

# **AIC 2004 Color and Paints**

**Interim Meeting of the  
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Porto Alegre, Brazil, November 3-5, 2004**



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## Cesia and paints: An atlas of cesia with painted samples

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### ABSTRACT

The name “cesia” has been given to the modes of appearance produced by different spatial distributions of light. The aim of this paper is to present a new atlas of cesia produced with painted samples. The atlas consists of 5 pages with 25 samples each, that is to say, a total of 125 samples. The samples in every page have a different degree of perceived *permeability* to light, from the opaque samples to the transparent ones, passing through samples with different degree of perceived turbidity. Furthermore, in each page, the variation of *darkness* (from very light to very dark) and the variation of *diffusivity* (from matte or translucent to glossy or crystalline) occur.

### 1. INTRODUCTION AND ANTECEDENTS

The name “cesia” has been given to the modes of appearance produced by different spatial distributions of light (Caivano 1991, 1993, 1994, 1996). From the physical point of view, an object may absorb light, and the non-absorbed portion can be either reflected by the material, or transmitted through it. Both reflection and transmission may occur regularly (specularly) or diffusely, and any intermediate combination may also appear. Those physical transfers are the stimuli for the visual sensations of cesia: matte appearance, glossy or mirror-like appearance, translucency, and transparency, with different degrees of darkness, and all the intermediate or combined cases. Every color appears in some of these modes of appearance, and vice versa. Now on, the stimulus for color can be produced by *primary sources* (objects that emit light) or by *secondary sources* (objects that reflect or transmit the light coming from another source). Both in a primary or a secondary source we can have a variation of color, but the variations of cesia only occur in secondary sources, that is to say, in objects that produce changes in the spatial distribution of the light that they receive. These changes are mainly due to micro-textural variations on the surface or in the volume of the object. If these textural variations are of a rather small size, then the texture itself is not perceived, but the effect produced on light is, and we see cesias.

The three variables originally proposed for cesia are *permeability*, *absorption*, and *diffusivity*. As the word “absorption” usually refers to a physical process, *darkness* is perhaps better to allude to the resulting visual sensation. Thus, the variables could be termed perceived *permeability* (or its opposite, *opacity*), perceived *darkness* (or its opposite, *lightness*), and perceived *diffusivity* (or its opposite, *regularity*, related to the distinctness of image, not only referred to the sharpness of images produced by reflection but also by transmission).

Paints are one of the most versatile materials to produce these kinds of variations. A paint may cover a surface, working as an opaque coating, and in that case the stimulus for cesia is due to the surface finishing. A rough surface produces a matte effect, while a polished surface produces gloss. But if the paint is more or less transparent, then, in addition to the surface finishing, the internal composition, working in the whole thickness of the layer, is important. In these cases, the stimuli for cesia are of a more complex nature. An atlas of cesia made with

pieces of glass was presented in AIC 1997, Kyoto (Caivano and Doria 1997). The samples in the atlas allow for comparison of different kind of specimens. The samples of glass range from translucent to transparent, matte to mirror, permeable to opaque, and light to dark (Figure 1).

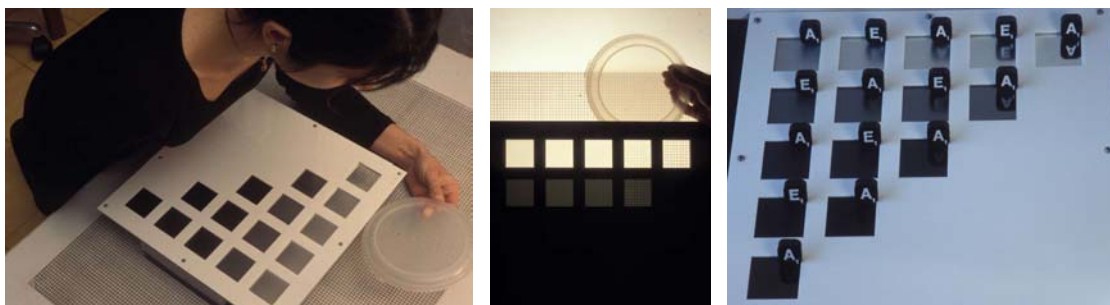


Figure 1. Atlas of cesia made of glass. Left and center: a specimen is being compared against the translucent and transparent samples. Right: the opaque samples, from matte to mirror.

