

TEXTILE DESIGN BASED ON BUILT ENVIRONMENT AND END-USERS SPECIFICITIES

Re-scaling a classroom with colored patterns on textile curtains

Jean-Luc Capron & Marie-Hélène Huysmans
Hic et nunC asbl, Rixensart, Belgium

Abstract

For a classroom with large windows on south and north façades, generating pupils' discomfort due to overheat and glare, the authors designed and printed curtains. Aims of the design is to provide a solution combining the necessity of a solar protection, with the need for a spatial balance between the scale of the group of pupils and a personal anchoring for each child. By taking in account space and user specificities, the nature, graphic delineation, size and colors of the pattern are defined to reach the objective of visually rescaling the classroom. The entire composition is made of vertical and horizontal stripes of a unique abstracted floral pattern, colorfully silkscreen printed on a translucent (non-opaque) unbleached textile.

The paper discusses in detail: (1) The entire process, which is of a type evaluation-design-evaluation, with on site and full-scale test of the pattern, scale and colors, as well as the global composition. (2) The results of a three years assessment program achieved by the authors, based on a post-occupancy evaluation approach and a survey focusing on three topics: general preferences (colors, shapes and patterns), perception of space (depth and anchoring) and users' feeling (comfort and quality). (3) The proposed guidelines for similar designs.

Keywords: built environment, colored patterns, children, perception, behavior.

1. DESIGN PROCESS

In a classroom of the Athénée Royal de Rixensart, an elementary school located nearby Brussels (Belgium), large windows on south and north façades generate discomfort of pupils due to overheat and glare [1]. In 1999, Jean-Luc Capron (Dr. Eng. Architect) and Marie-Hélène Huysmans (silkscreen artist), were asked to design and print about 70 m² of curtains. This task was part of a larger process, including a previous consultancy for the choice of appropriate colors for new individual desks and chairs, and a post-occupancy evaluation assessing the impact

of the printed curtains on pupils' behavior and well-being in this classroom.



Figure 1: Interior view of the classroom, with the printed curtains of south façade on the left and the one of the north on the right.

1.1. Design Context

The classroom is located within a prefabricated building made of a wooden structure with a span of 1.2 m between posts. The room is about 8.4 m long (7 spans) by 6 m wide (5 spans) and 3 m high. On the opposite side to the entrance door, the blackboard hangs on the west wall, so that natural light mainly reaches the pupils from left. The south façade presents windows on the full length, while on the north side the two spans close to the entrance door are opaque.

As it is a key point of our design approach, it is important to analyze how the classroom is used. The basic features with an impact on the use of the classroom are the colored individual desks that allow for more flexibility in the classroom. The sitting layout is function of the number of pupils to be hosted in a classroom, as well as with the pedagogical preferences of the teacher and the use of related devices, such as computers.

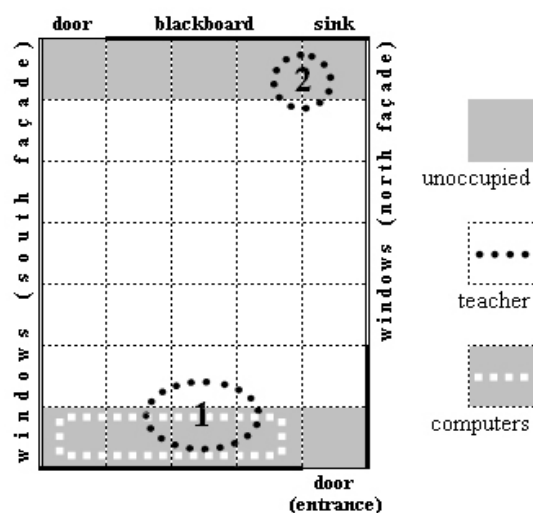


Figure 2: Plan of the classroom, with the two locations of the teacher's desk and the computers area.

Most of the pupils hosted in the classroom are 10-11 years old, about 1.40 m tall when standing and 1.15 m seated, with the eye level at about 1 m.

