AIC MIDTERM MEETING

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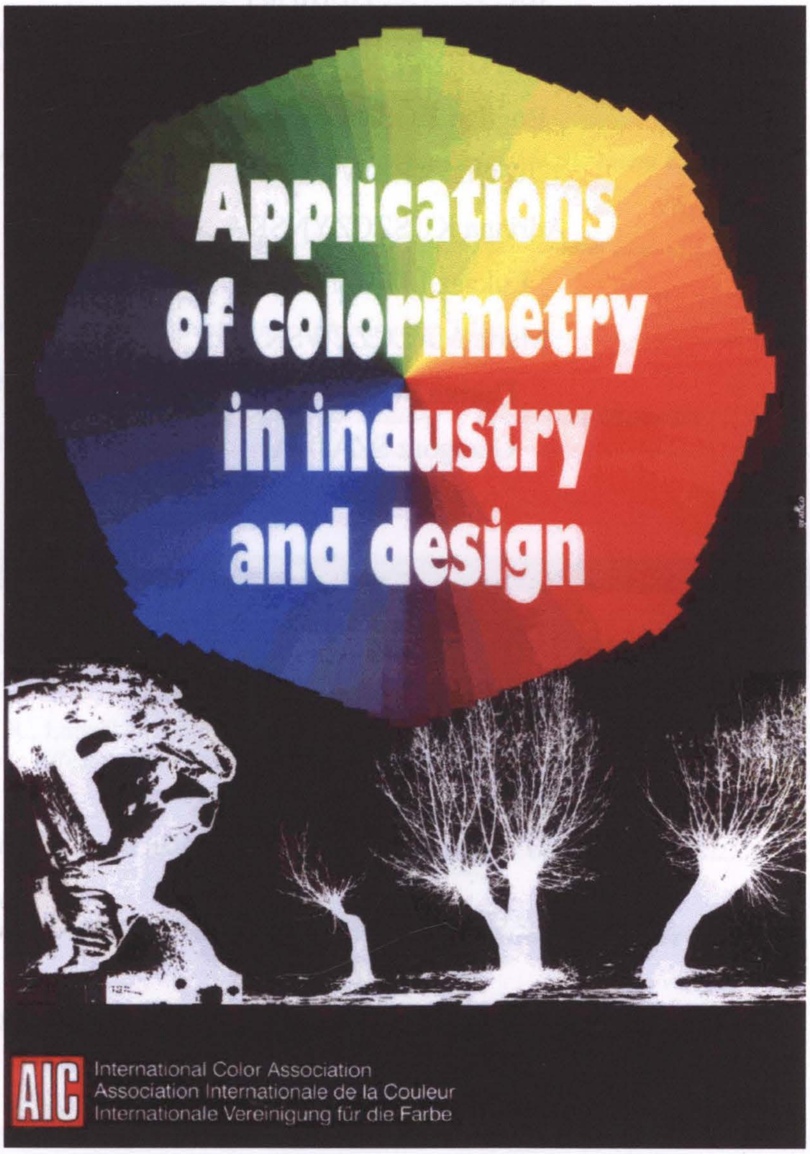

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EVALUATION OF APPEARANCE BY MEANS OF COLOR AND CESIA: VISUAL ESTIMATION AND COMPARISON WITH ATLAS SAMPLES

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1. Introduction

The concept of visual appearance includes such aspects as shape, texture, color, and cesia of objects. Of these four attributes, shape and texture are constructed by perceived spatial discontinuities, while color and cesia are the result of perceived light distribution. By color we mean the perception of *spectral* distributions and intensities of light, producing the sensations of yellowness, redness, blueness, greenness, whiteness, blackness, and any intermediate degree. Color is described by three parameters: hue, value, and chroma (according to the Munsell system); hue, blackness, and chromaticness (according to the Natural Color System). By cesia we mean the perception of *spatial* distributions and intensities of light, causing the sensations of matt opacity, mirrorlike appearance, translucency, transparency, darkness and any intermediate degree.[1] Cesia is also described by three parameters: permeability, absorption, and diffusivity.

[1] The word "cesia" designates with a single term an aspect that is close to what Richard Hunter calls "geometric attributes of appearance" (Hunter and Burns 1969). The origin of the term and the subsequent developments are described in Caivano (1991,1994,1994a).