## 2. THE ATLAS MADE WITH PAINTS

Now we want to present a new atlas of cesia produced with painted samples that is being developed. The atlas consists of 5 pages with 25 samples each, that is to say, a total of 125 samples. The samples in every page have a different degree of perceived *permeability* to light, from the opaque samples (1st page) to the transparent ones (5th page), passing through samples with different degree of perceived turbidity (Figure 2). Furthermore, in each page, the variation of *darkness* and the variation of *diffusivity* occur. For rather opaque objects, *darkness* goes from very light or white to very dark or black, and diffusivity goes from glossy to matte. For rather transparent objects, *darkness* goes from very clear to very dark or black, and diffusivity goes from crystalline to translucent. The notation for the three variables, *permeability / darkness / diffusivity*, goes from 0 to 1 or 0% to 100%.

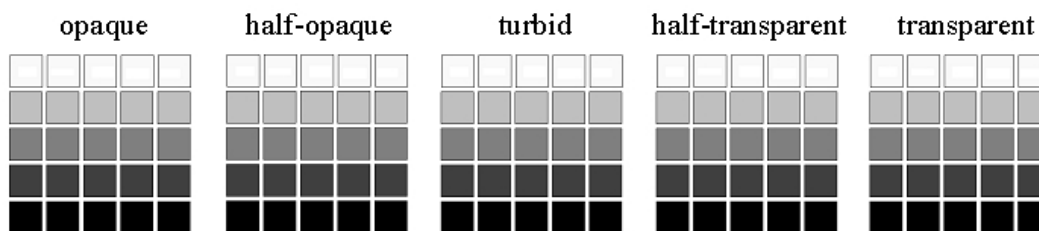


Figure 2. Scheme of development of the atlas, from the opaque samples to the permeable or transparent ones. In vertical, the variation of darkness. The variation of diffusivity (not shown here) occurs in horizontal, in each page.

All the samples are being produced by mixing 9 kinds of paints: alkyd enamel of white color (in matte, satin, and glossy finish), alkyd enamel of black color (also in matte, satin, and glossy finish), and clear alkyd varnish (in matte, satin, and glossy finish). The samples are painted on an opacity display and extended with a bird film applicator on a surface in which a pump has made vacuum (Figure 3).



Figure 3. Some of the materials and elements used to produce the samples.

These paints are mixed according to established proportions following arithmetic scales or scales derived from a power function (Stevens' law):  $sensation = k \cdot stimulus^\beta$  (Stevens 1975). A hypothesis is made for each kind of scale as to what are the  $\beta$  exponents that better work in each case. Then, the mixtures of paints are produced following the corresponding proportions and the samples are painted. And finally, when a scale of 5 steps has been completed, the whole scale is assessed visually to verify the regularity of the intervals and steps. If not approved, a new exponent  $\beta$  is tried and the whole procedure is repeated.

According to our results, scales of darkness follow a power function with  $\beta = 0.4$ , mixing black and white (for the opaque samples). The power function with  $\beta = 0.4$  also works mixing black and varnish (for the transparent samples), and mixing black, white and varnish (for the intermediate permeabilities). In these intermediate permeabilities, white is used to increase turbidity on the varnish. Scales of diffusivity are made by mixing the glossy paints with the satin paints, and the satin paints with the matte paints to obtain the intermediate degrees. These mixtures give correct results if they are made in a half and half proportion.

Figures 4 to 6 show some of the results achieved at this moment. This work is still in progress, and the final results will allow us to compare the atlas made of pieces of glass in 1997 with the present one made with paints, and speculate about the possibilities of cesia for different kind of materials.

