PERCIFAL: Visual analysis of space, light and colour

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Abstract

This paper addresses the need for better and more accurate methods of recording and analyzing the visual experience of architectural space. PERCIFAL (Perceptive Spatial Analysis of Colour and Light) is an ongoing project that aims at developing a method of analysis that can capture coherent spatial experiences of colour and light. The starting point for PERCIFAL is a method of visual evaluation of space and light, developed by Professor Anders Liljefors at the former department of architectural lighting at KTH Architecture. PERCIFAL is based on direct visual observations and the recording of these observations by verbal-semantic descriptions using a questionnaire. It has been developed primarily as an educational tool, but we see in it potential for a design tool for professionals as well as for an analytical method for research. The first test results, conducted in Sweden, Norway and Finland, show that the method has significant pedagogical merits and that it allows interesting comparisons between physical measurements and visual experiences of space, light and colour.

1. Introduction

PERCIFAL (Perceptive Spatial Analysis of Colour and Light) is a subproject within the Nordic research project *SYN-TES: Human colour and light synthesis; towards a coherent field of knowledge*. SYN-TES grew from a need to share knowledge and find better ways of communicating across disciplines and research areas that deal with the human experience of light and colour in space. The SYN-TES project gathers together experts in lighting, colour, design and teaching from several Nordic universities, research institutions and companies. This paper presents PERCIFAL's background and methodology. In a separate paper Professor Barbara Matusiak et al. present some examples of its use as a tool for visual analysis.

2. Background

Our visual experience of the world consists of a totality of inseparable qualities: space, motion, light, colour, objects, details surfaces and textures. Two essential aspects of spatial experience that are among the most difficult to record and describe accurately, are light and colour. All existing methods tend to reduce the temporal and multidimensional experience of space into either static and flat images or into abstract alphanumerical data. Static flat images, such as drawings, paintings and photographs, the conventional methods for recording experiences of light and colour in space, are able to convey much of the total layout and atmosphere of spaces. They are also extremely useful in recording shape, location and details, but they cannot communicate reliably information about surface colours or levels of illumination. These can be recorded and communicated by photometric means and colour sample matching, but these methods tell us nothing about the

spatial context – and therefore the *coherent experience* – of the colours, lights, shadows and surfaces. As Arne Valberg states: "There is a fundamental difference between the physically defined stimulus magnitudes (if they are photometric, colorimetric or other) and the subjectively perceived qualities." (Valberg 2005:178-79).

We experience colour and light largely as a result of perceptual adjustment and adaptation. Spatial perceptual situations are highly complex; as we move around and through space, our perception and experience of the spatial totality are successively and simultaneously affected by global and local adaptation to varying illuminations and colours. (Noë, 2004 :17). This interaction of subject and surroundings is essential to our perception and experience of the world and cannot be described in photometric terms. The total experience of space, conveyed mostly by visual perception, is the final test of the success or failure of any designed environment. PERCIFAL is aimed at providing a tool for understanding the role of some key visual components in successful spatial design. Such visual experiences as *lightness*, *brightness*, *highlight*, *glare*, *colour* and *shadow* cannot be captured or communicated by measuring. They are relational qualities that arise from the subject's participation and action in space. They must therefore be addressed and analyzed in the context of participation and action.

3. The PERCIFAL method

The starting point for PERCIFAL is a method of visual evaluation of space and light, developed by Professor Anders Liljefors at the former department of architectural lighting at KTH Architecture (Liljefors, 2006). The cornerstone of this method is the realization that key visual aspects of space and light cannot be described in photometric terms. Originally the method had a purely educational purpose and for several years it has been an important part of the diploma course in lighting design in Jönköping University. This is still a central feature of PERCIFAL and we aim to develop this aspect further. However, the project sees in it also significant potential for a design tool for professionals and a method of analysis for research purposes. The development is carried out under consent of and in collaboration with professor Liljefors. As an essential part of developing the method, the SYN-TES research team members have discussed and carried out their own perceptive spatial analyses starting from Liljefors□s concepts.

The PERCIFAL method is based on direct visual observations and the recording of these observations by verbal-semantic descriptions using a questionnaire. These can be complemented with photography, photometric measurement and colour sample matching for later comparison with the visual observations. When possible, plans and elevations of the space in question are used for marking observer positions and measurements. Before moving to the chosen space, the observers are prepared in a training session lasting about one hour. The purpose of the training is to ensure that concepts involved and the use of the questionnaire are clear to the observers. The method and its background are related and discussed with the group. A "dry run" in the training room or some other preliminary space can also be used as a part of the training. The observers are told that there are no "right" or "wrong" answers to the questions and that they should answer according to their observations, i.e. visual perceptions only.