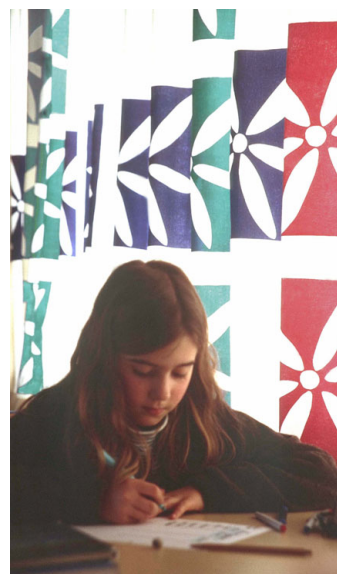


Figure 3: The horizontal stripe made of printed patterns is re-scaling the classroom height according to the one of a seated child.

The colors of the seats and individual desks were chosen among the restricted color chart provided by the furniture factory. The nearest NCS notations of the three chosen colors are 1070-R20B (tele magenta), 0040-R90B (pale blue) and 2060-B20G (turquoise blue). The selection of furniture colors was made several months before we made the curtains design, and therefore influenced the colors printed on the curtains.

1.2. Design Aims

The basic requirement for our design was to provide a solar protection, but also a visual screen between the classroom and the street nearby, in order to reduce the disturbance generated by the automotive and pedestrian traffic. We took also the opportunity to design a solution combining the initial requirements with the need for a spatial balance between the scale of the group of pupils and a personal anchoring for each child.

The textile-curtain solution was chosen for the low cost of their production and maintenance, and for an easy manipulation

by children. The tactile dimension of colored patterns silkscreen printed on textile has been discussed elsewhere [2].



Figure 4: On site, full-scale test to define the adequate high of the horizontal stripe made of juxtaposed *blue* patterns.

The pattern is an abstracted flower materialized by the unprinted surfaces that appear within a squared surface of about 32 cm by 35 cm printed in three different colors. Both pattern and layout design took advantage of a prior cross-cultural experiment based on black and white juxtaposed squares, randomly or not [3].

The patterns layout on the curtains has for support a tartan like rectangular grid, based on the span of the building structure. A rhythm occurs from a random like arrangement of the vertical stripes, by combining hues and interval.

1.3. Design Materialization

The curtains are made out of two meters high hangings pieces of unbleached serge cotton, with the bottom at about 70 cm from the floor and the top at 30 cm of the ceiling. As the printed colors are backlit, their perception varies with the sunlight color temperature and illuminance. Moreover, those factors differ between the south and the north side. For that reason, the three printed colors are called here: *red* for a S1070-R20B “fuchsia”, *green* for a S2050-B40G “turquoise”, and *blue* for a S2565-R80B “periwinkle”; the NCS references are mentioned as if the textile was laid on an opaque surface, thus with the printed surface illuminated. Therefore, in order to avoid confusion with the three colors when used as general color concept or preferences, the three printed colors are written in italics as *red*, *green* and *blue*.



Figure 5: View of the interior side of the south façade showing the rhythm generated by the vertical stripes made of *red* (medium grey) and *green* (light grey) patterns and the horizontal *blue* patterns (dark grey) on the printed curtains.

2. DESIGN ASSESSMENT

Assessment by users is part of our design approach based on a continuum of assessment-design-assessment. The results of such a survey are important because of a

lack of data about the influence of colors and textile on people behaviors in the built environment.

The survey is divided into six parts, each devoted to a specific topic — colors, shapes, patterns, space, comfort and

feeling — and is based on a set of questions answered in the classroom by each child sitting at his/her actual location. It was conducted during the academic years 1999-2002, with 51 children who filled the questionnaire on a sunny day, with the curtains drawn when the pupils answered questions about.

Designing the questionnaire, we pay a special attention to make the questions easily understandable and answerable by children. For example, in order to make the answers to questions related to sitting location easier, the survey form includes plans of the classroom with the division of the ceiling into thirty-five squares used as a reference grid. Each square is referenced by a letter and a number. The origin of the axes of reference is the south-west corner, on the top left corner of the plan. The use of the ceiling grid as reference, instead of the precise location of each pupil, allows taking in account the above described variations of the sitting layout in the classroom, which occurred during this three years survey. The plan is used both in the test, for the questions about the location of the occupied seats and the (dis)liked locations in the classroom, as well as for the graphic analysis of the processed statistical data, with a three steps grayscale.

