

Experience the Sky

PERCEPTION STUDY

# PERCEPTION STUDIES

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## Introduction

CoeLux® offers a new type of indoor illumination, which perfectly mimics the effects of sun and sky light entering a room on a sunny day.

Relying upon the comments from the several hundreds of people that have visited the first installations, it is evident that CoeLux® is capable of generating a very high living comfort even in fairly small spaces.

In order to provide a scientific support to the above claim, CoeLux® has begun a research investigation aimed at quantifying the positive impact on the wellbeing by means of psychological, physiological, biological and even medical tests.

# PERCEPTION STUDIES

## Introduction

In this context, Bartenbach GmbH, which has a long-lasting experience in the field of light perception psychology, has already performed in collaboration with CoeLux® a preliminary study regarding the impact of CoeLux® illumination on people.

To this end a sample of 100 people participated in a randomized controlled comparative study, by means of tests delivered both in CoeLux® illuminated room and in a second room identical to the first, but illuminated with top quality state of the art illumination, of similar (average) CCT, luminous flux, spectral quality etc. (hereinafter: «the Best Standard»).

# PERCEPTION STUDIES

Perception study aiming to measure the impact of natural light on psycho-physiological parameters



THE REFERENCE ROOM WITH A STANDARD LIGHTING SYSTEM



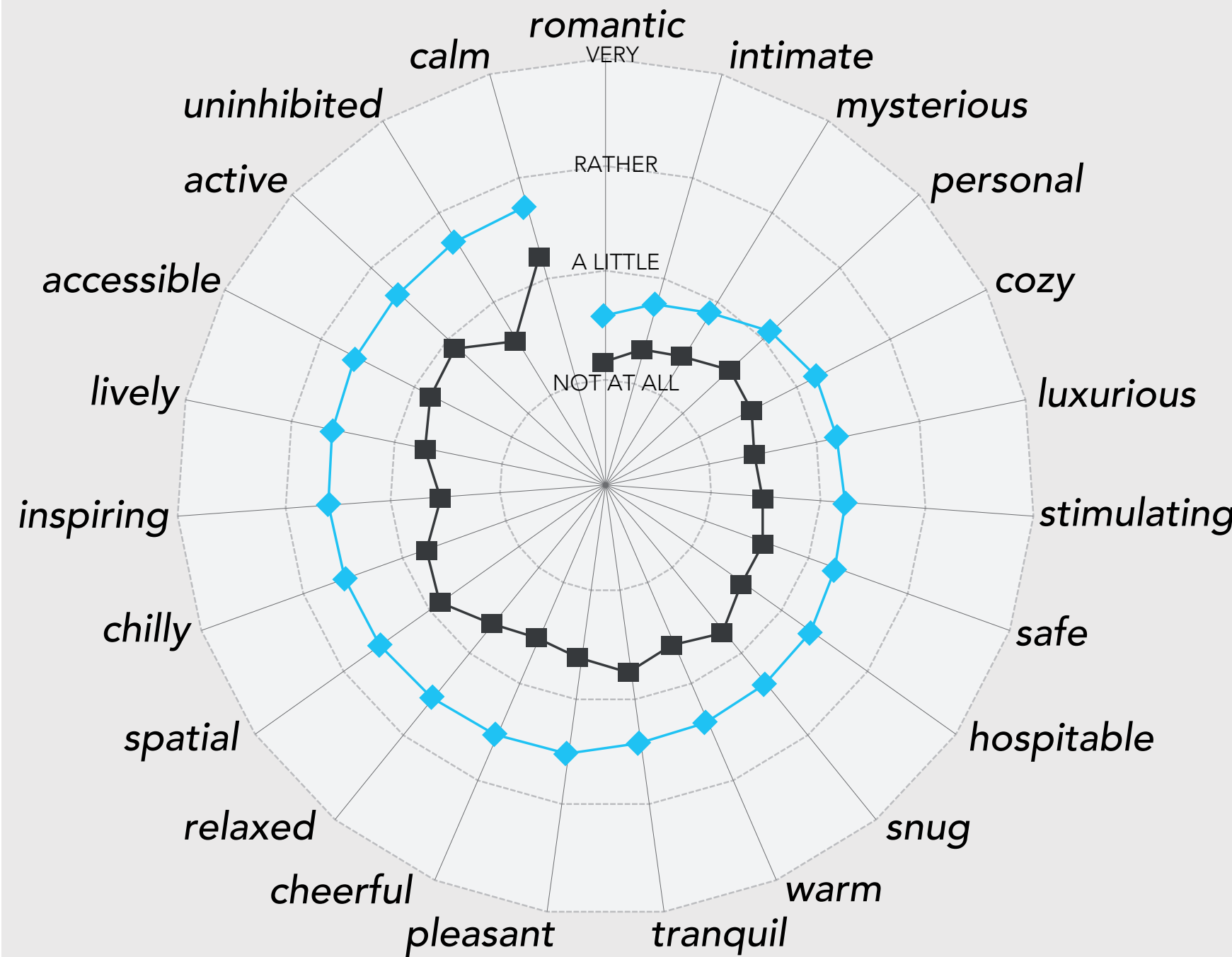
AMBIENCE OF THE COELUX® TEST ROOM

Perception Study Set Up:

- Two identical windowless rooms have been built for the test: one illuminated with CoeLux and the other one with standard Lighting Systems
- A sample of 200 persons have been selected with the following characteristics: Age between 18-65 year; 50% female
- Approval by Ethical committee (University of Innsbruck)