After moving to the space to be analyzed, the observers are given about twenty minutes to adapt to the lighting before starting observations proper. The observers can each be given specific viewing positions within the space or can be let move freely. The viewing positions are also recorded. The observation time can vary, but usually at least one hour is needed for a comprehensive analysis. The observers' answers are later analyzed statistically and their remarks summed up by

the supervisor(s). The results are shown and discussed in debriefing session with the observers. The debriefing is an important pedagogic aspect of the process.

The questionnaire is divided into the following eight main topics: *1) General impression of the space, 2) Overall level of light 3) Light distribution in the space, 4) Shadows and flecks of light, 5) Reflections and glare, 6) Colour of light, 7) Surface colours, 8) Interaction of space, objects and people*. Under the main headings there are more specific questions, which are either in the form of semantic differential scales or forced choice answers. For example under *3) Light distribution in the space* the observer is asked to answer the following questions:

> a) Horizontal distribution of light (between different parts of the space, at the same height from the floor): very even - - - - - very uneven?
> Which part of the space is dark/shaded?
> Which part is bright?
>
> b) Vertical distribution of light (between building parts at different heights): very even - - - - - very uneven?
> Which part of the space is dark/shaded?
> Which part is bright?

After each main topic the observer can add further remarks. There are several other places where observers are asked to answer freely in their own words. Sometimes the terms in question are given a short definition to help the observer understand the question and attend to the right phenomenon. For example: *Glare = an uncomfortable brightness contrast in one's field of vision*.

Some questions draw attention to factors that are not intrinsic qualities of the space itself, but rather indicators of visual experience in interaction with the space. Under the heading *Interaction of space, objects and people* observers are asked: *How natural does the colour of human skin/facial colour look in the space?* – an indicator of the chromatic quality of the ambient light; and *How easy/difficult is it to read the below text at normal reading distance in this space?* – the provided text is set in Arial 8pt, medium grey colour. The aim of the question is to assess both the level and chromatic quality of the ambient light.

4. Results and discussion

The authors have so far tried out the PERCIFAL method and accompanying questionnaire with seven groups in nine locations in Stockholm and Katrineholm (Sweden), Helsinki (Finland) and Trondheim (Norway) during spring and summer 2010. The observers were in most cases students of art, architecture and design but also lighting and design professionals were involved. So far the observers have had little difficulty in understanding the task at hand. A lot depends on how carefully the briefing is carried out and it is important to stress that observers should rely on their immediate perceptions rather than their preconceived conceptions of colour and light in space.

Some terms in the questionnaire were more susceptible to misinterpretation than others. For instance the concept of *glare* needed clarification. Glare is an entirely subjective percept, and at the same time one of the most important negative factors in lighting design. The definition of horizontal and vertical distribution of light and shadow, particularly in the case of very high spaces, also caused some difficulties. Light and shadow distribution can become extremely

complex and difficult to describe on a single scale. The effects of *cueing* and *expectations* became apparent in the questions concerning *glare* and *glitter*: they tended to elicit observations of many local instances of strong brightness contrasts and highlights rather than an overall analysis about visual comfort/discomfort. Also the whole notion of visual discomfort is highly contextual: car headlights at night can be irritatingly, even dangerously glaring whereas sunlight sparkling on water (with a far greater level of luminance) can be experienced as pleasant and enjoyable. Such problems have led the authors to consider using questions that are less direct (e.g. the ones concerning skin colour and legibility).

This subjective nature of some of the percepts brings us to the question: how reliable is PERCIFAL as a research method? The very aim of PERCIFAL is to help to describe the *coherent* and *holistic* experience of space rather than discreet and individual details. The approach is very similar to that of an artist: nonessential details must be sacrificed for the truthfulness of the whole. We have found that such a method can help to reveal essential aesthetic and visual-functional qualities of space that cannot be addressed equally well by other means. PERCIFAL is a way of collecting and systemizing analyzable data from individual observations. The methods of analysis are still under development, but even as such the method and data retrieved so far have proven to be of great educational value. Most of the observers reported that their perception and understanding of the visual factors in space became heightened as a result of the tests. They became particularly aware of the effect of *adaptation* to the perception of brightness and colour tone. They became also more aware of the meaning of such visual terms as brightness and lightness. The method and questionnaire are under continuous augmentation as the tests continue with more groups and locations. Each test so far has led to improvements and additions to the method.

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