The feedback we got from both the pupils and the teacher is very positive. Most of the pupils expressed a deep interest about the questions and clearly understood what are the purposes of the survey, as well as the aims of our design. In addition, the teacher asked to be informed about the results and was particularly interested by the location preference test.

The purpose of a design is to be enjoyed by most of the end-users, boys and girls. This includes color, shape and size of patterns as well as the global layout. Everyone knows about the differences between boys and girls of the age of the concerned pupils. Therefore, a special attention is paid in this

survey to the gender of the subjects. In addition, the results show how specificities of gender tastes diverge from clichés, such as pink as the girls' favorite color.

3. RESULTS AND DISCUSSION

This paper focuses on the aspects of the survey related to color in relation to space perception and use.

3.1. Color Preferences

The first set of questions of the survey deals with color preferences. The pupils are first asked to select three colors they prefer and three colors they dislike, among twelve colors named as: white, red, orange, yellow, green, turquoise, blue, violet, pink, brown, grey and black. As half of the proposed colors have to be selected, the non-selected colors are called "neutral" in this paper. The results show that blue is, by far, the preferred color by most of the pupils (76%), but a closer analysis shows that blue is indeed preferred by a majority of the girls (88%), while boys are not as keen of blue color (60%). Males subjects are more attracted by red (83%), while this color is mainly "neutral" for female subjects (79%).

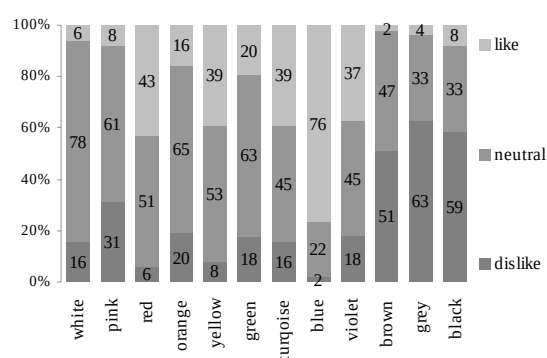


Figure 6: General color preferences by boys and girls, 1999-2002.

The combination of boys and girls preferences makes several colors to be "neutral": white, red, orange, yellow, green, turquoise, violet and pink. Surprisingly,

girls seem to be as less attracted by pink as boys are. This seems to contradict a gender a-priory, caricaturized by the pink color over-related to the Barbie doll. Pink becomes therefore a kind of affectively "neutral" hue for most of those children. Most of them seem indifferent to white (78%), but they generally reject dark colors, such as brown, grey and black.

A detailed analysis of the general color preference test shows only few variations of the results during three academic years. They can be summarized as slight accentuations of preferences, without any inversion of tendency. Therefore, results of the general color preferences test might be expected to be relevant for several years.

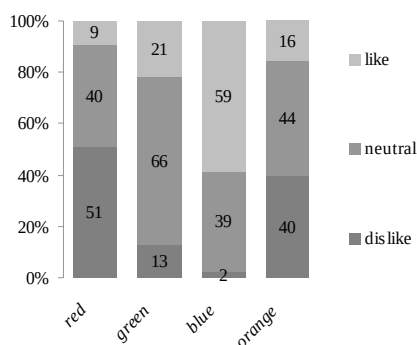


Figure 7: Boys and girls' printed curtains color preferences, 1999-2002.

A second set of questions is about both the colors of the pupils' chairs and desks and the similar colors of the printed patterns on the curtains. Both answers were similar, showing again a strong preference for the *blue*, a slightly negative response to *red* and a global indifference for *green* color.

3.2. Pattern Size

From the survey, we can assume that the designed pattern is not perceived as too large or too small, but merely of a "medium" scale. As the colored patterns are backlit, they seem to be smaller due to the irradiation effect and larger due to their

apparent brightness — brightness which is different on each windowed side due to their respective orientation. This can help to give answer to both the general perception of the motive as "medium" and the asymmetry of the spatial distribution of similar perception.

