

Modern pro-cognitive lighting increases mental and physical performance, improves health and helps in stressful situations.

Light falling into the eyes has a great impact on our present and long-term condition. It affects the quality of sleep, health, physical performance and mental resilience. Proper lighting is beneficial.. Otherwise it can do harm.

The rhythm of life has evolved from the alternations between day and night since time immemorial. In daylight, we are prepared for activity and performance, while in the dark, we rest during sleep. For many people, however, this relation between daylight and night darkness is disturbed. The problem also concerns workers in the security, protective or rescue services and in commercial organisations. When working, people commonly stay in unsuitably lit areas and during night shifts, they even have to stay awake. Our cognitive abilities deteriorate, the overall performance drops and our physical and mental health worsens under poor lighting in the form of low-quality fluorescent tubes or LED lights. The adverse impacts of poor light should therefore be prevented and mitigated. This can be achieved by application of bio-optimised lighting with spectral composition and other properties that are maximally approximated to the natural daylight to which human physiology is adapted.

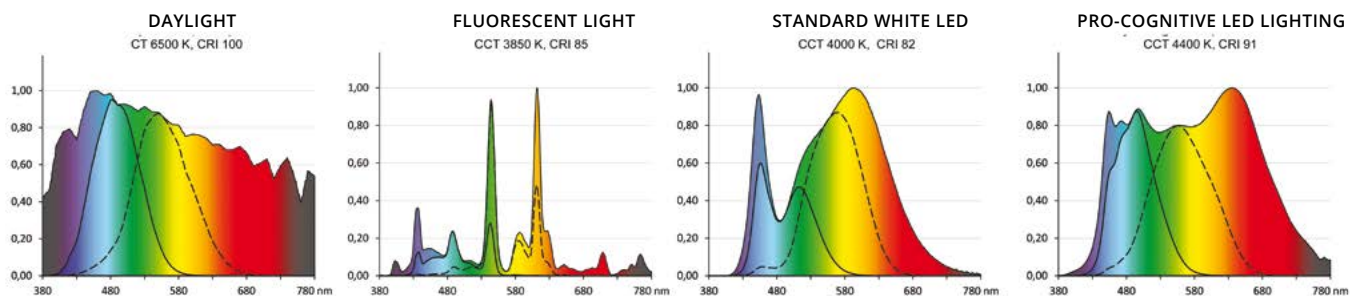
Over the day, wakefulness, performance and mood are supported by the blue spectral component

We must realise that since time immemorial, our daily (circadian) rhythm has been naturally synchronised with the sunlight. During the day, the sun shines on us with a balanced spectrum, which contains all wavelengths of the visible spectrum, i.e., all colours. The representation of the blue and green components is a signal that it is the day, therefore time for activity. This light activates production of serotonin in the body, which helps achieve full wakefulness and concentration, speeds up our reactions, increases the performance as well as the speed and quality of storing and calling the short-term memory. It also heavily affects our emotions and resilience in intense situations. Serotonin conditions the production of melatonin, an important hormone that is created in the epiphysis only at night in darkness. It has numerous crucial functions in the body. It acts as an „envoy“ of

a central clock, which starts regeneration and reparation of all tissues and organs, improves both falling asleep and the quality of sleep, thus contributing to the quality of the cognitive functions. It acts as an antioxidant, relieves the body of dangerous free radicals and has anti-inflammatory and anti-cancer effects.

Correct production and function of the mentioned hormones in the body ensure that people who work, study or perform mental or physical work in daylight or in artificial lighting resembling the sunlight achieve better results and higher resilience to stress. On the contrary, the performance and mood drop when working under poor lighting.

The quality and properties of the lighting render a huge potential to organisations that need efficient, resilient and balanced workers and teams. If there is not enough daylight coming into the space, special lighting can be a solution in addition to sun tunnel systems, for example. These bio-optimised light



Comparison of spectral composition and biological (full curve) and visual (dashed curve) efficiency of daylight, fluorescent light, standard white LED and bio-optimised pro-cognitive LED lighting, source: Lenka Maierová, ČVUT UCEEB

sources simulate and substitute natural daylight with their properties and the resulting biological efficiency.

Pro-cognitive lighting can simulate natural lighting conditions

Pro-cognitive lighting, much like daylight, contains all colours and lengthways and, in contrast to other standard artificial light sources, an increased share of a stimulating blue and azure component. Moreover, light from these sources is perfectly distributed evenly within the space. As a result, it does not feel unnatural, provides the highest visual comfort and an almost identical biological efficiency of the sun.

In contrast to pro-cognitive lighting, classic fluorescent tubes or standard LED lights are distant from the daylight. They lack balanced spectrum and optimal wavelengths, often making people feel tired and less alert under them. They also have a negative impact on overall health and vitality. Contrarily, according to numerous studies and research projects, high-quality lighting

conditions positively affect productivity, working pleasure, overall mood and relationships within teams.

Within local experiments in the Spectrasol Company, the University Centre for Energy Efficient Buildings of the Czech Technical University and the National Institute of Mental Health have proven the positive effect of pro-cognitive lighting in a school environment. Comparison of pro-cognitive and standard lighting in the form of classic fluorescent tubes and LED lights proved that under pro-cognitive light, students have far better grades and results in psychological tests. Their short-term memory, mental resilience and emotions also improved. On the contrary, overall sickness rate and late arrivals decreased. Cognitive abilities, activities and overall mood also improved when the lighting was installed experimentally in a nursing home and other facilities.

Last but not least, bio-optimised lighting can improve conditions for people working on shifts. Night shifts entail an enormous and unnatural burden. The

World Health Organisation even included them as potential carcinogens. Reduced quality of sleep and chronic sleep deficit, the so-called social jet lag, are frequently responsible for higher error rates, lower concentration and a reduced ability to cope with emotional stress. Exposure through suitable lighting can contribute to improved light hygiene and consequently better management of crisis situations.

Quality lighting is one of the cornerstones when creating a stimulating and comfortable working environment as regards its direct impact on our performance, health and vitality. Thanks to modern technologies, it also constitutes a strong potential for improved activities and results of the defence, security and integrated rescue services.

*Daniel Jesenský and Hynek Medřický,
Spectrasol*



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