To describe appearance with certain accuracy one must quantify the mentioned variables, and this implies some kind of measurement. Basically, one can make instrumental or visual measurements. Usually, instrumental measurement is more applied in industry, while visual assessment is more applied in design.

There are two basic kinds of apparatus for instrumental measurement: spectrophotometers measure spectral distribution and intensity of visible radiation, the physical stimuli for color, while goniophotometers measure angular distribution and intensity of visible radiation, the physical stimuli for cesia.

The usual techniques for visual measurement involve comparison between the specimen under evaluation and some reference standard. Color atlases are developed with the purpose of having standard color samples. An atlas of cesia is under development with the aim of having standard cesia samples (Caivano and Doria 1997). But even without an atlas one can make somehow accurate estimates by using mental points of reference both in color and cesia perception. I will present an overview of known techniques for the visual assessment of color, and will describe procedures -that can be easily used by designers- for the visual appraisal of cesia.

2. Visual assessment using standard samples

Having an atlas with standard samples, the observer chooses the chip that better resembles the specimen under evaluation and gets the corresponding notation, i.e., the values for the three parameters.

2.1. Modalities of observation for color evaluation

For color evaluation, it is important to use geometries of observation that avoid the perception of gloss, transparency, and texture.

A geometry of 0/45 or 45/0 degrees between the direction of illumination and observation with respect to the normal to the surface is usually employed to avoid gloss (Figure 1).

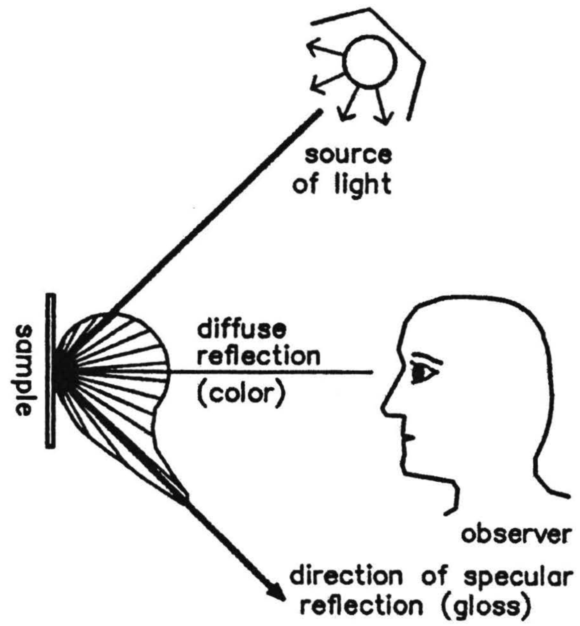

Figure 1. Geometry of observation for color assessment.

Transparency is avoided by placing an opaque white surface under the specimen, which in this way can be adequately compared with an opaque sample. That is to say, if we need to assess the color of a transparent specimen, and we have opaque standard color samples (as it is the case with samples in the Munsell and NCS atlas), the white opaque surface under the specimen provides the standard background that allows for the comparison. For better results, this surface should be a white sample of the atlas we are using. The same procedure can be employed with translucent specimens.

With texture, the problem is more complicated. Sometimes, one wants to include texture in the overall color assessment. For instance, if one wants to evaluate the color of a certain area in a large printed announcement made with the process of four colors reproduction (which results in superimposed screens of yellow, magenta, cyan, and black dots), it is absurd to make the comparison by getting close to the announcement and placing the standard sample on it, because one is interested in the resulting color as perceived from a certain distance, not in the color of every printed dot. In this case, the best method is to take an adequate distance from the specimen so that a uniform color is perceived. This color is the visual synthesis of the different colored dots in the textured surface. In this way, one is able to compare it with the uniform color of a standard sample. This method is similar to the one described by Karin Fridell Anter (1997) to evaluate *perceived* color of facades, that is, the color seen in a specific situation. But sometimes, when the material is uniformly pigmented and the texture is produced by surface's relief only, one may want to exclude texture in order to reproduce the color of the material independently of the surface's discontinuities. In this case, the specimen should be illuminated from a suitable angle to avoid shadows, usually at zero degrees to the normal. The observation should be made at 45 degrees, with sample and specimen close to each other. This method ensures that one is evaluating what Fridell Anter (1997) calls *inherent* color, that is, the color presented by the object when it is observed under the same standardized conditions by which the samples of the atlas are in accordance with their notations.