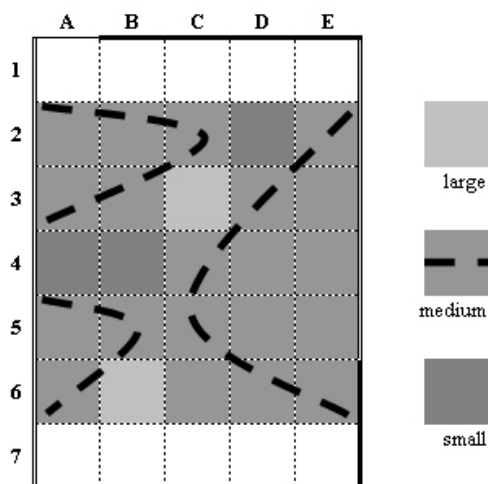


Figure 8: Perceived size of printed patterns.

3.3. Color Depth

The data collected from the survey about the perception of depth for each of the printed colors are of a special interest in relation with our aim of rescaling the classroom by means of colored patterns printed on the curtains. Among the factors that can help to understand the perception of *blue* patterns as nearer (45%) and the *red* as farer (40%) is the importance of lightness in the phenomenon of advancing and receding colors [4]. The respective position of the printed colored patterns on the textile support and the orientation of curtain towards the sun — high luminance of the sunlight coming from the south versus low luminance coming from the north — are also acting on the perception process of depth. The relation between the viewer and the patterns is a factor providing helpful information about the quite "indeterminate" depth feature of the *green* patterns.

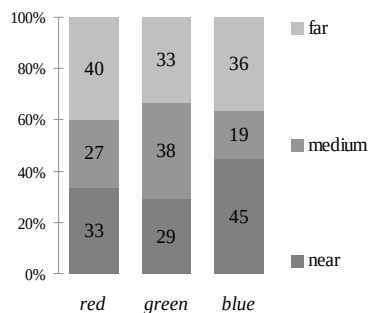


Figure 10: Perceived depth of printed colors.

Quite unsurprisingly, most of the pupils who associate the *green* patterns with the “near” attribute are sitting close to the curtains, and those sitting more in the center perceive the *green* patterns as “far”. The *red* patterns are perceived as having no specific depth attribute by the pupils located near the south curtains, but they seem to be more distant for those sitting closer to the north curtains. In addition, the *red* patterns are perceived as “near” by most of the pupils sitting around the central area of the classroom. The *blue* patterns are perceived as “far” by the pupils close to the colored patterns, and more especially by those close to the north curtains, with the exception of those sitting in the center of the classroom. On the contrary, the children sitting between the two-mentioned areas perceive as “far” the *blue* patterns.

As some distortions in the perception of depth might come from the fact that some subjects can look to the curtains located on the north or on the south side. Further survey should be conducted in order to make clearer which of the curtains are taken as reference by the pupils answering the question about the feeling of depth associated with the printed colors. Nevertheless, at this level of analysis and as expressed on the graphic synthesis, we could already note that the perception of distance associated with the *red* colored patterns is reverse to the perception of the

blue and *green* colors. This opposition in the assessment of distance between a *red* pattern and *green-blue* patterns may refer to the perception of depth of *red* and *blue* colors.

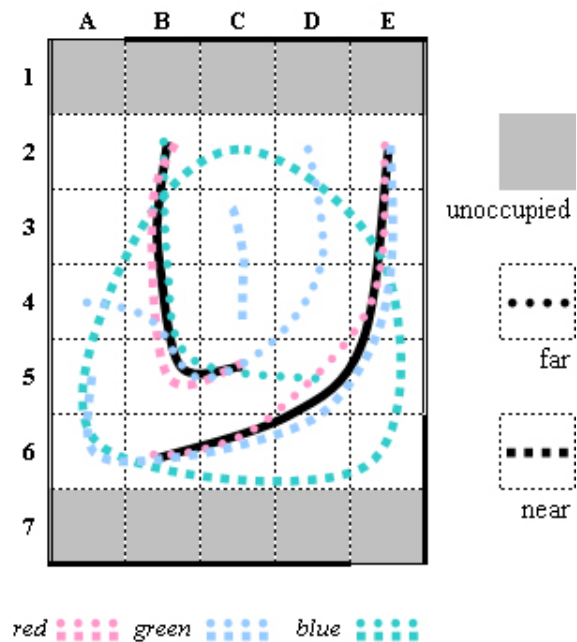


Figure 11: Synthesis of perceived depth of the printed colors.