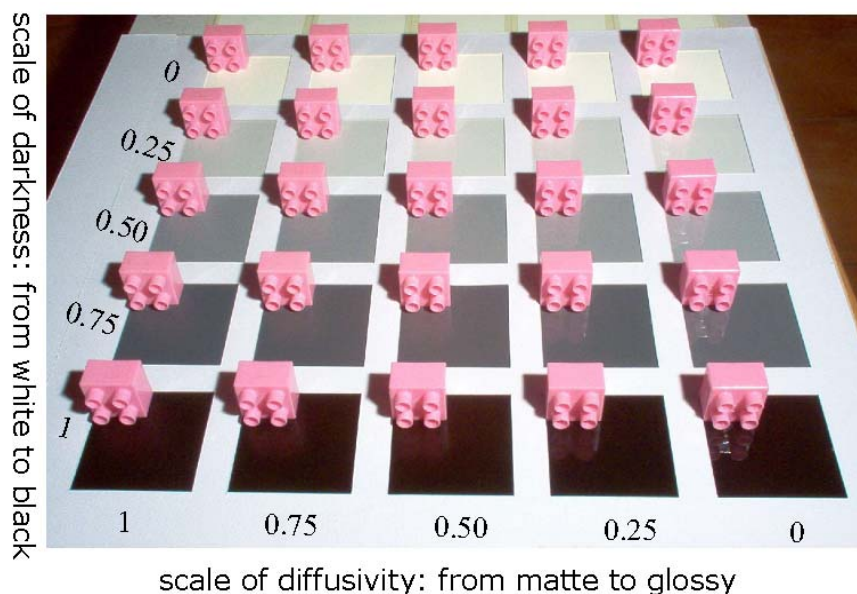


Figure 4. Page of opaque samples, with the variation of darkness and diffusivity. For this photograph, an object has been placed on each sample so as to appreciate the variation of diffusivity (more evident in the dark zone).

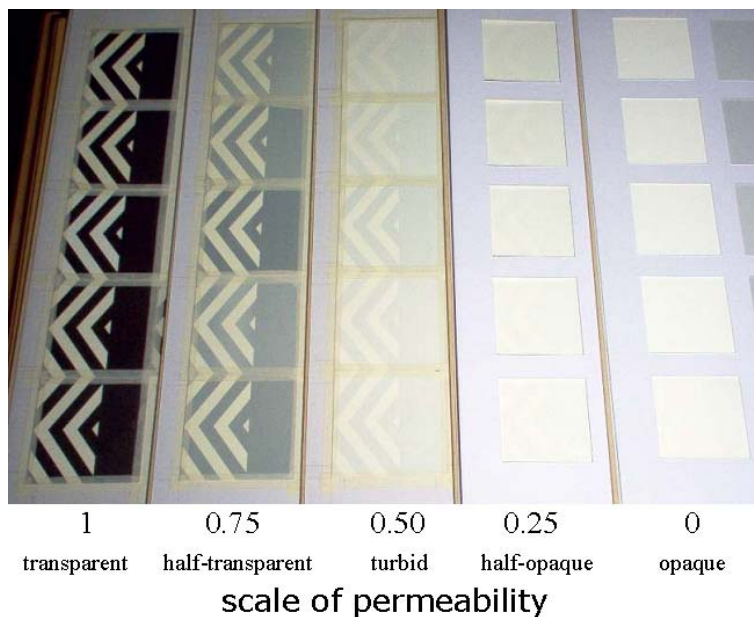


Figure 5. Five steps of permeability. Even when it cannot be appreciated in the photograph, the variation of diffusivity occurs in vertical for each step. With the addition of the variation in darkness, each of these scales originates, in turn, a whole page like the one in Figure 4.

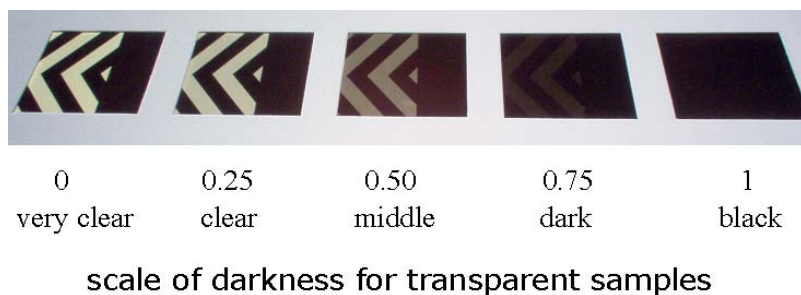


Figure 6. The variation of darkness for a transparent sample (permeability 1), with a certain degree of diffusivity (in this case, diffusivity 0).

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