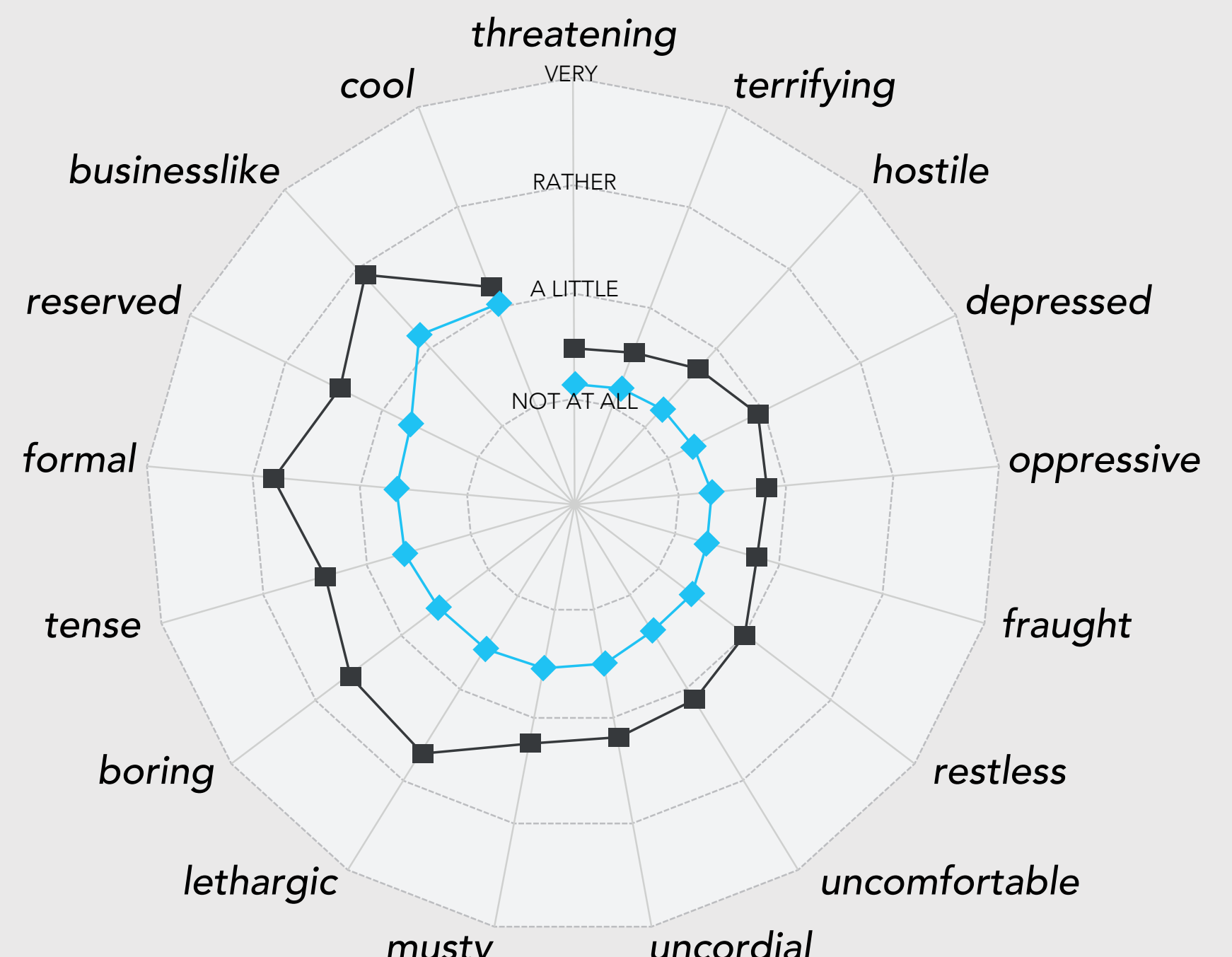
# PERCEIVED AMBIENT QUALITY

## POSITIVE ASSOCIATIONS



Standard vs CoeLux®

## NEGATIVE ASSOCIATIONS



Standard vs CoeLux®

# MULTI-DIMENSIONAL Perception study

## PSYCO-PHYSIOLOGICAL PARAMETERS

PERCEIVED MOOD STATE >

PERCEIVED ANXIETY >

PERCEIVED ROOM ENVIRONMENT >

PERCEIVED STRESS STATE >

SUSTAINED ATTENTION >

## MEASUREMENTS TEST

- Performance-related Activity (25 Items)
- General Well-being (24 Items)
- General Deactivation (32 Items)

- State-Trait Anxiety Inventory (STAI)
- Claustrophobic Symptoms Checklist

- Room Atmosphere Questionnaire (RAQ)
- Perceived Restorativeness Scale (PRS)

- Dundee Stress State Questionnaire (DSSQ):
  - Energetic Arousal Scale
  - Tension Scale

- Acoustic Go-/No Go-Task

# PERCEIVED MOOD STATE

## Performance-Related Activity

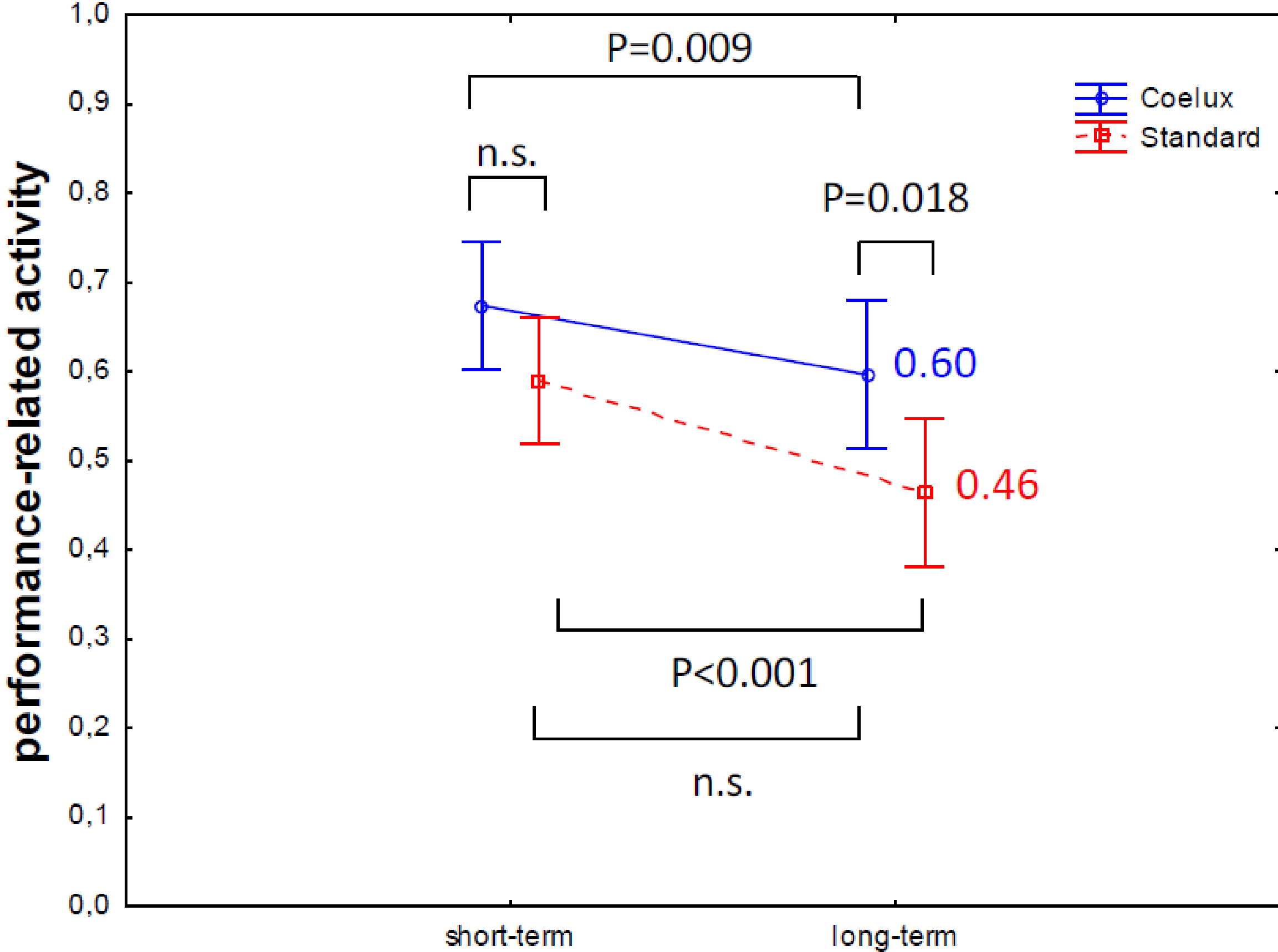
**Measures:** 25 items measured, e.g. keen, eager, motivated to work, active, energetic, forthcoming, persistent, concentrated, ...

