



CIE RESEARCH:

CIE Supports Tailored Lighting Recommendations

**Special
Excerpt**

CIE Supports Tailored Lighting Recommendations

The International Commission on Illumination (CIE) understands the importance of adjusting lighting to optimally serve the needs of individuals and in different applications. A concerted research effort is required to deliver knowledge that can support specific lighting recommendations for specific populations and times.

Individuals differ widely in their visual capabilities and needs. However, lighting recommendations are based on results averaged across samples, usually drawn from able-bodied young adults active during daytime, and hence may not account for individuals or minority groups with specific needs. These differences can include the age, race, and health (visual and other) of the observer. Moreover, needs can vary within application contexts at different times, which current recommendations do not reflect.

Tailored lighting recommendations are needed in both interior and exterior lighting. These two application fields are covered by CIE Division 3 “Interior Environment and Lighting Design” and CIE Division 4 “Transportation and Exterior Applications”. An important development took place in October 2017, when by merging the former CIE Divisions 4 and 5, a new Division 4 has been commenced that now covers the full range of exterior applications and strengthens closer collaboration of experts in this field. However, research on tailored lighting demands close collaboration between fundamental research and application research. Fundamental research is represented by CIE Division 1 “Vision and Colour”, responsible for studying visual responses to light and establishing the related standards and also CIE Division 6 “Photobiology and Photochemistry” which addresses biological effects of light and radiation.

Elderly and Visually Impaired

In many countries, people are living to older ages, and the proportion of older people is increasing. With age, the visual system deteriorates, and this means that lighting recommendations based primarily on research with younger populations may not be suitable. Although there is good knowledge of the visual changes that occur with age, such as diminished visual acuity and increased susceptibility to disability glare, far less is known about how to adapt lighting design and recommendations to the visual needs of those with specific visual impairments. The knowledge generated under this topic would lead to benefits for segments of society that are not well served by current recommendations, including those with visual impairments.

In the past few years the CIE has published three reports which are a start to addressing these needs, primarily for interior lighting applications.

CIE reports on this topic:

- CIE 227:2017 Lighting for Older People and People with Visual Impairment in Buildings
- CIE 218:2016 Research Roadmap for Healthful Interior Lighting Applications
- CIE 196:2011 CIE Guide to Increasing Accessibility in Light and Lighting

For outdoor lighting, far less knowledge is available. One application where this might be critical is lighting for drivers, given that the outcome of inadequate vision may have serious implications. Work on this issue is underway in technical committee TC 4-54

“Road Lighting for Ageing Drivers”.

More fundamental work is occurring in TC 1-84 “Definition of Visual Field for Conspicuity” and TC 1-89 “Enhancement of Images for Colour Defective Observers”, the latter focused on a specific visual problem.

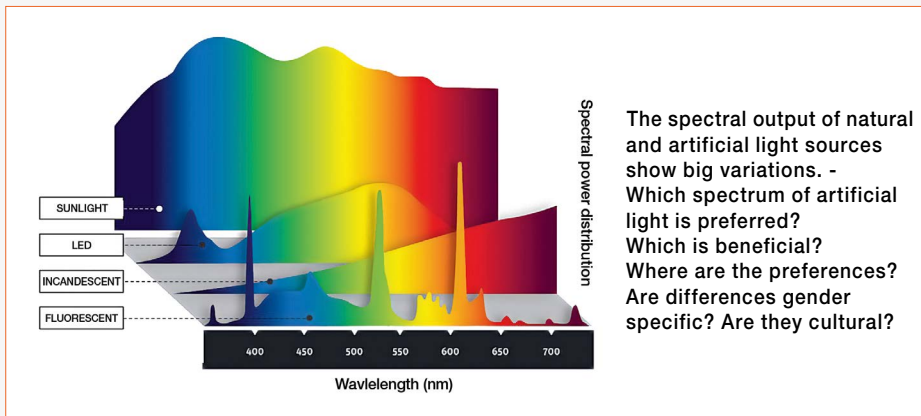
Key research questions being currently considered include:

- What are the age-related changes in non-visual photoreceptors (ipRGC) and neural responses? How does this change lighting recommendations for the elderly?
- Which ageing effects of the visual system are most detrimental to the performance of workers, drivers and pedestrians and how could or should this be taken into account in lighting design and requirements?
- How do visual impairments or disabilities affect the performance of people and how should these be taken into account in lighting design?

