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Traitement des ambiances lumineuses, sensibilité perceptive et incidences sur le comportement dans un espace social

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Abstract:

An original aspect of this research is that *it allies three domains of enquiry*, i.e. cognitive psychology, environmental psychology and architectural lighting, in search of answers to the following questions: is the behaviour in a social space affected by luminous ambience and by perceptive sensitivity of its users, and in what ways? Most current research involving ambience in buildings considers an average user only, and most work in the domain of cognitive psychology applied to perception describes luminous ambience only very summarily.

The method used adds another original aspect: because of the expenses involved in changing an existing lighting arrangement, one very rarely encounters studies of the same public space under two different luminous ambiances, as was done in this research: the usual ambience on one hand and a modified ambience on the other. An additional originality is the choice of public spaces for leisure rather than work.

Principal results, as of September 2002 - Architectural lighting: measurement and analysis of a number of selected fields of vision under current luminous ambience at the two chosen sites (cafeterias). Design and building of the modified luminous ambience at the two sites, its measurement and analysis in the same fields of vision. Study of the impact of variations in natural lighting in a situation of mixed architectural lighting. Establishment of a protocol for the light measurements and of models for their interpretation. Contributions towards the determination of thresholds for comfort or pleasantness in terms of contrast and graduation, this in collaboration with the other participants. Production of images with controlled levels of contrast.

Environmental psychology: identification of usage profiles in public spaces such as cafeterias. Identification of the spatial and functional characteristics which determine usage. Evaluation of the effect of a modification of the luminous ambience on the choice of a sitting location in three distinct populations: general, anhedonic and moderately hedonic. Analysis of links between reasons given for visiting the cafeteria and the choice of a sitting location. Definition of the reasons given for the choice of a particular seating zone according to the three types of population. Comparison of the nature and frequency of such explanations in the two luminous ambiances. Identification of the most common physical, spatial and functional reasons given for the choice of a seat. Characterisation of the degree of satisfaction with the spaces in the two luminous ambiances as a function of the population type. Advances in the methods of cartographic description of behaviour and perception.

Keywords: luminous ambience + personality + perception + adaptive behaviour

Reminder of the interest and the aims of the project as initially defined

The aim of this research project was to employ the fields of knowledge and the techniques of cognitive psychology, environmental psychology and architectural lighting in the service of architectural design. Starting from the fact that when designing a building the architect will define the functional characteristics and aesthetic qualities of spaces while taking into account the quality of their ambience, be it thermal, acoustic or luminous...In this project we concentrate on the characteristics of luminous ambience. Apart from his personal sensitivities, the architect, in order to generate the ambiances, has at his disposal a specific know-how and design tools, which constitute a fundamental aspect of the design and building process. Ultimately, nevertheless, the success of the building will depend on the user's subjective perceptions and behavioural responses induced by its architecture. Indeed, the "hiatus observed between designer and user is a problem" for architecture. Leisure spaces where there is a great number of different users are a case in point.

For this reason, the project sets out to use in parallel :

- sophisticated techniques for the measurement of physical characteristics of light, which enable an analytic expression of the vast diversity of "luminous stimuli" appearing on the internal envelope of a space.
- techniques for studying the ways in which individuals process the information received from luminous ambiances and the ways they adapt to them physiologically.
- and the techniques which allow the observation and analysis of behavioural reactions of various individuals to those luminous ambiances.

The influence of environmental characteristics is very subtle and may be obscured when dealing with individuals from a general population. We therefore chose to study, apart from the general population, also populations whose personality traits incline them either to a hyper- or to a hypo-sensitivity to environmental stimuli, the aim being to experimentally obtain a magnifying "lens" effect. We assumed that this comparative approach would help us to better appreciate the extent to which adaptive behaviour depends on sensitivity to stimuli, luminous stimuli in particular.

We assumed that the results could point to the variety of luminous ambiances and their qualities, desirable in a leisure space in order to facilitate the process of adaptation in individuals showing extremes of sensitivity. These results were to encourage architects to vary the ambiances of a space and to indicate the variables of luminous ambience which should be taken into account in order to produce a pleasant space. They were intended to define more clearly the notions of comfort and pleasantness (or well-being) in architectural space.

In the *architectural lighting* approach the aims were: 1- to study several fields of vision rather than only one in each space, so as to analyse the behaviour of subjects as a function of their own field of vision, 2- to study the influence of variation of natural light in a mixed (natural and artificial) lighting situation, 3- suggest interpretative models because the great variety of "light stimuli" measured on the internal envelope produces a great mass of measurements needing to be interpreted and synthesised.

The contribution of the laboratory of *environmental psychology* has two aims:

- 1- A first approach, based on an established method of observation, analyses the spatial behaviour of users of the cafeterias, as well as their distribution in space and duration of occupation in the different zones of which each space is composed., 2- a second approach, based on semi-directive interviews, produces an understanding of how the users perceive and evaluate the environmental characteristics of these leisure spaces, and those pertaining to the luminous ambience in particular.
- 2- In the *electrophysiological approach*, the working hypothesis is that primary anhedonics are likely to have a weak sensory sensibility which would explain their search of extreme stimuli. Secondary anhedonics on the other hand, are likely to be hypersensitive to sensory stimuli and would therefore have a lower threshold of discomfort, which would incite them to isolate themselves from an environment perceived as overly aggressive – thus producing their type of anhedony. The principal aim would be to test this hypothesis in order to better understand the process of behavioural adaptation of population with extreme sensitivity to stimuli of the luminous ambience, both in the laboratory and in situ.