**Rationale:** actual mood state at the beginning (Short-term) and at the end of the data collection period (Long-term)

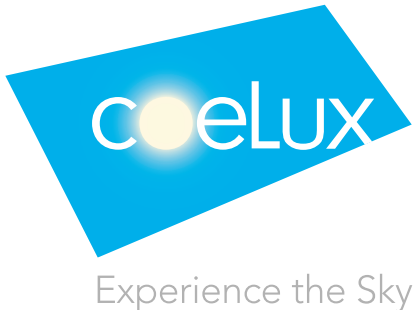
### Key findings:

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CoeLux® Performance-Related Activity Score is **30% higher** than standard



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# PERCEIVED MOOD STATE

## General Well-Being

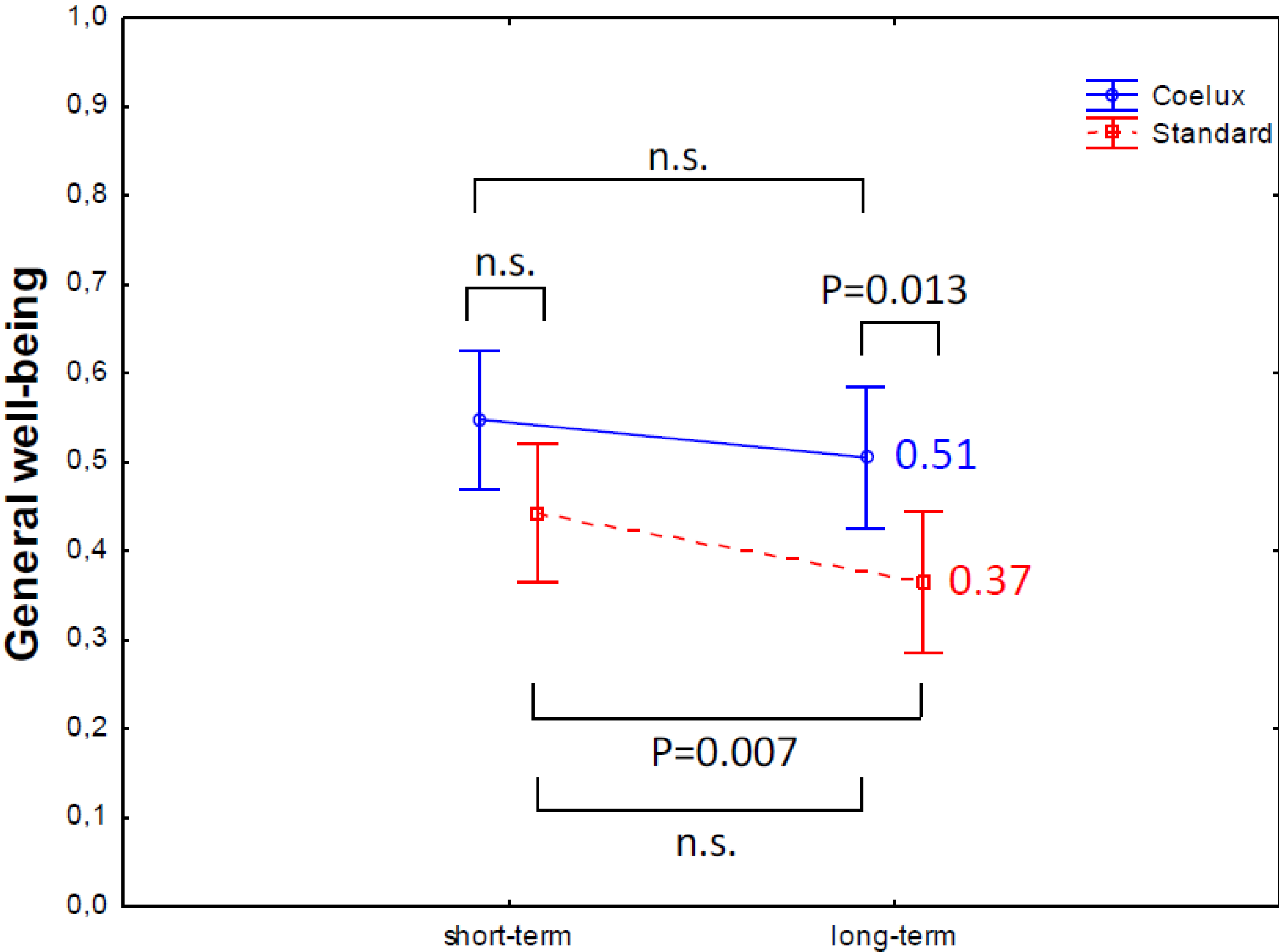
**Measures:** 24 items measured, e.g. confident, unconcerned, pleased, comfortable, in good spirit, ...

