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SPORTS

White Paper on BioCentric Lighting™

BIOCENTRIC LIGHTING AND ATHLETES

There is a growing interest in the use of light to improve athletic performance. Light is the most important external synchronizer for the circadian rhythms in the body, rhythms that are internally driven variations in an individual's biological and behavioral functions that cycle over roughly a 24-hour period. As an athlete's unique circadian rhythm affects individual performance, light can be used to modulate this rhythm as well as having direct beneficial effect on alertness and wellbeing.

We all know that some perform better in the morning whereas others prefer nighttime exercise.

A group of researchers categorized elite athletes according to their body clock types into early, intermediate and late circadian types. They found performance differences that could be up to 26 % over the course of the day depending on the type¹.

Early circadian types performed their best at around 12 pm, intermediate at around 4 pm and late circadian types at around 8 pm.

Others have found similar results. Baseball players who were morning larks had significantly higher batting averages in day games² and evening-type swimmers swam on average 6 % slower in the morning than they did in the evening. Morning type swimmers required 5-7 times more effort in the evening trial to achieve the same performance result as in the morning trial³.

Alerting effect of light

Light invoke several direct effects on human physiology. Light exposure leads to increased heart rate, increased alertness and a reduction of sleepiness. It is well documented that light also improves the feeling of well-

being⁴. International competitions often take place in the late evening, a time when circadian related increase in melatonin is expected with detrimental effect on cognitive and physical performance.

Very limited research on the effect of different light exposure on physical performance exists so far. Early results in a recent study, where well trained men performed a 12 min time trial on a bicycle ergometer in the evening, did not show any benefit on maximal physical performance for blue light exposure prior to training, but did show an advantage on maintaining their performance compared to the control group with normal light exposure⁵.

Sleep, circadian disruption and athletic performance

Balancing training, work commitments, family and personal life is a difficult challenge for an elite athlete and many times sleep pay the price.

A study among 46 Great Britain Olympic squad members revealed that athletes experienced poorer markers of sleep compared to age matched nonathletic individuals. An Australian study revealed that international

and national athletes slept on average 6h and 42 min per night, far from the recommended minimum of 7 hours per night⁶.

For athletes sleep deprivation can have several negative effects on performance. A greater chance for injury was found among athletes who slept less than 7 hours⁷ and without enough sleep, the physical output is impaired (sprint speed, reaction time).

Other related affected areas as well are immunity and cognition (memory, executive function)⁸.



Studies also report a decrease in performance regarding endurance performance. Diminished motivation due to sleep deprivation is thought to be part of the explanation for that. Evening performance seems to be influenced to a greater extent by sleep deprivation than morning performance⁹.

Sleep deprivation also affects learning. Quality sleep on the first night following training is critical and scientific research suggest that sleep-dependent motor sequence learning depends on quality sleep within the first 24 hours after training⁹.

Travelling

International travel is nowadays part of many international athletes life. Feeling fatigued is clearly not the optimal mindset in which to perform at one's best and this affects performance.

Travelling across time zones leads to a desynchronization of circadian rhythms where the human body tries to adapt to the time changes. Generally travelling westward is more easily adaptable than travelling eastward and the human body adjusts on average

one hour per day to a time zone shift.

Most acclimated to the time zone will perform better and indeed American football teams residing perform better than the teams travelling eastward.

Ideally any athletes should travel several days in advance to adjust to the new time zone. Many times this is not possible. Instead light can be one measure to help to readjust the body's clock.

The International Federation of Sports Medicine recommends to gradually shift the sleep schedule (30 to 60 minutes per day) toward that of the destination for a few days prior to departure by using appropriately timed bright light and darkness, melatonin, or exercise to shift circadian rhythms¹⁰.

Summary

- Chronobiology has an impact on athletic performance
- Light can increase alertness and reduce sleepiness
- Sleep is important for physical performance and training
- Light can be used to adjust a disturbed circadian rhythm

