

SUMMARY OF RESEARCH

Overview

We spend 80% of our time indoors, and working for over eight hours in poor light can be exhausting. Recent lighting industry research shows, however, that the right office lighting not only makes the office environment more appealing, it can raise office workers' productivity and bring a range of health and well-being improvements as well as financial benefits. But different individuals and different tasks require different lighting requirements so one solution is to give people control over the brightness and spectrum of white light in their offices. Below, Philips has summarized the basic findings that lighting professionals, architects, building designers and business owners need to know.

Brighter office lighting brings a range of benefits

We receive over three quarters of our information through our eyes. Around 50% of our brain is involved in processing that information, and poor lighting makes it a struggle to make sense of what we're seeing. Offices should make best use of natural lighting (seating people next to windows for example) while cutting glare, and adding task lights where needed. Light should be evenly distributed, and you can improve the perceived brightness of a space by lighting walls and other vertical surfaces. Increasingly, research is showing that merely complying with existing laws and regulations is not enough to create a healthy environment. Using natural light, increasing light levels up to around 1000 lux, and employing cooler light tones can all be beneficial.

Better lighting can:

- improve visual acuity (Adrian 1993, Sagawa et al 2003, Berman et al 2006) and reduce blurring (Di 2010, 2011)
- enhance concentration and alertness (Steidle 2010, Hoffmann 2008, Ruger 2005)
- improve reading speed (Mott 2012, Barkmann 2010, Fuchs 2001)
- reduce evening fatigue (Ariès 2005)
- improve mood (Ballal et al 2006) and subjective well-being (Leather 1998, Oldham & Fried 1987, Wang & Boubabri 2009)
- reduce double vision, headaches, eye strain and – because the eye muscles are connected to the neck muscles – neck pain (Hemphälä 2013)
- improve job satisfaction (Charles 2003), organizational commitment and employee engagement (Veitch 2010).

While much lower and warmer light levels:

- enhance creative thinking (Steidle 2011)
- enhance cooperative behavior (Baron 1992, Galetska et al 2011).

Cooler white colors can improve performance, too

'White' light is made up of all colors, and scientists are finding that the color temperatures of white light are also important. Somewhat confusingly, 'warmer' colors like yellow and red (of candle light or sunsets, for example) have low color temperatures while 'cooler' colors like blue (of the midday sun) have high color temperatures. Although the literature consistently reports the benefits of improved lighting, we are all unique. Our individual vision needs don't depend on the physical requirements of the task alone, but also on our individual visual perception. Some people find warmer light tones to be more comfortable.

In general, however, using bluer (cooler) light:

- shows greater contrast between detail and background (Adrian 1993)
- reduces eye tiredness (Di 2011), improves alertness and concentration (Mills 2007, Rautkylä et al 2010, Viola 2008) reduces sleepiness and increases self-reported performance (Viola 2008)
- improves task performance at dimmed light levels (Berman et al 1994, Boyce 2003).

Give people control

Everyone's eyes are unique, and their characteristics are constantly changing as we grow older. Allowing people to control their own light levels – optimizing both intensity and color spectrum – helps people to perform their tasks. Optimizing light levels to people's individual preferences gives:

- best visual comfort for visually demanding tasks like reading and studying (Butler et al 1987, Dunn 1985) self-reported sharper vision, improved contrast and optimum eye comfort (Van den Berg, Internal research, Philips EyeComfort Pro desk light 2013)
- higher job satisfaction (Lee and Brand 2005, Herman Miller 2007), improved mood and comfort (Newsham 2003) and higher perceived productivity (Bordass 1993)
- lower error rates, absences from work and intent to change jobs while improving health, productivity and collaboration (Newham 2009, Veitch 2011, Bluysen 1996 & 2011, van der Voordt 2003).

Age-friendly lighting

With many countries increasing the age for retirement, our global workforce is getting older. Older peoples' eyes capture less light – at the age of 60 you need significantly more light than you needed at 20 to see the same detail. In dim light, older people have to work harder to process information, which is tiring. They also have increased sensitivity to glare. So, older people need lighting that is brighter and more carefully designed to see clearly. One possible solution is extra task lighting, with desk lights enhancing the visual environment and creating a personal space.

In addition to the guidelines we've given above, task lighting for older people can:

- double reading speeds (Geerdinck et al 2009)
- improve task performance (Berman et al 1994)

PHILIPS

- sharpen self-reported vision, improve contrast and eye comfort (Van den Berg, Internal research, Philips EyeComfort Pro desk light 2013)
- reduce the effort needed for visual tasks, so by the end of the day improving alertness, and cutting fatigue, and associated physical complaints (Hemphälä 2013).

Other factors: sound, energy efficiency and HVACs

Light is of course not the only factor in producing a comfortable atmosphere, particularly in open-plan offices. Gensler in 2008 isolated four essential work modes: 'focus', 'learn', 'collaborate' and 'socialize'. Open plan offices encourage collaboration and socializing, but it is difficult to concentrate in noisy environments, which means people can lose focus and find learning more difficult.

Important aspects include:

- background noise reduction to create a more comfortable environment, some greater alertness, and improve workplace satisfaction (Newsham 2009)
- energy efficiency, with LED lights enhancing brightness during only part of the day (http://www.lightingeurope.org/uploads/files/Human_Centric_Lighting_general_overview_September_2014.pdf, <http://lightingforpeople.eu/lighting-applications/>)
- ventilation, with natural ventilation wherever possible and at least complying with HVAC standards like ASHRAE 55
- air quality (Milton, Glencross, & Walters 2000)
- thermal comfort, acoustic qualities (Banbury & Berry, 1998)
- ergonomic furniture (Vischer, 2007)
- use of daylight (Elzeyadi, 2011) and artificial light to influence the job performance, health and well-being of office employees (Alker, Malanca, Pottage, & O'Brien, n.d.)
- a generally comfortable office environment (http://www.wbdg.org/design/provide_comfort.php).