**Rationale:** actual mood state at the beginning (Short-term) and at the end of the data collection period (Long-term)

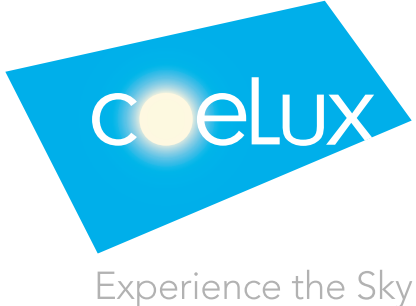
**Key findings:**

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CoeLux® General Well-Being is rated **38% higher** than standard



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# PERCEIVED MOOD STATE

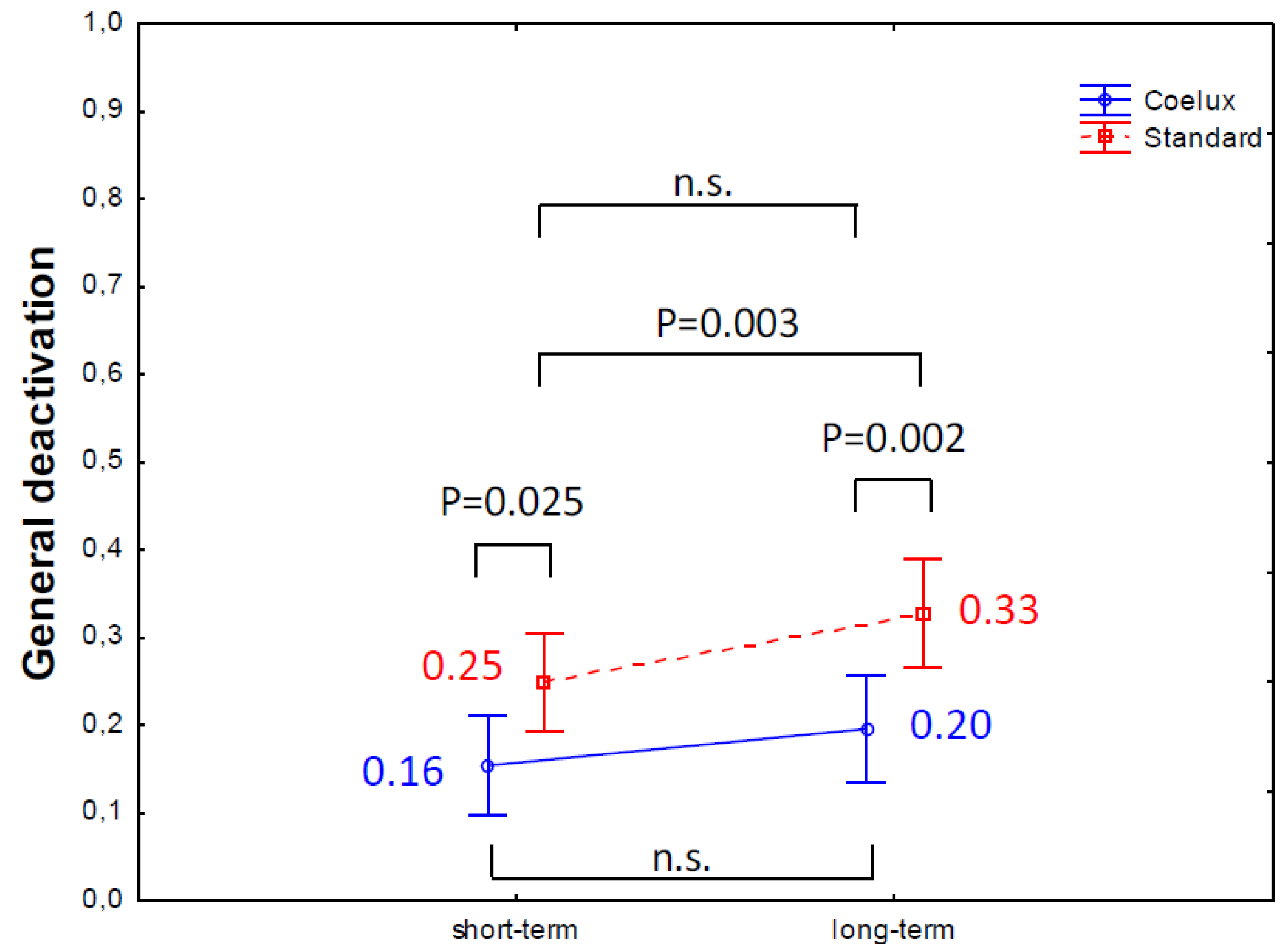
## General Deactivation

**Measures:** 32 items measured, e.g. careless, spiritless, powerless, lazy, passive, slow, sleepy, demoralized, ...

**Rationale:** actual mood state at the beginning (Short-term) and at the end of the data collection period (Long-term)

### Key findings:

CoeLux® General Deactivation is **36% less strong** than standard in short-term and **39% in long-term**