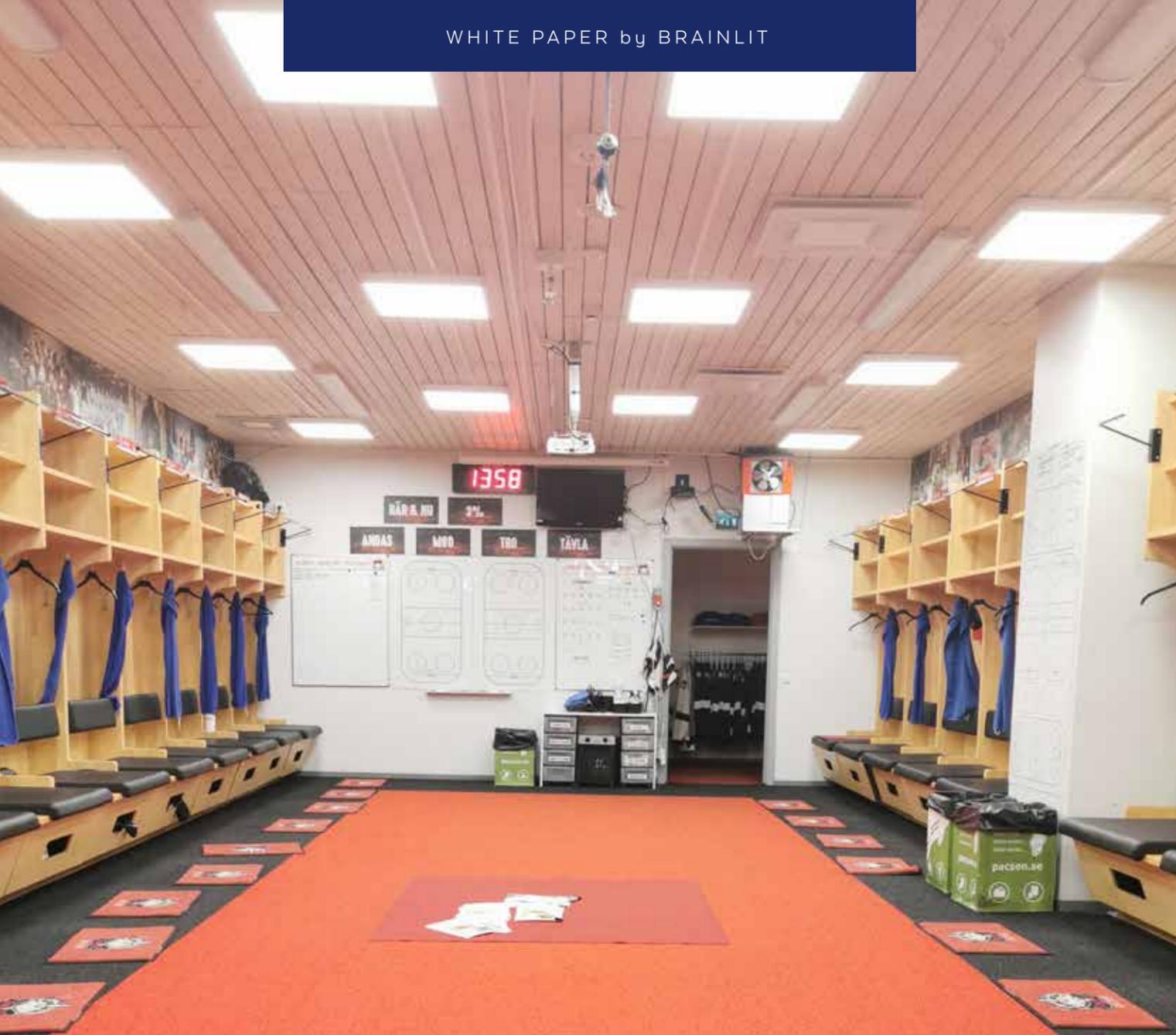
When performing on a high level, looking for a 1 % advantage quickly adds up to victories. Any elite performing athlete evaluates all aspects that impact output carefully.

Improving sleep and adapting diurnal rhythm to circadian chronotype seems to be beneficial for athletic performance. Good sleep and even sleep extension can be advantageous as seen in improved reaction time, turn time and overall sprint among swimmers⁶.

Timed personalized light that stabilizes the circadian rhythms may improve performance. Furthermore, the direct alerting effect of light could be used to improve alertness and motivation.

Light showers that provide high intensity cold white light may also be used to activate and boost energy.

This field of research is still evolving and new findings provide understandings of the beneficial effects of light for athletic performance and wellbeing. The BCL™ system is easily adaptable to meet these new insights.



References

1. Facer-Childs E, Brandstaetter R. The impact of circadian phenotype and time since awakening on diurnal performance in athletes. *Curr Biol*. 2015;25(4):518-522. doi:10.1016/j.cub.2014.12.036
2. Interview Dr Michele Lastella PhD. https://www.youtube.com/watch?v=Z5a1_V_2i5g&t=219s.
3. Anderson A, Murray G, Herlihy M, et al. Circadian effects on performance and effort in collegiate swimmers. *J Circadian Rhythms*. 2018;16(1):1-9. doi:10.5334/jcr.165
4. Cajochen C, Chellappa S, Schmidt C. What keeps us awake?—the role of clocks and hourglasses, light, and melatonin. *Int Rev Neurobiol*. 2010;93(C):57-90. doi:10.1016/S0074-7742(10)93003-1
5. Knaier R, Schäfer J, Rossmeissl A, et al. Effects of bright and blue light on acoustic reaction time and maximum

- handgrip strength in male athletes: a randomized controlled trial. *Eur J Appl Physiol*. 2017;117(8):1689-1696. doi:10.1007/s00421-017-3659-0
6. Halson SL, Juliff LE. Sleep, sport, and the brain 2. *234:13-31*.
7. Gao B, Dwivedi S, Milewski MD, Cruz AI. Chronic Lack of Sleep Is Associated With Increased Sports Injury in Adolescents: a Systematic Review and Meta-Analysis. *Orthop J Sport Med*. 2019;7(3_suppl):2325967119S0013. doi:10.1177/2325967119S00132
8. Thun E, Bjorvatn B, Flo E, Harris A, Pallesen S. Sleep, circadian rhythms, and athletic performance. *Sleep Med Rev*. 2015. doi:10.1016/j.smrv.2014.11.003
9. Venter RE. Role of sleep in performance and recovery of athletes: A review article. *South African J Res Sport Phys Educ Recreat*. 2012;34(1):167-184.
10. FIMS Position Statement: Air Travel and Performance in Sports. March 2004.

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