



## Light Work Sleep: The Results

**FUTURE Designs explored the effects that light and sleep have on our wellness with a sleep experiment carried out over 24 hours, during the week of the longest day of the year**

From 10am on Tuesday 19<sup>th</sup> June until 10am on Wednesday 20<sup>th</sup> June, lighting experts FUTURE Designs, performed an experiment to test and analyse the effects of light on the circadian rhythms of two volunteers, with the intention to record how different types of light can affect the human wake and sleep functions.

### **THE EXPERIMENT**

Led by their consultant sleep expert, Dr Neil Stanley, the experiment took place at FUTURE Designs new Technology Hub in Clerkenwell.

Two separated areas of the Technology Hub were lit to extremes of the Kelvin band - cool versus warm light. The two different lighting tones were created by FUTURE Designs bespoke, digitally controlled wall to wall lit ceiling panels. One side was lit to 6000 kelvins in a cool white light, the other to 2700 kelvins of a warm white light and both were lit throughout the day and night.

The volunteers who were of similar age, height and weight worked and slept in the window of the Technology Hub over a 24 hour period. Passer-bys were encouraged to observe the spaces and read about the experiment dubbed Light Work Sleep.

During the simulated working day, the volunteers had their memory, reaction time and vigilance measured regularly by Dr Neil Stanley, and they were questioned about their mood and alertness. Their cognitive function was tested on the second morning and evaluated.

### **THE RESULTS**

The various assessments returned a lot of information to analyse, as both volunteers completed 20 tasks, several times throughout the 24 hours to provide the data. The results, per assessment, were as follows:

**Karolinska Sleepiness Scale:** *a measure of subjective sleepiness*

2700K produced lower levels of sleepiness across the entire experiment

**Card sorting Task 1:** *timed card sorting task*

6000K generally improved the time to complete this task

**Card sorting Task 2:** *timed card sorting task*

6000K generally improved the time to complete this task

**Psychomotor Vigilance Task:** *timed reaction task measuring the reaction to a number of stimuli which requires the subject to be vigilant to the appearance of the stimulus*

Overall 6000K seemed to have negative effect on reaction time to the stimulus

**Driving Reaction Time:** *timed reaction test*

Both conditions improved the reaction time (they got quicker)

**Number Memory Task:** *numerical memory task*

There appears to be little effect on this task

**Word Memory Task:** *verbal memory test, involving saying whether you have or have not seen a word previously presented*

Overall 6000K seemed to have a less negative effect on verbal memory

**Can-2 Task:** *timed letter search involving searching a grid of letters and cancelling occurrence of the 2 stimulus letters. The score is the number of letters cancelled in 2 minutes.*

Overall performance reduced in both conditions

**Can-6 Task:** *timed letter search, involved searching a grid of letters and cancelling occurrence of the 6 stimulus letters. The score is the number of letters cancelled in 5 minutes.*

Overall there was little constant effect under either condition

The next set of data are all derived from the **Line Analogue Rating Scale**, a measure of subjective mood.

**Line Analogue Rating Scale:** *subjective measure Anxiety*

Overall 6000K seemed to produce less anxiety across the day

**Line Analogue Rating Scale:** *subjective measure Tiredness*

Overall 2700K produced less tiredness across the day

**Line Analogue Rating Scale:** *subjective measure Relaxation*

There were mixed reaction to feelings of relaxation although 6000K produced more relaxation in the later part of the day

**Line Analogue Rating Scale:** *subjective measure Drowsiness*

6000K produced much higher levels of drowsiness during the afternoon and evening

**Line Analogue Rating Scale:** *subjective measure Dizziness*

Little effect could be seen on dizziness

**Line Analogue Rating Scale: *subjective measure Happiness***

Little effect was seen on happiness

**Line Analogue Rating Scale: *subjective measure Clumsiness***

6000K produced a much higher feeling of clumsiness across the day

**Line Analogue Rating Scale: *subjective measure Sadness***

There was little effect on sadness

**Line Analogue Rating Scale: *subjective measure Alertness***

Overall 6000K produced much lower subjective alertness across the study particularly in the afternoon and evening

**Line Analogue Rating Scale: *subjective measure Energy***

Overall 6000K produced much lower feelings of energy during the day particularly in the afternoon and evening

**Line Analogue Rating Scale: *subjective measure Depression***

Overall there was little effect of levels of depression

## THE CONCLUSION

The realities of performing an experiment like Light Work Sleep in the window of a showroom presented some limitations and meant that controlling all the variables to a clinical level wasn't possible. Given that, we should not read too much into the results of the psychological tests, although the assessments indicated there were some clear differences between the two conditions on some of the tasks.

Even under imperfect testing environs, it became clear that different lighting conditions can have a significant effect on performance, feelings of alertness and particularly on subjective mood. During Light Work Sleep the 6000k cool white light subject felt less alert across the day, particularly in the afternoon and evening. This result could be thought as going against the theory that blue light is capable of producing alertness and improvements in performance. While this may be the case in an ideal environment under more 'real-world' conditions, as seen in this experiment many other factors can also have an effect.

Prolonged exposure to 6000k cool white light, particularly in the afternoon and evening, may in itself be wearying given that it is the opposite to the natural changes in sunlight at this time. Additionally, exposure to sunlight may negate the relaxing effects of a simulated 2700k warm white light overhead.

Personality and motivation may play a big part, e.g. a bright summer's day causes some people to head to the mountains to hike and others to spend the day lying on a beach, therefore it is possible that there was a paradoxical effect to the 6000k cool white light environment.

Humans do not only use light as a 'zeitgeber' (time-giver), we respond to other things such as social interactions and food intake. Although in our experiment we controlled the timings of food, the individuals' response to feeding e.g. the joy of a nice meal as compared to an average meal could have played a part in their response to the situation.

Perhaps this is the most important take-away from Light Work Sleep. A vital contributing factor to the reactions of the volunteers is individual differences. While the subjects were matched for gender, age, build etc and conditions, other than the light, were as far as possible identical, the results are going to be heavily influenced by the differences in mood and sleepiness levels between the subjects.

For instance, looking at the KSS raw scores instead of looking at change from baseline we can see that our volunteer in the 2700k warm white light was quite sleepy at the start of the study compared to our volunteer in 6000k cool white light, thus she had less room for change in her scores of sleepiness under conditions that are thought to be more relaxing. I.e. the effect would have probably have had to be proportionally larger in her case for her to have noticed a measurable change. This could also explain why she showed less change in her Line Analogue Rating Scale measures related to alertness.

So, in summary while tuneable white light may have the ability to modulate alertness and performance it is only one of many factors that affect our everyday life, the relative contribution of the effect of light on everyday alertness and performance needs to be elucidated.