Understanding these issues is expected to drive technological change by providing the evidence needed for the development of suitable lighting technologies or design practices to assist these populations.

Health Conditions

Other user groups of special interest are those susceptible to migraine headache, epilepsy, and depression. The potential beneficiaries of this work are many. For example, there is some evidence that certain individuals are more susceptible to spatial and temporal patterns of light and are at risk of headache, eyestrain,



and visual disturbance as a result, but there are no specific lighting design recommendations for these individuals and no validated method for identifying those who might need this assistance. However, any recommendations from the research should also consider the impact on the wider population who might not need this assistance.

In a related vein, there is evidence that lighting recommendations could be made conditional in order to provide guidance that balances different concerns. For example, high colour fidelity may improve visual performance such that illuminance levels could be reduced. This could be of benefit to those with colour vision deficiencies, as well as offering the opportunity to reduce lighting energy use.

Genetic and Cultural Differences

Differences in visual needs associated with genetic variation are investigated within very current research projects and have been reported at the last CIE mid-term meeting in Korea. It was found out that level of melanin in the human eye is responsible for different visual perception. This may explain differences in research results between Asian populations and others, and might also account for the observed differences in lighting practice in different cultures. Other research projects are aimed at study of facial skin tone preferences in relation to light source spectrum. However, results of such investigations are yet isolated and require broader confirmation what is indispensable without support in form of further research activities.

Season and Time of Day

Visual needs differ not only between individuals but they vary also with season and time of day. Ergonomic lighting supports working enthusiasm by conscious control of hormonal processes through spectral distribution of light, its timing and intensity. Good lighting prevents fatigue, which can lead to errors. Once the work is done, lighting should help to create a relaxing atmosphere for regeneration. This has often to be satisfied by the same lighting installation.

Interaction of Different User Groups

Meeting the varying needs of different users in the same space is another point of interest. Some of the applications where this problem is particularly significant: classrooms (teacher vs. children), retail shops (shopping assistant vs. customers), sport facilities (athletes vs. referees, fans and camera systems), roads (drivers, pedestrians, inhabitants).

Applications

The need for recommendations to support both visual and non-visual effects of light on humans is obvious in lighting of interior workplaces, particularly those occupied on a 24-hour basis. Outdoor workplaces have been studied less, but the challenge is no different, especially at night. Night workplaces face challenges to keep the workers active and alert - night shifts are known for loss of attention, fatigue and sleepiness. Increasing light levels and blue content in the spectrum may help the workers, however, obtrusive light may harm inhabitants living nearby working sites, disturbing their sleep. Intrusion of stray

light in the night-time environment must be limited to protect the local ecosystem.

The question is how to balance these contradictory requirements and how to optimize the lighting system with respect to the needs of different people, the ecology, and with the best energy performance.

The situation in road lighting and public lighting of exterior communications in general is very similar. For drivers it is important to support visual performance and to prevent fatigue. However, pedestrians are affected by the same lighting but they may require more relaxing effects so that they can sleep easily shortly after they finish their walk outdoors.

Home lighting itself is an unknown territory. There are only few scientific papers on this subject available. People coming home from workplace, shopping or having spent some time outdoors by sporting or cultural activities require different quality of light in evening and early morning hours than outside. There are few studies on lighting quality preferences and a strong support for research must be devoted for that area. Feedback from questionnaire-based investigations showed that ordinary people are unable to set the lighting according to their real needs and preferences and recommendations would be much appreciated here.

New Technologies for Demanding Lighting Tasks

With tailored lighting a new era in lighting is emerging. It is hard to imagine that tailored lighting can be of a static type and only determined for a single group of users, ignoring others who share the same space. Happily, technology exists today to enable the tailored control we foresee: the possibility to compose a light spectrum and to change it easily, almost infinite dimming options, and dimming reacting immediately. Nevertheless to realize this vision we must first understand what people need, both physiologically and psychologically, and set proper criteria for lighting parameters by a holistic approach. CIE calls on the lighting community to help to generate the knowledge we need to make the best use of the tremendous new capabilities of lighting systems. ■

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