

Predilection to daylight is especially clear in the AN-AL group. They commented that they prefer daylight for reading mostly because it is easier for them to find a comfortable reading position, so they may hold paper close to the eyes and avoid deep shadows.

*Which light distribution do you prefer in a room for permanent stay?*

	<b>N (18)</b>	<b>AL-AN (6)</b>	<b>RP (5)</b>
Very even	6	3	2
Even	3	3	1
Varied	8	0	1
Very varied	1	0	1

All light sensitive objects prefer even or very even light distribution, objects from other groups have split opinion.

*Which light level do you prefer in a room for permanent stay?*

	<b>N (18)</b>	<b>AL-AN (6)</b>	<b>RP (5)</b>
High	11	1	1
Low	7	5	4

Most visually impaired objects claim, that they prefer generally low light level in a room for permanent stay.

## **5. Conclusions and discussion**

It was a good correlation between the daylighting preferences that appeared in the full-scale study and the answers given in the interview.

The following trend preferences were found in the study:

Objects having diagnosis ocular albinisme (AL) and aniridi (AN):

- the visual contact with the outside is very important,
- large windows, giving a wide and remote view toward greenery and/or water are preferred
- glary light sources are not acceptable:
  - a view toward sky should be avoided: windows should be situated as low as possible or sunshading devices should be used to effectively reduce the luminance on the window surface when the sky luminance is too high
  - any electrical light sources that may cause glare should be avoided
  - electrical light sources that create a strong light spots (especially on room surfaces having high reflection factors) should be used with care
- rather low mean illuminance
  - rather small windows
- rather even light distribution
  - lamps that give an even light distribution on the room surfaces, e.g. wall-washers, are a good choice

- dark spaces in the room should be avoided e.g. in corners or beneath a table
- modeling is important for visibility, e.g. shading devices should not diffuse light completely,
- daylight (delivered through windows) is a preferable lighting for reading (in contrast to electrical light delivered from small fixtures), a preferable reading position is with the back to the window
- a preferable sitting position in the room, e.g. by the table, is with the back to the window, or with the side if the window is not in the visual field,

Objects having diagnosis retinitis pigmentosa (RP):

- the visual contact with the outside is important,
- large windows, giving a wide and remote view toward water, greenery and/or human activities are preferable
- glary light sources are not acceptable:
  - a view toward sky should be minimized, sunshading devices should be used to reduce the luminance of the window surface depending on the sky conditions
  - any electrical light sources that may cause glare should be avoided
- rather high illuminance levels are preferred
  - rather large windows
  - many lamps giving a rather high mean illuminance
- varied, but not glary light distribution is preferred
  - spots dimmed by e.g. 50%, that give a varied light distribution but not too high luminances on the room surfaces are a good choice
- both, daylighting and electrical lighting are acceptable for reading, a preferable reading position by a window is with the back to the window
- a preferable sitting position in the room, e.g. by the table, is with the back or the side to the window, a position with the view toward the window is not acceptable at all.

Normally seeing objects:

- the visual contact with the outside is very important,
- large windows, giving a wide and remote view toward water and/or greenery are preferable,
  - horizontal, rather than vertical windows,
  - if venetian blinds: inside, rather than outside, light wood or white rather than dark or colored
  - if curtains: very thin or thin, white or neutral color
- rather high illuminance levels are preferred
  - large or very large windows
  - many lamps giving a rather high mean electrical illuminance
- clear preferences for light distribution were not found
  - lighting made of wall-washers in the 100% power was the best choice
  - lighting made of spots dimmed by e.g. 50%, was as good choice as lighting made of wall-washers dimmed 50%
- glary light sources are annoying but not unacceptable:

- daylighting rather than electrical lighting are preferred for reading, a preferable reading position by a window is with the back/side to the window
- a preferable sitting position in the room, e.g. by the table, is with the back to the side wall that gives overview over activities in the room, possibility for the view out and the feeling of protection owing to the wall.

This research project showed considerable differences with regard to lighting preferences between subjects with normal vision and subjects with visual impairment from three diagnosis groups. We learned that the luminance distribution in a room is a very important behavioral factor for visually impaired people. The danger for visual discomfort is much higher than for normally seeing people because the adaptation process is poorer and much slower. Therefore any potential sources for glare, both windows and lamps should be controlled.

Even if we find trend preferences for each diagnosis group, intra-group differences are so large that individual lighting assessments and the mapping of individual lighting needs are needed. We might also suspect that for other eye diseases, new preferences will be discovered, and thus emphasize the need for an individual approach.

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## References

1. Aries, M. (2005) *Human Lighting Demands: Healthy Lighting in an Office Environment*. Eindhoven University Press,.
2. Bek, T og Ehlers, N (2004). Uvea. I: Høvdning, G. (red.) *Oftalmologi*
3. Beus & Small, (2005), web; <http://www.emedicine.com/oph/topic704.htm>
4. Boyce, P.R. (2003) *Human factors in lighting* New York, NY, Taylor & Francis.
5. Bullimore, M.A. and Bailey, I. L. (1995). Reading and eye movements in age-related maculopathy. *Optometry and Vision Science*, 72, 125-138
6. Canter D. (1977) *The psychology of place*, London : Architectural Press.
7. Christoffersen, J., E. Pettersen et al. (1999) *Windows and daylight – a post occupancy evaluation of offices*. Hørsholm, Statens Byggeforskningsinstitut (SBI)
8. Collins, B.L. (1975) *Windows and people: a literature survey. Psychological reaction to environments with and without windows*. Gaithersburg, MD, Natural Bureau of Standards.
9. Cornelissen, F. W., Bootsma, A., & Kooijman, A. C. (1995). Object perception by visually impaired people at different light levels. *Vision Research*, 35, 161-168.
10. Cornelissen, F. W., Kooijman, A. C., Dumbar, G., van der Wildt, G. J., & Nijland, R. (1991). Illumination research as part of a visual assessment of visually impaired individuals. *Documenta Ophthalmologica*, 78, 195-203
11. Day, S (1990). Uveal tract. I: Taylor, D (red) *Pediatric Ophthalmology*. Blackwell Scientific Publications, Cambridge, USA