2.2. Modalities of observation for cesia evaluation

In order to evaluate cesia using standard samples for comparison, the geometries of observation are also very important. Cesia is not an intrinsic quality of materials and surfaces. It is the visual sensation resulting from the physical characteristics of the material, the kind of illumination and the viewing conditions. The perceived cesia changes with the intensity of illumination and the side from which it comes, so that a common window can be seen as transparent, half mirror or full mirror depending on those conditions. Cesia also changes with the quality of lighting, whether it is diffuse or concentrated, so that the same object may appear matt or glossy. It also changes with the angle of the surface with respect to the direction of illumination and observation.

Thus, the same categories of *inherent* and *perceived* can be applied to cesia. Inherent cesia is the cesia that the object presents when it is viewed under the same standard conditions by which the samples of the atlas are in accordance with their notations. Perceived cesia is the appearance that the object presents at a given situation. Stripes cut out from the same sheet of polyester film have an inherent degree of diffusivity which is the same for all of them. But placed at different distances from the background they produce different degrees of diffusivity, and consequently the perceived cesia changes.

For visual comparisons with standard samples, it is critical to hold the same geometry and conditions for specimen and sample. I am not going to enter into details here about the standard conditions of illumination and observation for the samples in the atlas of cesia, but let me just say that a special arrangement is needed for each page of different permeability. For permeability near 100 % (transparent or translucent), the right geometry of observation is shown in Figure 2. For opaque specimens, with 0 % permeability, there are the two possibilities: 1) diffuse lighting and the face of the observer used as reference, according to how is it reflected on the samples; 2) diffuse lighting, a grid that is reflected on the samples, and observation from the direction of specular reflection (Figure 3).[2]

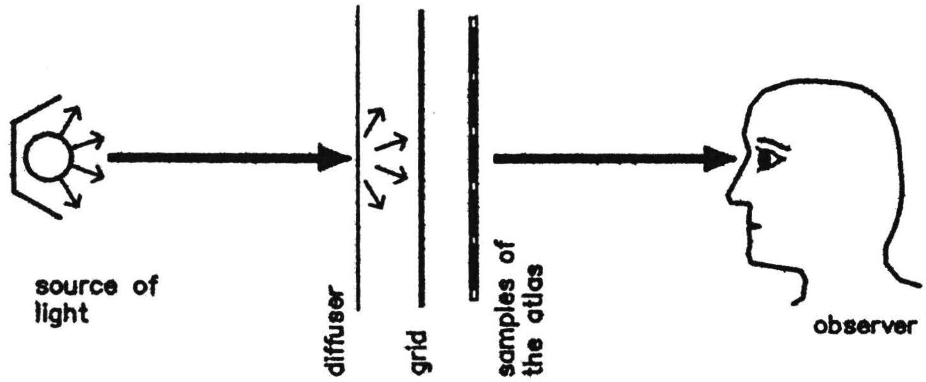

Figure 2. Geometry of observation for cesia assessment: permeability near 100 % (transparent and translucent specimens).

