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## International Dark-Sky Association

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### The Aging Eye—Some Basic Information

The issue of the aging eye will become an increasingly important one over the coming years. The population as a whole is aging; we are getting older. That will require many necessary changes in how we plan for and design our interior and our exterior environment. For example, most lighting research studies have used relatively young subjects. Almost all current recommended lighting levels have been established for young eyes. But eyes age, and many things relative to vision change for the older eye. Lighting levels must be amended, glare becomes much more important, and so on. It is critical to understand these differences and to allow for them.

This information sheet just scratches the surface on the subject of the aging eye, but it offers a beginning to appreciating the issues. We hope it stimulates more interest in the topic.

#### Some basic information

The average age of the population of the United States continues to increase, as it does worldwide. Life expectancy now approaches 80 years of age in many countries, and the number of people aged 65-85 in the developing countries will increase in the next decades by at least 50 percent. It is critical that this fact be taken into account in planning for the future. With age, we undergo a natural process that reduces our visual abilities.

Glare, illumination level, and transient adaptation are all important for the aging eye. One must consider proper lighting as a significant issue for the older adult's health and quality of life. We all need good lighting, but this is especially true for the elderly.

Dr. Everett Koop stated in 1992 "in order to control healthcare costs, the one thing that we cannot have too much of is prevention." Prevention is important for both wellness and to avoid accidents.

There are major concerns about good lighting for the elderly. Note that almost all recommendations about lighting levels and other parameters have been determined solely for the younger eye. The older eye is different. Some of these issues are listed and then discussed in more depth below.

- Aging eyes need more light, especially for low contrast tasks.
- Aging eyes are more sensitive to glare.
- Aging eyes function better with higher contrast for many tasks, like reading.
- Aging eyes need better lighting uniformity (but only if there is adequate contrast!).
- Peripheral vision may diminish.
- Changing the eye's focus from one distance to another is more difficult.
- Aging eyes respond better with reduced visual clutter and confusion in the visual field.
- As one ages, experiencing a more natural day/night cycle becomes increasingly important.

All of these speak to the need for quality lighting, indoors and outdoors. They all reinforce IDA's position on the need for quality nighttime lighting and a better nighttime environment.

#### Some quotes from various sources

Research on the effects of glare on the aging eye show a doubling of the adverse impacts of glare by age 70 and a tripling by age 83.

The elderly are particularly susceptible to disability glare, discomfort glare, veiling reflections, and markedly differing luminance levels.

Since aging eyes are sensitive to glare, bright light sources should be out of direct view or shielded so direct glare is avoided. The only thing we can do to decrease or avoid disability glare is to screen the glaring light from reaching the eye.

Glare is frequently caused by light sources that are brighter than their surroundings, and that are directly seen along the line of sight at normal viewing angles.

Control and reduce scattered light. Provide good object contrast while limiting the total amount of light entering the eye. Eliminate or reduce light from all sources that contribute to corneal illuminance but do not illuminate the objects needing to be seen. Employ reverse contrast by using brighter print on a darker background, thus offering the same contrast but drastically reducing the total flux entering the eye. (In signs, for example, use darker backgrounds and light lettering for good contrast and visibility.) Light only the areas where light is needed.

Adaptation control is important. The time required to adapt to changing light levels is much longer for the aged. This means that going from bright areas to dark ones, and the reverse, can be a real problem. Good visibility is difficult when moving between spaces lighted at very different light levels. The adaptation time is longer when going from bright to dark than the reverse. One example seen frequently these days is in going from an overlit service station back out onto the street or highway. Ironically, the excessive lighting is "justified" in terms of safety rather than marketing. Similar differences can be seen when going from overlit entryways to walkways or parking lots. The solution is not to raise lighting levels in all darker areas (an impossible task) but to use rational levels in the brighter areas. Large differences in light level should be minimized in transition areas, such as building entrances, parking lots, walkways, and streets. While differences in light level are important in any lighting design, they are of paramount importance for the elderly. In addition, lighting should not be directed toward the viewer's eyes so as to cause glare and veiling luminance.

Adequate contrast is an essential element of good lighting, but too much contrast can decrease the ability to see well.

Good lighting in transition areas makes the adjustment easier when going between places with differing levels of brightness. An even light distribution that does not create deep shadows makes pathways easier to travel. Using light to emphasize dangerous areas, such as steps, changes in ground level, and sharp corners can help prevent accidents.

Quality, not quantity, of lighting is what counts. By quality one means: freedom from glare, freedom from veiling reflections, freedom from flicker, smooth transitions, and appropriate spectral distribution. Quality night lighting takes into account the strengths and weaknesses of human vision.

It is important also for our body systems to be connected to the time of day: daylight or adequate indoor lighting levels in the day (or

during waking hours), and darkness during sleeping hours. Daylight and darkness are important for synchronization of our circadian rhythms (sleep/awake cycle). While adequate daylight is needed in the day, darkness is also needed at night. These body clock issues are important considerations, especially for the elderly.

### **Summarizing some of the special concerns of older drivers**

- Overcoming glare (approaching headlights, glare from roadway lighting and adjacent facilities, and driving towards the low sun)
- Entering or leaving areas that are much brighter than their surroundings (transient adaptation)
- Seeing into shadowed areas in places where high contrast exists
- Reading signs with inadequate conspicuity (or contrast); here, as in most other applications, adding more light is not the answer, as high luminance levels can be disabling under the mesopic luminance conditions of night driving
- Dirty windshields (veiling luminance)

### **References**

Many exist. Begin by searching on the Web for "Aging Eye" and other key words or phrases.

The following two publications have very good information, and references:

"Lighting and the Visual Environment for Senior Living," IESNA Recommended Practice No. 28, 1998. Prepared by the IESNA Committee on Lighting for the Aged and Partially Sighted. Chair: E. Noell, Center of Design for an Aging Society, 6205 SW Hood Ave., Portland, OR 97201.

"Lighting for Aging Vision and Health," Proceedings of the 3rd International Symposium, March 22-23, 1995, Orlando, FL. Sponsored by the Lighting Research Institute.

Governments are beginning to pay attention to this issue, as are organizations such as the AARP. Check your local library and other resources for more information. Let us know of the good things you find so we can add them to our reference lists.

Many of the discussions and recommendations in the literature deal with interior lighting, but the same factors usually apply to outdoor lighting as well.