3.4. Classroom size

The goal of our design is to modify the global perception of the classroom and a global analysis of data shows that the classroom is perceived as smaller with the curtains drawn, by only a small amount of pupils (19%), while a short majority (51%) perceives it as bigger. Unsurprisingly, the length is mainly perceived as increased (64%) and so is the width (43%), while the height is perceived as unchanged (45%) or even perceived as lower (31%). The perception of the vertical dimension is of a special interest for the assessment of one of the design goals: to create a “virtual ceiling” lowering the high of the classroom. The distribution of data reported on the plan of the classroom shows how perceptions of spatial features as increased are organized along a diagonal axis. The direction of this

axis is partly related to the orientation of the curtains and their backlit colored printed patterns. This is confirmed by the decreased dimensional feature perceived by pupils sitting in the south-west corner of the classroom. In addition, it is worth to mention that children sitting at the back of the classroom perceive the space as lower, thus revealing how space might be rescale to a more human dimension.

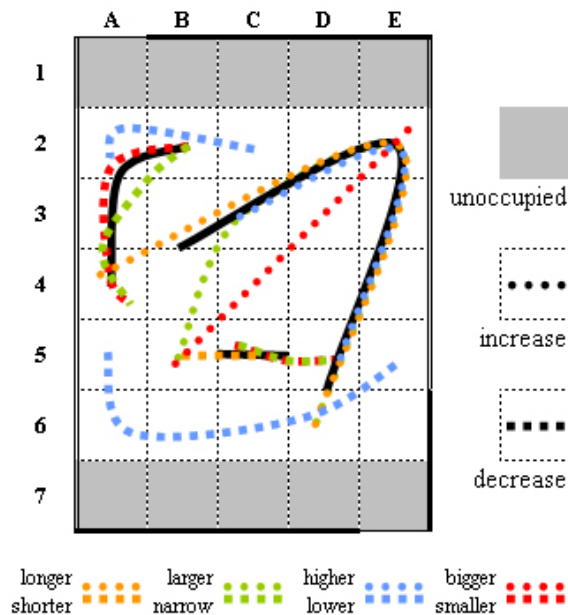


Figure 12: Synthesis of the perceived spatial features of the classroom.

3.5. Classroom Appropriation

The last point of the survey to be analyzed here is the general improvement of the end-users well-being, by means of the feeling of "being in my classroom". Globally, the answers to this question are positive (46%), with only few children (17%) having more difficulties to "feel at home" in the classroom when the curtains are drawn. The relationship between the location of the pupils and the type of answer show that improvements due to the curtains, their design layout and colored printed patterns, mainly occur for pupils sitting at the back and along the aisles of the classroom. The

lack of improvement for those sitting at the very back of the classroom tends to show the limits of interaction between pupils and teacher, resulting for instance from the acoustic properties of the room. Data, like those collected by Sommer [5], about the participation rate of pupils in similar straight-row classrooms show how pupils sitting at same position have difficulties in interacting with the teacher and take part to pedagogical activities. The comparison of both set of data, by means of the pupils' sitting locations in the classroom, shows a correlation between improvements of the pupils' well-being and better participation to pedagogical activities. Therefore, the enhancement of the feeling of "being in my classroom" for the children sitting at the back and along the aisles of the classroom would make more pupils feeling to be a member of the group. This feeling allows the teacher to be more devoted to pedagogical activities, which not only helps those precise children, but all the pupils in the classroom.