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# PERCEIVED ANXIETY

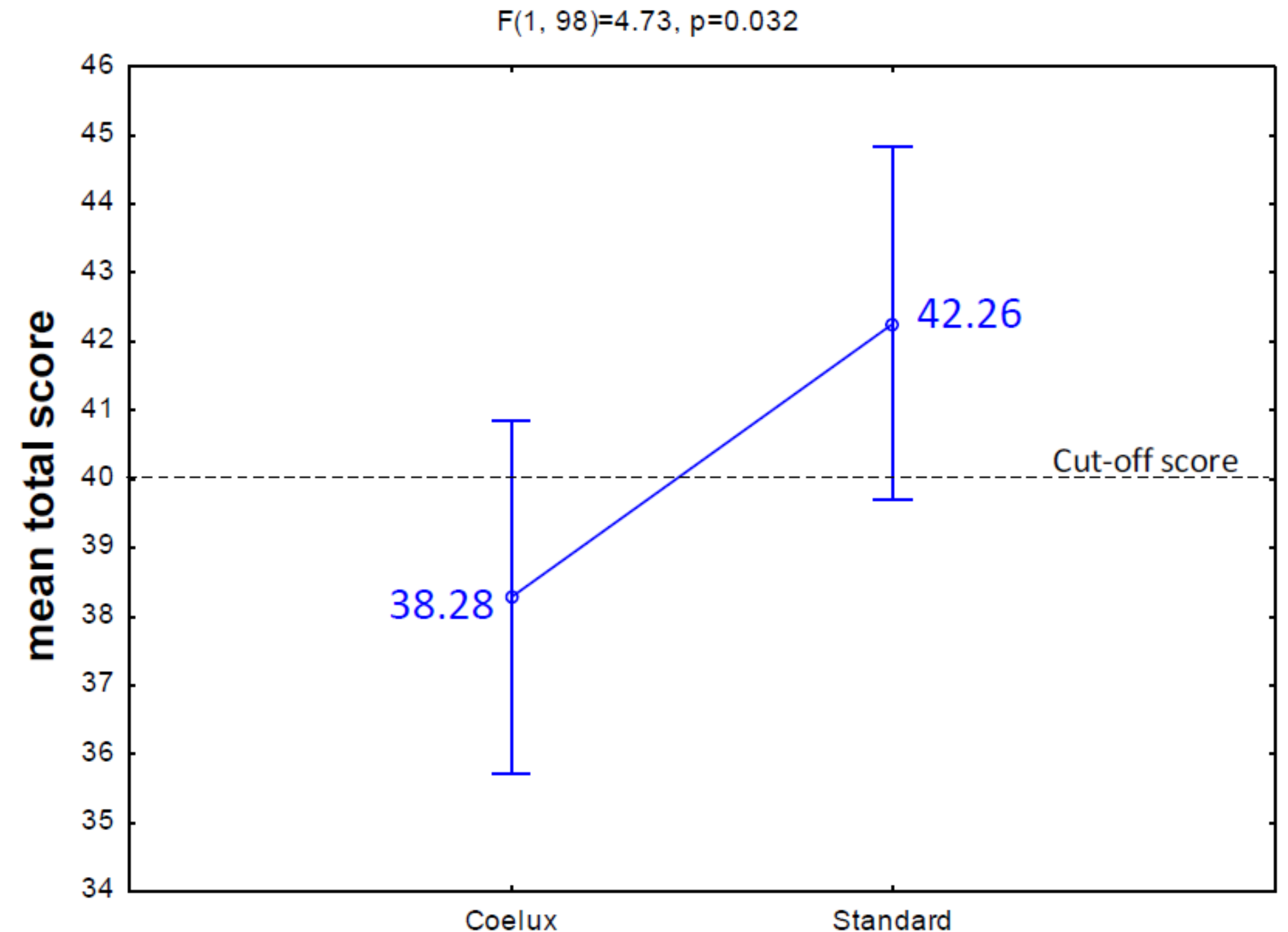
## State-Trait Anxiety Inventory (STAI)

**Measures:** a total anxiety score was derived by adding the ratings (1 to 4) of 20 items, e.g. feel calm, secure, tens, upset, satisfied, frightened, nervous, relaxed, worried, ...

**Rationale:** room lighting long-term effects on the perceived anxiety state have been measured. A Cut-Point of 40 \*\* detects clinically significant symptoms for S-Anxiety Scale

### Key findings:

Under CoeLux® state anxiety was rated significantly lower than standard. Actually standard lighting crossed the cut-off score of STAI indicating clinically relevant heightened anxiety scores.



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\*\*"Measure of Anxiety" by Laura J. Julian, PhD, University of California, San Francisco – 2011 November pg. 2

# PERCEIVED ANXIETY

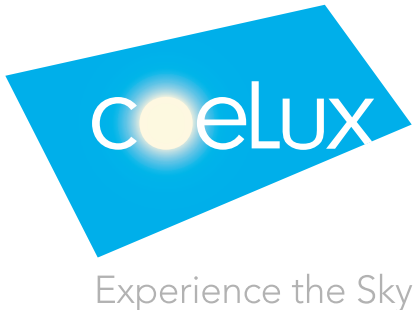
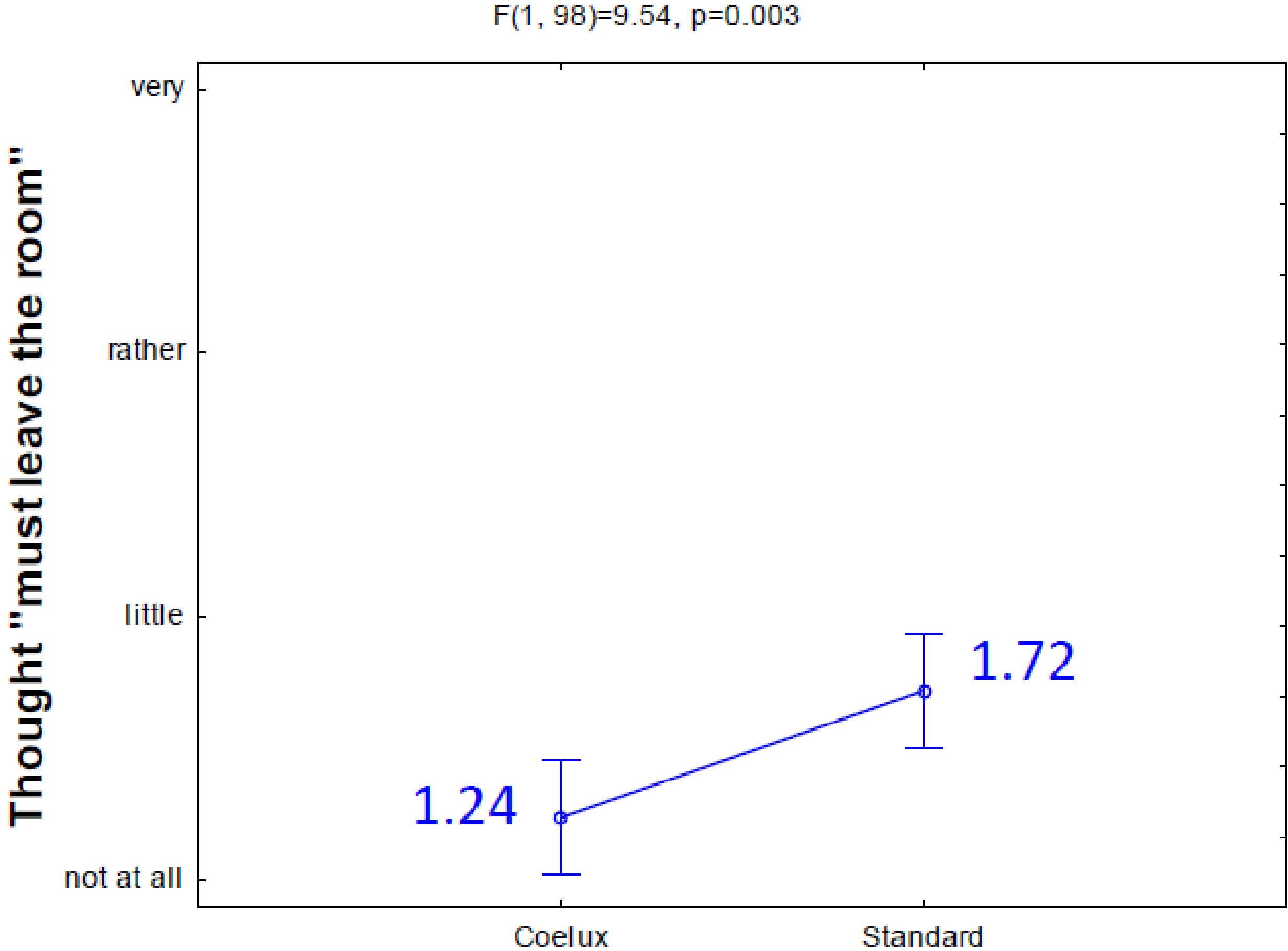
## Claustrophobic Symptoms Checklist

