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Demonstration of a special viewer to investigate the perception and assessment of artificially illuminated rooms

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Demonstration of a special viewer to investigate the perception and assessment of artificially illuminated rooms

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Introduction

It is well known, that photometric assessment of a lighting system is not sufficient to produce indoor illumination that satisfies occupants (Tiller 1990). The reason is, that light does not only cause visibility of objects, which can be measured, but it acts also as a carrier of information. These two aspects can be connected to the following requirements:

- The illumination must not cause inconvenience. Sources of disturbances are glare, light deficiency, shadow, flicker, etc. These can be measured by means of photometric methods.
- The illumination must improve comfort. Light should organise the properties of information in the environment of humans. For example it can emphasize important information (eye-catcher) or it can stimulate desired associations (e.g., private ↔ public). Comfort is increased if these associations match the expected interior of the room.

The objective of the study was to establish new fundamentals for assessment of well-being (emotion) and the formation of associations (attribution).

Methods

In order to get realistic presentations of lighting systems and of the lit indoor environment we evaluated different experimental set-ups (Tab.1) and different possibilities of picture generation (Tab.2).

Tab.1: Parameters of experimental observation set-ups influencing the realism of presentations.

<table>
<thead>
<tr>
<th>observation equipment</th>
<th>stereoscopic vision</th>
<th>extended, regular visual field</th>
<th>eye movements</th>
<th>head movements</th>
<th>regular eye convergence</th>
<th>regular eye accommodation</th>
<th>measurement of luminance</th>
<th>fast, flexible experimental setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>lighting laboratory</td>
<td>++ ++ ++ ++ ++ ++</td>
<td>• reality</td>
<td>• slide projection</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>mock-up model 1:10</td>
<td>++ + - 0 0 + 0 + 0</td>
<td>• reality</td>
<td>• slide projection</td>
<td></td>
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<td></td>
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<tr>
<td>projection in half sphere (perimeter)</td>
<td>0 + + + 0 - + +</td>
<td>• slide projection</td>
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<tr>
<td>stereoscopic projection on screen</td>
<td>- - + - 0 - 0 + 0</td>
<td>• VDU</td>
<td>• slide projection</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>stereoscopic projection into eyes</td>
<td>+ + 0 - - 0 + +</td>
<td>• VDU</td>
<td>• slide projection</td>
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</tbody>
</table>

It was important to have a flexible system that allows changing lighting scenes rapidly. Therefore we have chosen stereoscopic projection of photographic slides into the eyes. The achieved realism is mainly a consequence of the extended and regular visual field. Stereoscopic vision pleases the subjects but enhances perception of depth only for short distances.
Tab.2: Parameters of picture generation influencing the realism of presentations.

<table>
<thead>
<tr>
<th></th>
<th>high resolution</th>
<th>extended range of luminance</th>
<th>colours</th>
<th>high flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>reality</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>slide projection</td>
<td>+</td>
<td>+</td>
<td>o</td>
<td>–</td>
</tr>
<tr>
<td>VDU</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>paper photograph</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>o</td>
</tr>
</tbody>
</table>

+ = possible; o = possible with additional expenditure; – = not possible

So-called “lighting scenarios” were used as objective world. The scenarios are realistic stereoscopic pictures of various types of interior lighting (Fig.2) generated with a special slide viewer (Fig.3). With this system the different effects of the lighting scenarios were recorded from 21 subjects using mutual comparison (MDS: Borg, Groenen 1997) as well as a built-in acoustical questionnaire.

Results

The results show, that the model of a mental construct system can be concretised by means of the special viewer. Subsequently we could establish a connection between the lighting scenarios and the mental construct system (Fig.4) on one hand as well as between the mental construct system and the subjective assessments on the other hand (not shown).

Fig.2: Luminance distribution of lighting scenarios.

Fig.3: Slide viewer in order to project stereoscopic pictures into the eyes (eye movement recording has not been used in these experiments).

Fig.4: 3-dimensional mental lighting construct, calculated from mutual scenario comparisons. Each sphere represents one lighting scenario (marked as in Fig.2). The distance between two spheres represents the perceived difference between the two corresponding scenarios. The subjects have unconsciously chosen three Dimensions to judge the differences.

Conclusions

The demonstrated system can represent interiors realistically. It is usable therefore as tool in basic research. It can be discussed, how the findings can be put into illumination planning practice. There is no need to alter planning tools but to modify planning concepts. These concepts should be based upon a common mental construct system of the planned building by all participants (architect, builder-owner, lighting engineer, user etc.). The demonstrated viewer can also be developed further (e.g. using high-resolution VDU-screens instead of slides), in order to get a planning tool for architects.

References
