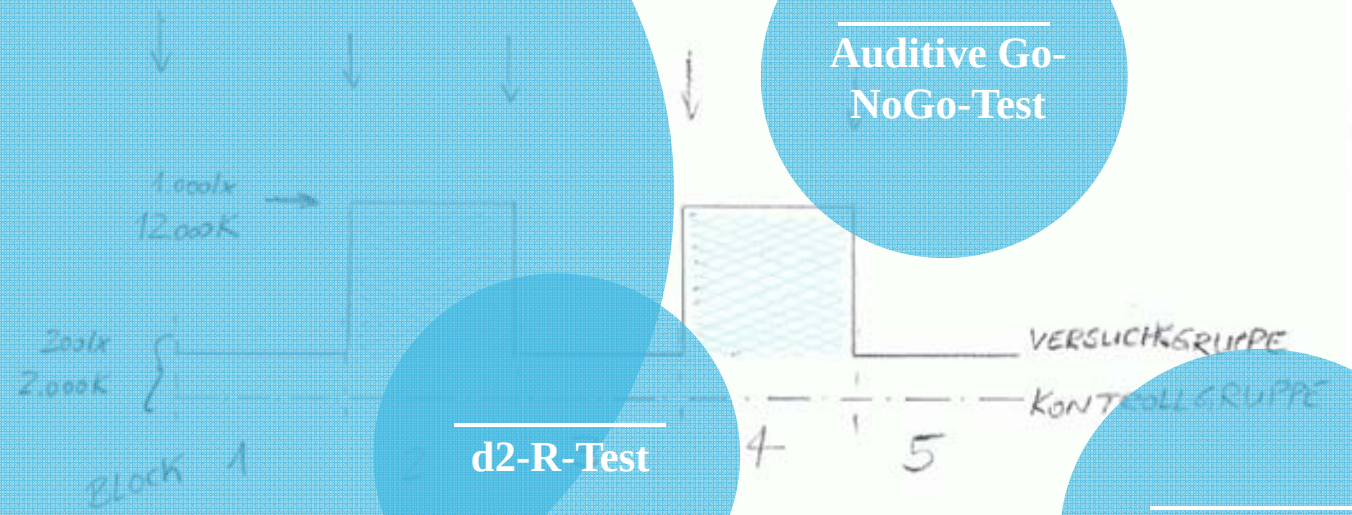
Test Procedure – Pre-Phase



Test Procedure – Experimental Phase



Analysis & Results



Auditive Go-NoGo-Test

d2-R-Test

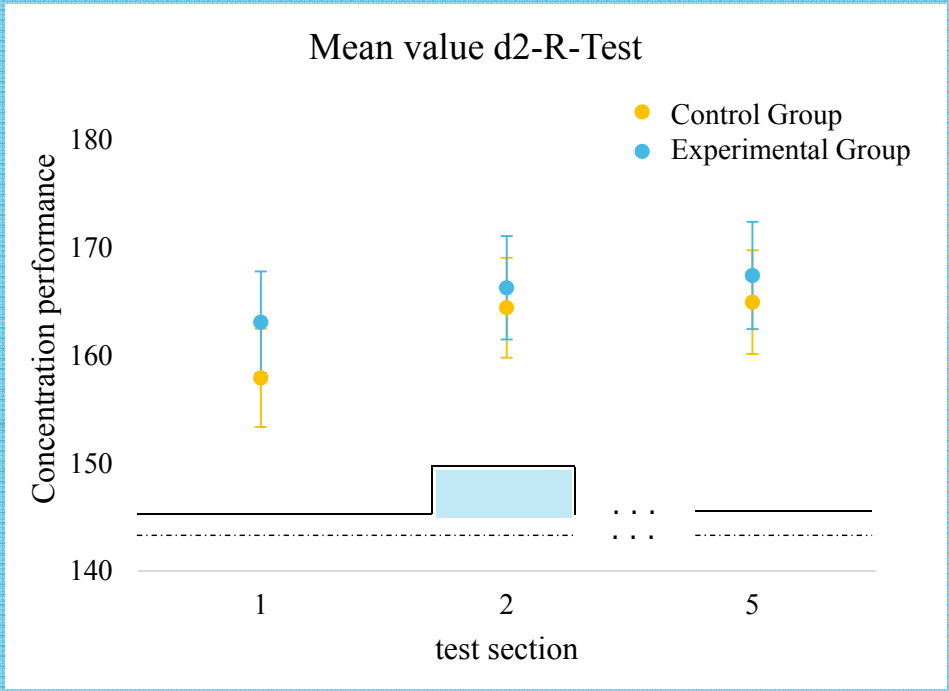
Questionnaires

d2-R-Test

Results from Mixed-Anova-Analysis:

No significant interaction between concentration performanec over time and group

F(2; 116) = 1,596, p = 0,207

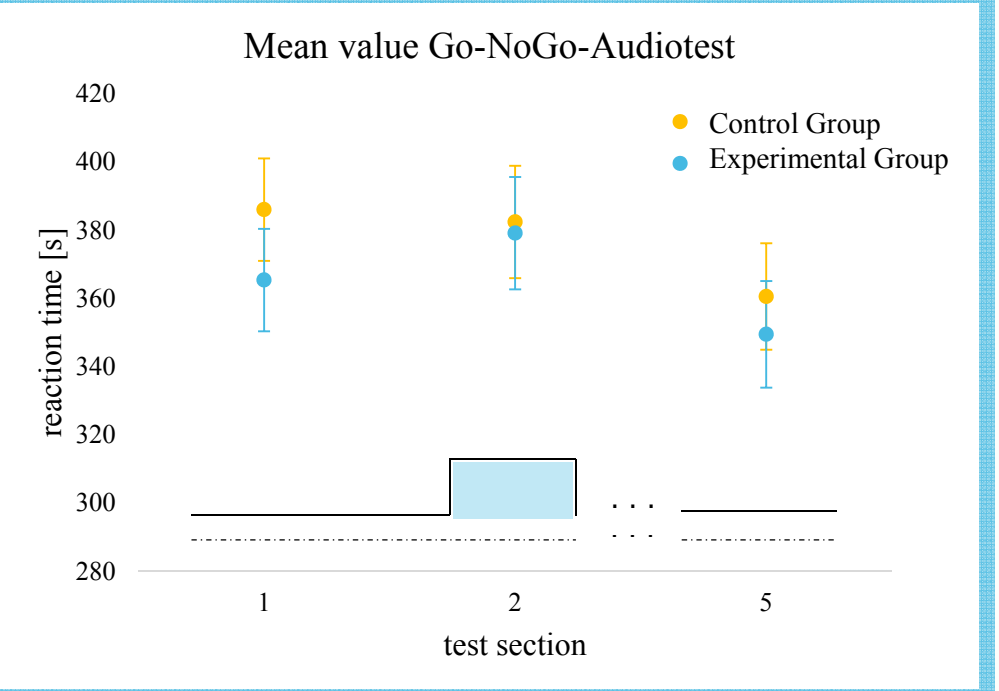


Auditive Go-NoGo-Test

Results from Mixed-Anova-Analysis:

No significant interaction between mean reaction time over time and group

$F(2; 112) = 0{,}794$, $p = 0{,}454$



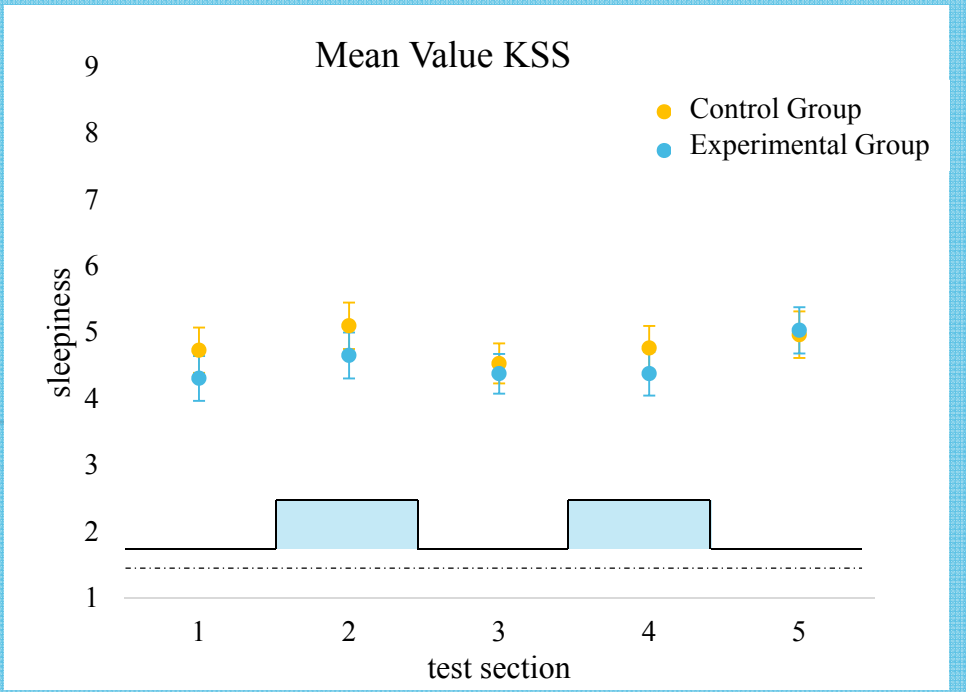
Questionnaires: Well-Being

Karolinska-Sleepiness-Scale:
1 = *extremely alert*
9 = *extremely sleepy, fighting sleep*