**Measures:** two out of 6 claustrophobic symptoms were significantly different between the two lighting conditions: item "I feel dizzy" and item "I think that I must leave the room"

**Rationale:** to quantify potential lighting effects on claustrophobic feelings

### Key findings:

The feeling "must leave the room" was rated **28% lower** under CoeLux® than standard



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# PERCEIVED ROOM ENVIRONMENT

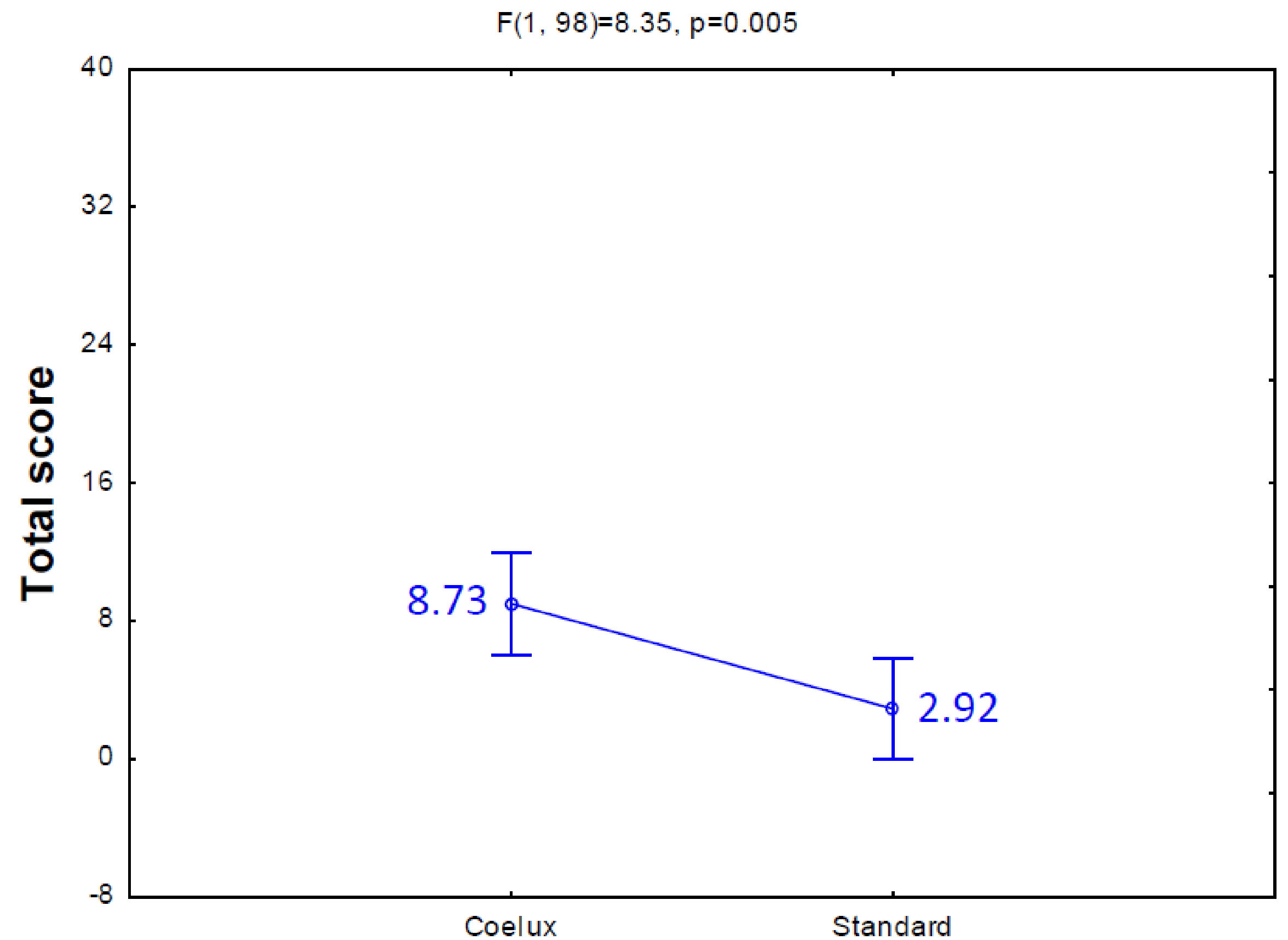
## Perceived Restorativeness Scale | Sub-scale "Fascination"

**Measures:** 8 items (6 positives, 2 negatives) where scored on 7-point Likert Scale, e.g. "my attention is drawn to many interesting things", "I want to spend more time looking at the surroundings", "the place is boring", "the setting is fascinating", ...

