
REFERENCE LIST OF SCIENTIFIC STUDIES CONCERNING POSSIBLE EFFECTS OF HCL

Are all these effects really proven by scientific studies?

Application	Scientifically proven effects
Office	improved accuracy (+12%) and productivity (+10%) in office work (see Ref. A #1)
Office, Education	improved short and long term concentration (+100%) and concentration performance (+85%) , (Ref. A #2)
Office, Education	improved memory functions (visual +69%, verbal +120%) (Ref. A #2)
Office, Education	improved processing speed (+50%) (Ref. A #2)
Office, Education	improved working memory (+20%) (Ref. A #3)
Education	improved reading speed in pupils (+35%), reduced error rate (-40%) (Ref. A #5)
Education	improved relaxation by warm white light (restlessness -76%) (Ref. A #5)
General	improved alertness (Ref. C #1)
Industry	improved productivity in simple tasks in industrial work places (+4,5%) (Ref. C #5)
Hospital, elderly care	improved sleep, daytime activity, performance and social behavior in elderly people (Ref. B #1, B #2, B #3)
Hospital, elderly care	improved (re-established) circadian rhythm in elderly people (Ref. B #3)

References

A) Office and Education related references

- #1 improved **accuracy** (+12%) and **productivity** (+10%) in office work; Nelson et al.; The snowball effect of healthy offices; Healthy Offices Research, CBRE, 2017
- #2 improved short and long term **concentration** (+100%) and **concentration performance** (+85%); improved **memory functions** (visual +69%, verbal +120%); improved **processing speed** (+50%); Keis, O., et al. (2014). "Influence of blue-enriched classroom lighting on students' cognitive performance." TiNSE
- #3 Improved **working memory** (+20%) ; Kretschmer, V., et al. (2012). "Bright-light effects on cognitive performance in elderly persons working simulated night shifts: psychological well-being as a mediator?" Int. Arch. Occup. Environm. Health.
- #5 improved **reading speed** in pupils (+35%), **reduced error** rate (-40%) Barkmann, C., et al. (2011). "Applicability and efficacy of variable light in schools." Physiology & Behavior **105**(3): 621-627

B) Elderly Care

- #1 C. A. Sust et al.; Improved quality of life for resident dementia patients: St. Katharina research project in Vienna; Zumtobel Research 2012
- #2 D. Lang et al.; Positive effects of biologically effective light on residents in nursing homes suffering from dementia; IES Symposium Light and Seniors, Washington (2012), symposium proceedings
- #3 Riemersma-van der Lek, R. F., et al. (2008). "Effect of bright light and melatonin on cognitive and noncognitive function in elderly residents of group care facilities: a randomized controlled trial." JAMA : the journal of the American Medical Association **299**(22): 2642-2655.

C) Metastudies, including additional references

- #1 improved **alertness** by bright light (>1000 lx) and high CCT (5-6000K) (many studies, see literature review by Souman) Souman, J. L., et al. (2018). "Acute alerting effects of light: A systematic literature review." Behav Brain Res **337**: 228-239.
- #2 L. Schlangen et al. (2014); Lighting for health and well-being in education, work places, nursing homes, domestic applications, and smart cities; Deliverable 3.2 and 3.4, Accelerate SSL Innovation for Europe, FP7-ICT-2013-11-619249; <http://lightingforpeople.eu/2016/wp-content/uploads/2016/03/SSLerate-3.2-3.4-v4.pdf>
- #3 M. Giménez et al (2016); Report on Metric to Quantify Biological Light Exposure Doses; Final report deliverable 3.7, Accelerate SSL Innovation for Europe, FP7-ICT-2013-11-619249; [http://lightingforpeople.eu/2016/wp-content/uploads/2016/10/SSL-erateReport on metric to quantify biological light exposure doses.pdf](http://lightingforpeople.eu/2016/wp-content/uploads/2016/10/SSL-erateReport%20on%20metric%20to%20quantify%20biological%20light%20exposure%20doses.pdf)
- #4 Human Centric Lighting: Going Beyond Energy Efficiency; Market Study, A.T. Kearney (2013)
- #5 Quantified benefits of Human Centric Lighting; Market Study, A.T. Kearney (2015)