Results from Mixed-Anova-Analysis:

No significant interaction between subjective sleepiness over time and group

$F(3{,}503;\ 119{,}696) = 1{,}165;\ p = 0{,}327$

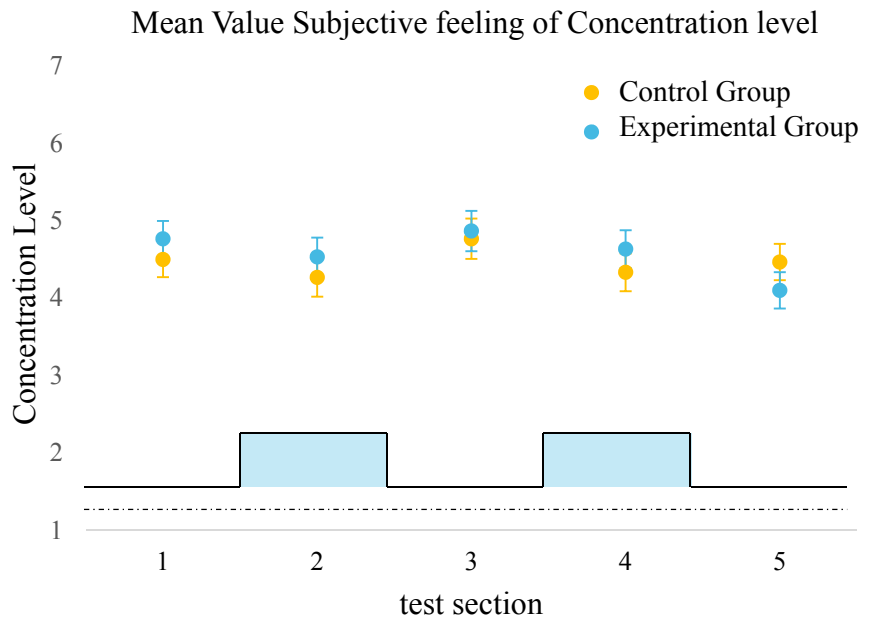


Questionnaires: Well-Being

Results from Mixed-Anova-Analysis:

No significant interaction between subjective feeling of concentration level, motivation level and stress level over time and group.

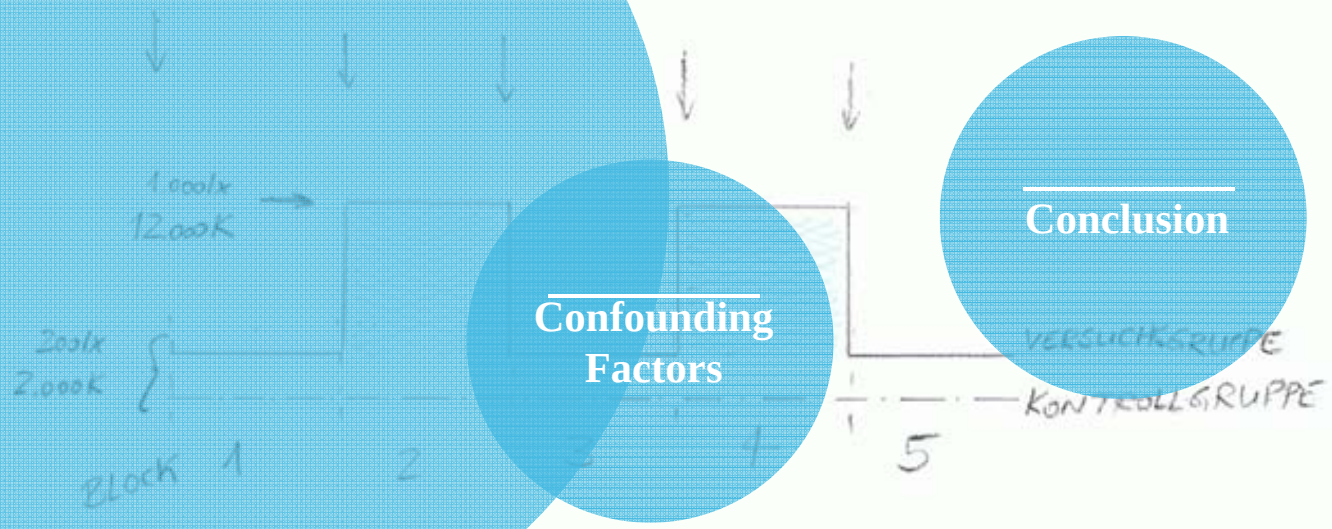
Concentration Scale:
1 = *unconcentrated*; 7 = *concentrated*