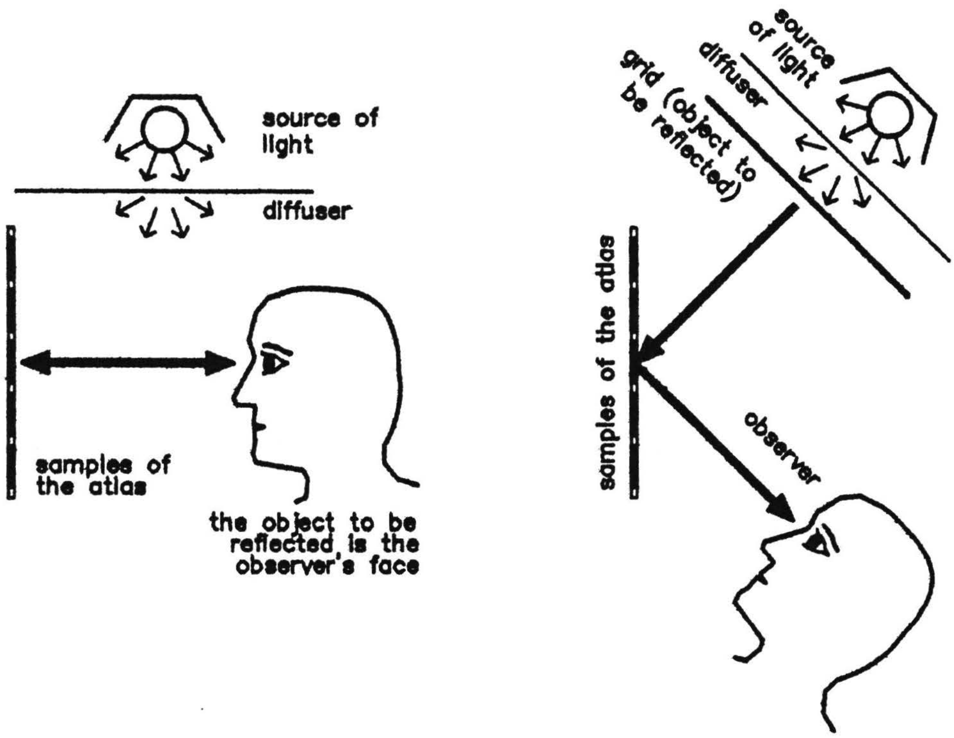

Figure 3. Geometries of observation for cesia assessment: permeability 0 % (glossy or matt opaque specimens).

[2] This arrangement is similar to the one described by the ASTM (1990).

There are also some hints to avoid the other variables entering into the visual perception and making the comparison difficult. In this case, one usually wants to exclude color and texture. For instance, suppose that we need to assess the cesia of a yellow translucent specimen, but we have achromatic standard cesia samples. This case is symmetrically opposite to the case of evaluating a translucent colored specimen with the usual opaque color samples of an atlas.

	SPECIMEN	STANDARD SAMPLE	ASSESSMENT
1)	yellow ***translucent***	yellow ***opaque***	color (yellowness)
2)	***yellow*** translucent	***achromatic*** translucent	cesia (translucency)

In the first case, we have seen, the solution is to put a white opaque sheet under the translucent specimen. In the second case, it is not possible to turn a chromatic specimen into achromatic in order to evaluate translucency without the disturbing color difference. The only possible solution is to look for the samples that match the specimen in lightness (or absorption). For instance, in the case of a yellow translucent specimen, the matching samples would be the lighter translucent grays in the absorption scale of the cesia atlas. Then, one is able to compare specimen and sample in terms of permeability and diffusivity.

3. Visual assessment without having standard samples

How is it possible to assess color without having standard samples? In a paper presented at the AIC Meeting 1997 in Kyoto (Caivano, Mattiello, and Biondini 1997), this experience is described. Students were confronted to the task of evaluating hue, value, and chroma (according to the Munsell system), and hue, blackness, and chromaticness (according to the Natural Color System), only by using mental points of reference and a description of the system. They were not allowed to see the atlas.

With regard to cesia, it is relatively easy to make visual assessments in terms of permeability, absorption, and diffusivity, without having the atlas at hand. A person normally has an exact idea or mental representation of transparency, translucency, matt opacity, mirrorlike appearance, and blackness. In addition, some of these five reference points of cesia can be easily contrasted with physical situations that are found everywhere. Clean air can be used as a sample of perfect transparency. Thus, the image of an object or background seen without the interposition of any other object (just clean air in between) can be compared with the image of the same object or background seen through the specimen under evaluation. The pattern of letters in a book or newspaper provides a good background-object for this. As diffusivity changes with different distances among observer, specimen, and reference background, the best way to evaluate translucent specimens is to put them close to the eyes and at a certain distance from the background. The same physical point of reference can be used to assess the degree of diffusivity of an opaque specimen.

A mirror is another physical point of reference that is easily found (as a matter of fact, any woman carries a mirror in her handbag). It provides a sample for 0 % permeability and near 0 % diffusivity and absorption. Thus, the degree of diffusivity and absorption of an opaque specimen may be visually assessed by evaluating how does it reflect some background object in comparison with a mirror.

4. Conclusion

In conclusion, it is necessary to have a clear idea of what one wants to assess. If one is asking for the "inherent" cesia of an object, then the geometries of observation should be the standard ones, and it is better to use the atlas for comparison. But if one is interested in the perceived cesia at a given situation, it is quite possible to evaluate just what one is seeing by using mental points of reference. As with the experience with color, the cesia notations given by various observers to specimens having different cesia (once they have understood the system) do not differ too much.

Acknowledgement

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