**Rationale:** quantify the impact of room lighting installations on perceived restorative environment

### Key findings:

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Total score of fascination was significantly higher under CoeLux® than standard lighting



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# PERCEIVED STRESS STATE

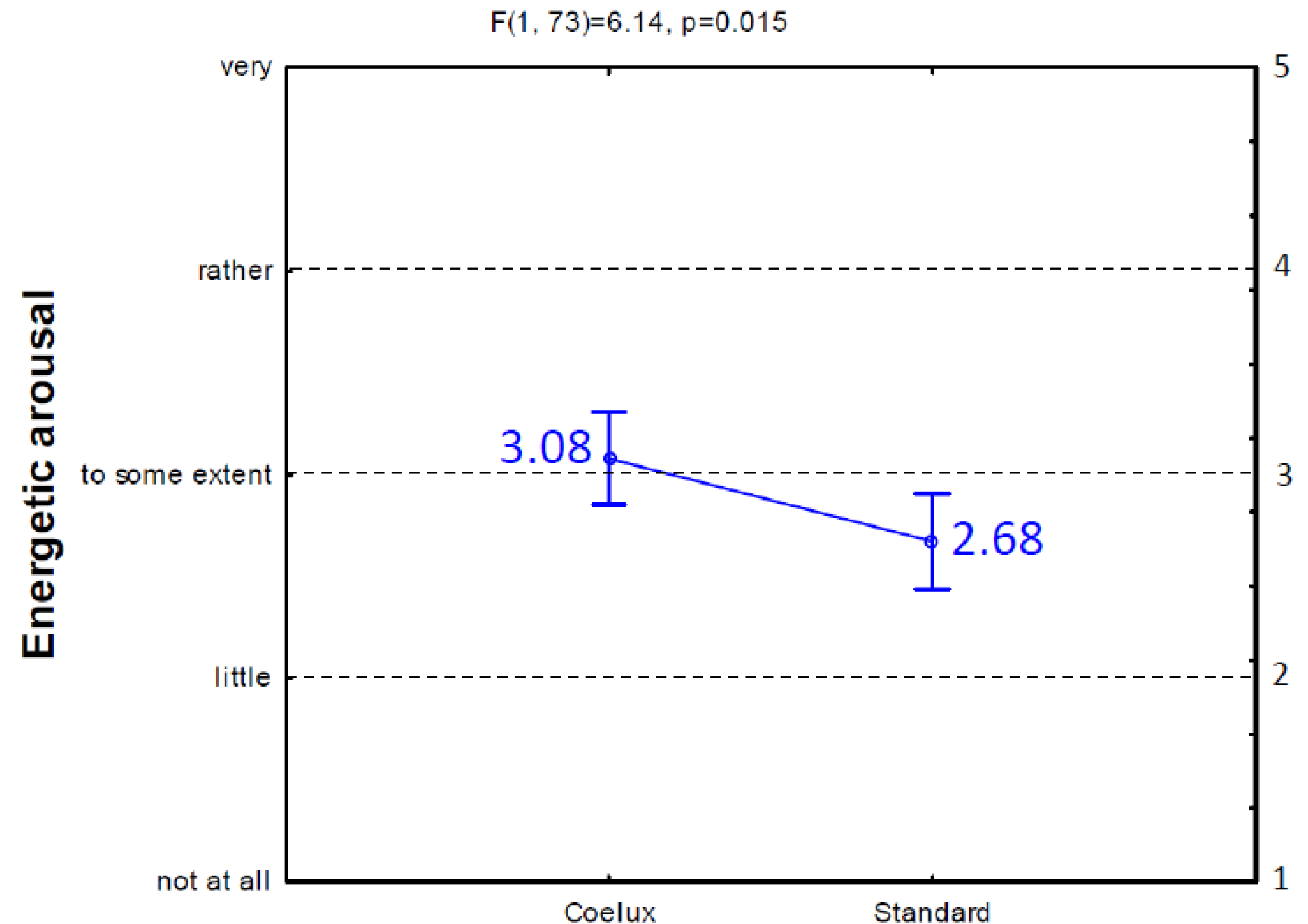
## Dundee Stress State Questionnaire | Energetic Arousal Scale

**Measures:** DSSQ test focused on Task Engagement factor - Energetic Arousal subscales (EA; alert - lethargic)

**Rationale:** DSSQ has been utilized to quantify the impact of different room lighting installations on stress responses in sustained performance. Typically, a decrease in energetic arousal is accompanied by an increase in tense arousal, thus indicating that vigilance is emotionally stressful

### Key findings:

The Energetic Arousal Score was **15% higher** under CoeLux® than standard



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# PERCEIVED STRESS STATE

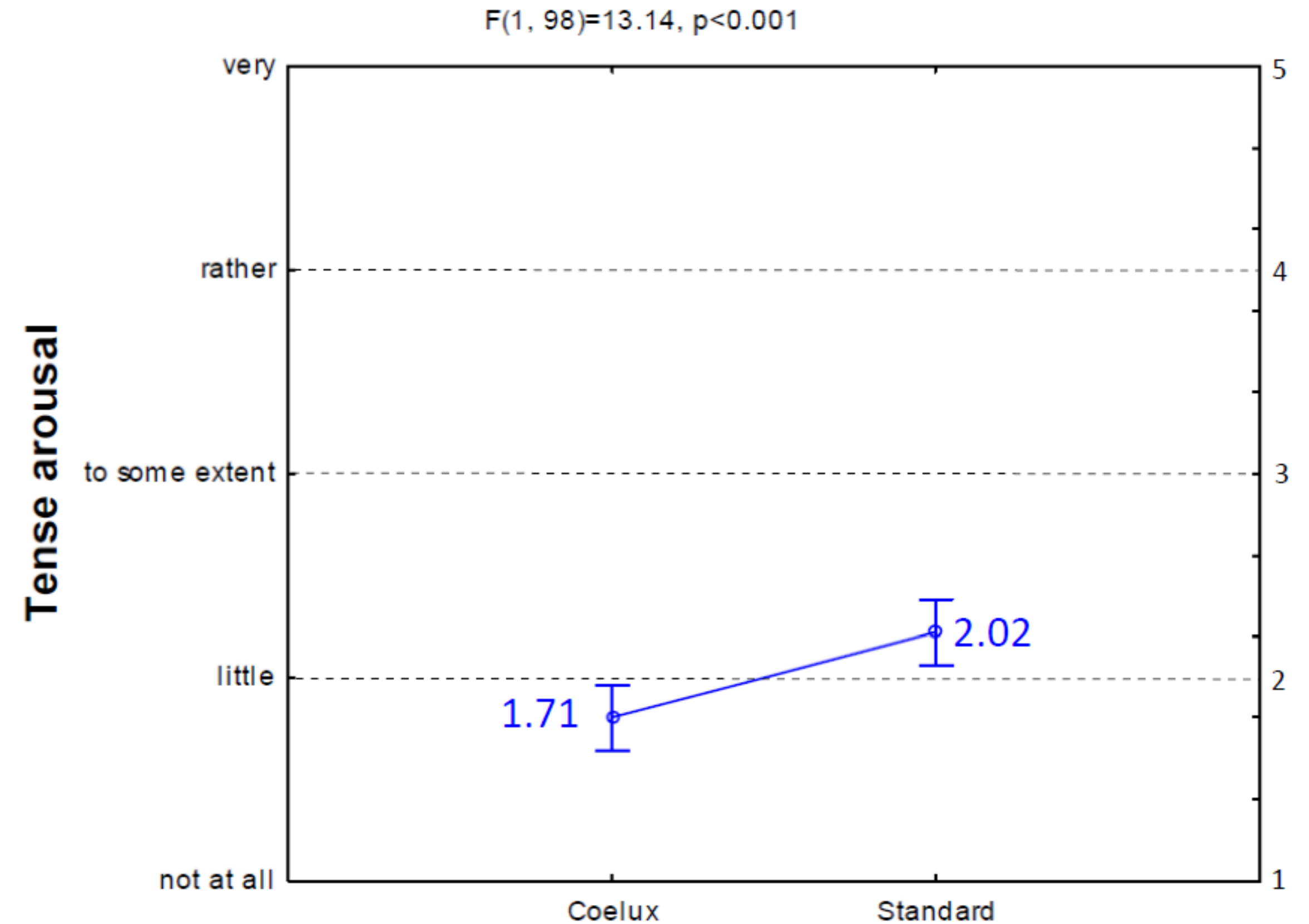
## Dundee Stress State Questionnaire | Tension Scale