Results Overview

	Result	Control Group	Experimental Group
	Alertness	↑	↑
Well-being	Subjective Sleepiness (KSS)	↑	↑
	Subjective Concentration Level	↔	↓
	Subjective Stress Level	↔	↓
	Subjective Motivation Level	↓	↓

Discussion



Confounding Factors

Conclusion

Discussion

Dynamic light changes of light level as well as spectral power distribution can improve alertness and well-being during the physiological afternoon sleepiness.

- Improvement of test results, but no statistic significance between groups
  + mismatch to subjective feeling of level of concentration

- No positive effect of dynamic light change to well-being

  → *Hypothesis cannot be verified*

Discussion

Missing of effect because of ….

- Type of Lighting?
- No real Placebo effect?
- Not optimal activation of ipRGCs/Incidence angle of light?
- Confounding factors?

Confounding Factors & scope for improvement

Experiment	Participants	Lighting conditions
Presence of test leader	Number of attendees	Influence of daylight
Technical problems with equipment	Behavior	Type of lighting
Room climate	Influence through day activity	No real placebo effect
		Incidence angle of light/activation of ipRGCs

Conclusion

- Complexity of influence of ligth on biological and cognitive processes and well-being
- Dependent from parameters, which are difficult to control

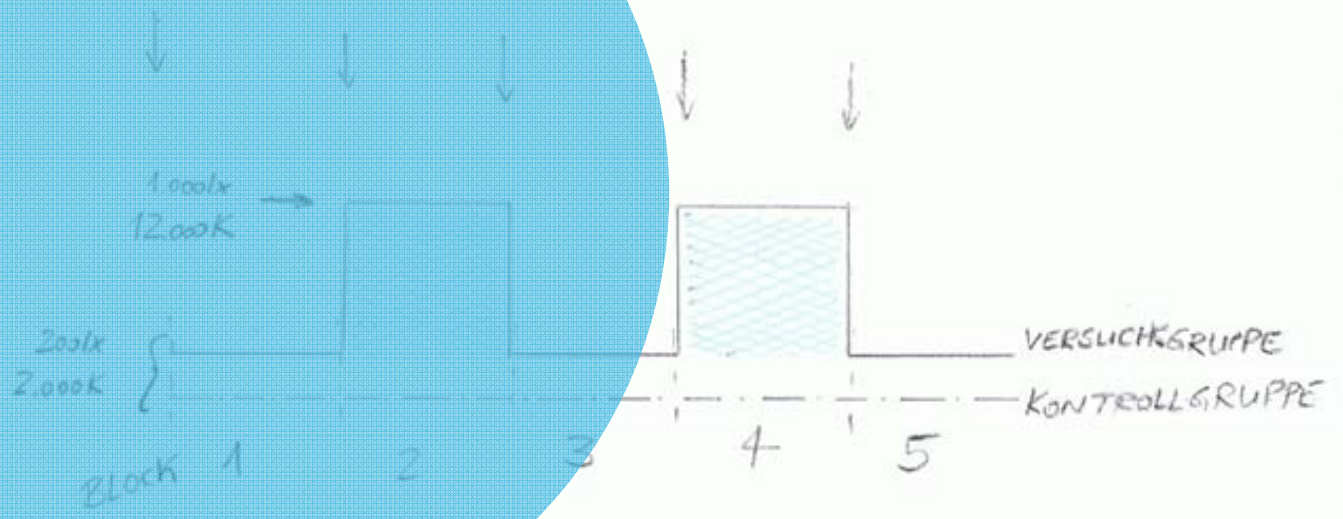
Still, study can be used as …

- Opportunity for comparisons to other studies (summer study)
- Basis for further investigations

What should be considered for upcoming studies?

- Elimination of confounding factors
- Change/Improvement of study design and concentration tests
- Influence on elderly people ….

Questions?


1.000lx
12.000K
200lx
2.000K
VERSUCHSGRUPPE
KONTROLLGRUPPE
Block 1
2
3
4
5

Literature

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