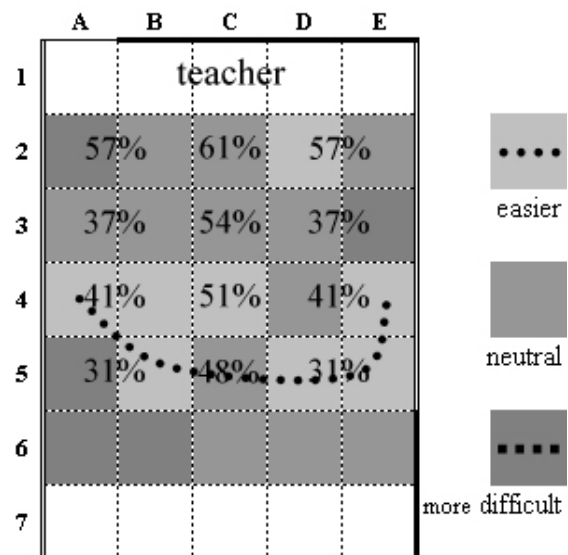


Figure 13: Feeling of "being in my classroom" compared with Sommer's data about pupils' participation in straight-row classrooms [5].

4. DESIGN GUIDELINES

As a conclusion, we could state that large printed textile surfaces, such as curtains in a classroom, designed with concern for both, the scale of the room and the scale of the end-users require looking for:

- The perceptive dynamic generated by the composition of the colored patterns, providing a balance between the scale of the group and the one of the child.
- Territorial anchorage and appropriation of the space achieved by the association of a textile support and the colorful patterns, laid out according to a horizontal segmentation and vertical rhythmic.
- Colors, pattern, composition — and the interaction between those perceptual factors — rescaling the classroom dimensional characteristics to a perceived size, in accordance to pupils' scale, individually sitting.
- Patterns, colors and textile supports acting on a semantic dimension, as a mean of personalization.

We therefore would like to propose some guidelines that could enhance the well-being of children in a classroom by the use of colors on textile surfaces.

- Textile fabrics: by its textural characteristics, it adds a tactile dimension to the visual perception of printed colors.

Printed colors: by their ability to be perceived as advancing or receding, they can modify the perception of depth of the surrounding surfaces enclosing a room.

Patterns layout: by the composition and position on vertical surfaces, it rescales rooms, thus helping for spatial anchoring and concentration on the performed activity.

5. REFERENCES

- [1] Capron, Jean-Luc & Huysmans, Marie-Hélène: Facteurs humains, environnement construit et développement durable, *Le développement durable : quel impact sur l'architecture ?*, I.S.A. St-Luc, Bruxelles, to be published.
- [2] Capron, Jean-Luc & Huysmans, Marie-Hélène: A Perceptual Approach of Visual Arts in Hospitals: Printed textiles and space boundaries, *Arte e Ospedale – Visual Art in Hospital* (Fondazione Michelucci ed.), Gli Ori – maschietto & musolino, Firenze, 1999, pp. 301-311.
- [3] Farkas A., Maruyama M., Yatsuka H. & Capron J.-L., Measurement of beauty: Japanese-Hungarian[-Belgian] comparative study, *International Journal of Psychology* vol. 27 (3/4), Lawrence Erlbaum Associates, Hove (UK)-Hillsdale (USA), 92.06, p. 554.
- [4] Ponet, Lies: *Espace couleur ! Vers une utilisation objective de la couleur dans l'environnement construit : le cas de la chambre hyperbare* (J.-L. Capron dir.), I.S.A. St-Luc, Bruxelles, 2000.
- [5] Sommer, Robert: *Personal Space: the behavioral basis of design*, Prentice-Hall, Englewood Cliffs, 1969.

This research has been self-funded by Hic et nunC and the AIC presentation was funded by the Fond National de la Recherche Scientifique (BE), the Faculté Polytechnique de Mons (BE) and the Institut Supérieur d'Architecture St-Luc Bruxelles (BE) — alphabetically listed.

Dr. Eng. Architect Jean-Luc Capron, Hic et nunC asbl – human factors and built environment, Beau Site 2° Avenue 3, B-1330 Rixensart, Belgium, Phone: + 32 2 653 66 12, E-mail: hic_et_nunc@belgacom.net, Web: http://users.belgacom.net/hic_et_nunc

Ass. Prof., Institut Supérieur d'Architecture Bruxelles, Brussels, Belgium

Lecturer, Faculté Polytechnique de Mons, Service d'Architecture Civile, Mons, Belgium

Silkscreen Artist Marie-Hélène Huysmans, Hic et nunC asbl