**Measures:** DSSQ test focused on Distress factor  
- Tense Arousal subscales (TA; nervous - relaxed)

**Rationale:** DSSQ has been utilized to quantify the impact of different room lighting installations on stress responses in sustained performance. Typically, a decrease in energetic arousal is accompanied by an increase in tense arousal, thus indicating that vigilance is emotionally stressful

### Key findings:

The Tense Arousal Score was **15% lower** under CoeLux® than standard



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# SUSTAINED ATTENTION

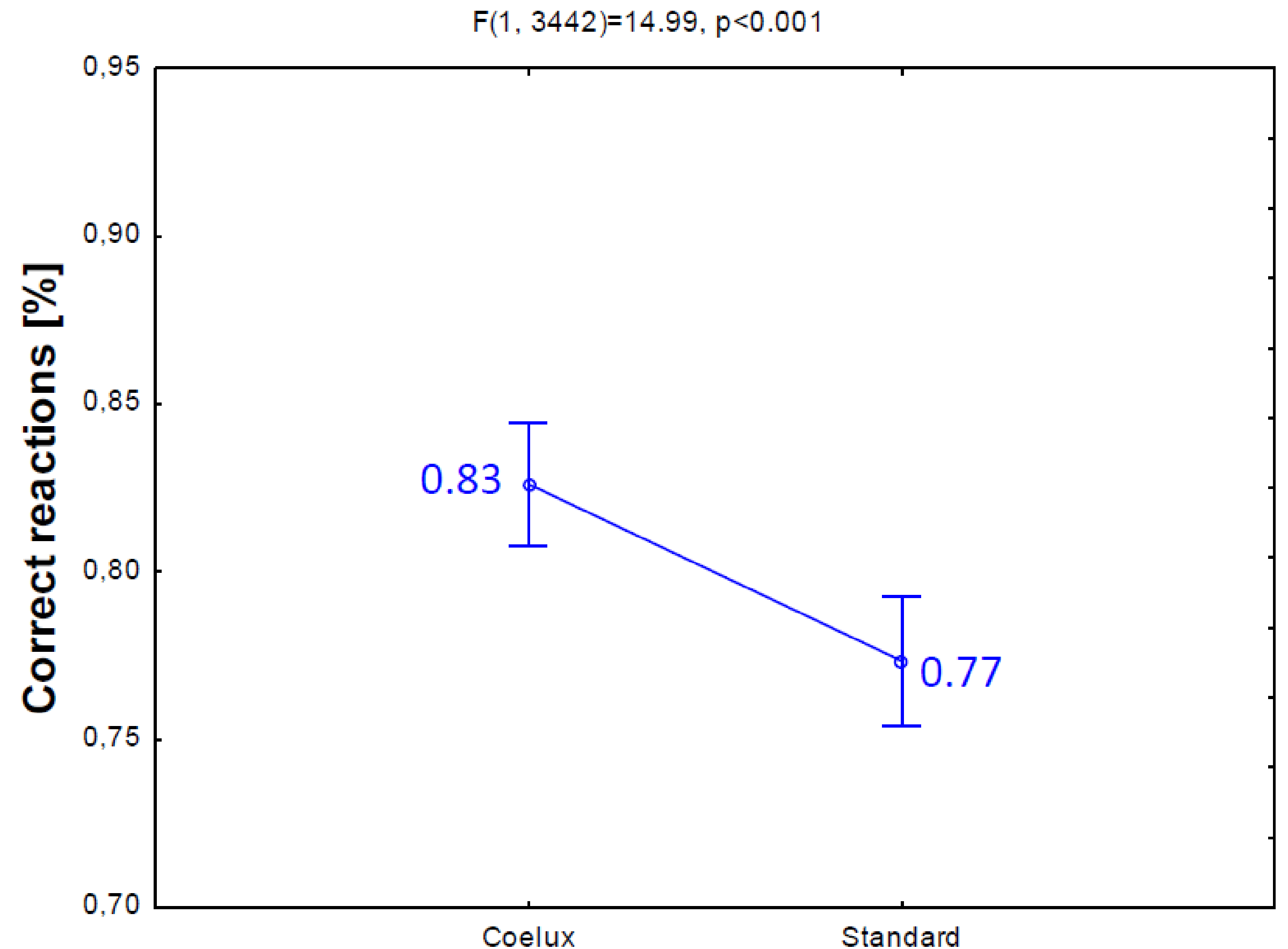
## Acoustic Go-/No Go-Task

**Measures:** 54 pairs of tones, each tone heard for 80ms and the two tones separated by 500ms. The first tone at 1000Hz while second tone was either higher (1100Hz) or lower (900Hz). Whenever the second tone was higher, the test person had to press a button as fast as possible or restrain from a reaction

**Rationale:** quantify impact of different room lighting on correct reactions in the sustained attention test

### Key findings:

The Correct Reactions were **8% higher** under CoeLux® than standard



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