Summary of the results effectively attained

Architectural lighting

A space has numerous fields of vision

At the two sites the cafeterias are composed of several spatial zones (7 zones were defined at Paris V cafeteria, 11 at the Grand Palais cafeteria). The analysis of the luminous ambiances (in terms of maximum contrast, graduation and spectral composition, for example) in the fields of vision of the zones showed an overall monotony, due to the characteristics of the distribution of luminous flow. This was particularly so in zones 1 to 4 and 7, at Paris V. In most of the fields of vision of those zones we noted contrasts which could cause discomfort. Zones 5 and 6 being placed deep in the space, darker and more intimate, were different but similar to each other. Similar results were obtained at the Grand Palais. This led us to the following definition of the modified ambiances: differentiate the ambiance of each zone and eliminate possible sources of discomfort.

Design, construction and analysis of measurements in the modified ambiances.

The luminous ambiances in zones 2, 3 and 5 were modified at the Paris V cafeteria as well as those in zones 7,8,9 and 10 at the cafeteria of the Grand Palais. These modifications introduced a variation of the ambiances and therefore eliminated monotony. Diminution of excessive contrasts was achieved completely at Paris V and partially at the Grand Palais. In order to enlarge the field of observations by the team of the Laboratory For Environmental Psychology, the vertical position of a number of suspended lighting fixtures could be varied in height by the users who could thus choose the most comfortable position.

The study of the influence of variations in natural lighting in the case of mixed lighting, natural and artificial, gave rise to the definition of "a protocol for the measurement of illumination and chromaticities in a space with mixed lighting" (publication by L. Mudri of the Ecole d'Architecture Paris-Belleville and by M. Perraudeau of the CSTB in preparation). We defined a way to calibrate the measurements of luminance and chromatic coordinates (x and y) in the interior in relation to the variation of illuminance and spectral distribution of natural (exterior) light coming through the glazed surfaces of the locale. This protocol improves on a preceding protocol defined in earlier research, which took into account natural light in luminance measurements only (excluding chromaticity).

Establishment of interpretative models

The analyses of data from measurements of luminance on the interior envelope led us to express the results in terms of frequency per unit area rather than in terms of averages of particular surfaces or of the field of vision.. These analyses also allowed us to further develop the correlation qualitative/quantitative based on calculations of contrast and graduation with measured data. [Mudri, 2002]. This is a first level of correlation. The expressions elicited from the subjects in conjunction with their seating position would supply another level of results.

A method for the production of images with controlled levels of contrast

These images are intended to be presented to the subjects chosen for participation in this project. We designed the method of producing these images. For each of the 10 scenes chosen, three images are produced which only differ in the level of contrasts without affecting other photometric or geometric parameters. Contrasts in these three images vary from 1/2 to 1/40 going from the most graduated to the most contrasted.

Environmental Psychology

Analysis of spatial behaviour of the users

A first series of analyses done under the usual conditions (initial luminous ambiance) of the two sites under study enabled us establish quite different usage profiles in leisure spaces of the cafeteria type. In parallel the study of occupation patterns in the different sectors of the cafeterias, as defined by their functional and spatial characteristics, showed marked differences in the duration of occupation and

the types of activity encountered [Legendre, Bignami, Canales, & Amador, 2002]. Also, in the first site, the of choice of seating in the initial situation compared with the situation where the luminous ambience was modified showed marked differences in the reactions of the populations under consideration. In the general population, observed in the cafeteria, a significant difference in distribution pointed to the diminished appeal of the modified sectors. An opposite tendency was noticed in the persons invited to be interviewed. This tendency was stronger in the persons identified as anhedonics than in those identified as moderately hedonic.

Perception and evaluation of environmental characteristics

The reasons given for their presence in the cafeteria vary according to the zones where the users are interviewed [Casal, Matheau-Police, & Legendre, 2002]. The reasons for the choice of a particular zone vary according to the populations under study and the type of ambience. For instance, for one of the two populations invited to interview, if lighting seemed a criterion of choice of seating in the initial ambience, this was no longer the case in the modified ambience. Whichever the population under study, the physical traits of the cafeteria (furnishings in particular) as well as spatial and functional characteristics (distance or nearness of the services on offer, of the entrance) are most commonly cited as reasons for the choice of a seat. Nevertheless, when questions concerning luminous ambience are asked in a direct form, the discourse changes as a function of the population type, especially as far as attention to detail is concerned. What is more, the terms used to describe luminous ambience by anhedonics differ in the initial ambience from those relating to the modified ambience. The two situations, initial and modified, are both evaluated favourably. But anhedonics tend to have a more marked difference in the evaluation than the other two populations (general population and moderate hedonics).

Methodological development

This study allowed us to develop and refine certain technical aspects of behavioural cartography, and to extend its principle to perceptions and evaluations expressed by the users of a space [Legendre, & Depeau, 2003].

Coordination of the research groups

According to the programme of the intermediary report, certain analyses continue, notably:

Identification of contrast thresholds of comfortable and/or pleasant contrasts and graduations

We have accumulated elements contributing to such an identification. This will be the subject of coordinated work between the Laboratory of Environmental Psychology and LAIADE. In this work the luminous characteristics of the zones will be compared with the choices and evaluations made by the users.

Publications resulting from this research:

Mudri L., 2002, Luminous ambience, quantitative/qualitative data and subjective response, First International Workshop on Architectural and Urban Ambient Environment ; Nantes 6-8 février 2002

Mudri L., Legendre A., Pierson A., Dimensions of personality in the responses to luminous ambiances, PLEA 2001, Florianópolis - Brazil, 7-9 November 2001

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Mudri L., Luminous Ambience : Qualitative Interpretation of Quantitative Data and Energy Savings ; WREC2005 - *World Renewable Energy Congress*. Aberdeen/Scotland, Mai 2005 - accepté pour publication by Elsevier Ltd.