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SOCIAL LEGIBILITY, THE COGNITIVE MAP AND URBAN BEHAVIOUR

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Abstract

This study clarifies the concept of legibility by introducing its social dimension. Social legibility is a complement to the spatial and behavioural legibility already developed in literature. This investigation used field experimentation to operationalize a variable of social legibility which is based on continuum of cultural distance between individual and surroundings. Consequently, subjects were sampled on the cultural origin of city-dwellers (African vs European), maintaining constant the culturally marked site (Paris, as European city), in order to analyse the influence of propositional representation on spatial representation and urban behaviour. Results show that: (1) the characters of environmental meanings (physical, social, functional, use and landmarks characters) depend on cultural origin: Africans refer more to the utilization than the other attributes, whereas Europeans use physical attributes as often as the utilization; (2) spatial products of Paris are more accurate when physical codes are meaningful. However, when physical codes are not legible, urban practices allow us to elaborate meanings. In conclusion, the social legibility seems to determine the qualitative bond between the adaptive and the exploratory stage. It seems important to elaborate a tool collecting the structure of the environmental meanings to diagnose individual and social problems that occur in cities, with the prospect to reduce them.

Introduction

Legibility is one of the founding concepts of environmental psycology. Consequently, Lynch's first research work (1960) is at the origin of a great deal of investigations on spatial cognition. Actually, we can distinguish two acceptances of legibility. The first criterion for the acceptance of legibility concerns the spatial representation of the surroundings. Legibility is essentially considered to be a physical and spatial quality of the surroundings. This perspective hypothesizes that surroundings influence directly spatial cognition (Lynch, 1960), and spatial representation is isomorphic to the physical structure (Kosslyn, 1975). Much research demonstrates that cognitive map knowledge is more coherent in structure where the perception of the spatial structure is relatively easy (De Jonge, 1962; Canter & Tagg, 1975; Zannaras, 1976; Evans *et al.*, 1984). The complexity of the urban structure, the level of differentiation of urban elements and its visual aspect are the main variables influencing legibility in terms of spatial representation. Nevertheless, spatial representation is not only based on Euclidean information, but also on cluster and cognitive processes of categorization and hierarchy (Hirtle & Jonides, 1985; Holding, 1992, 1994; Kitchin, 1994). Thus, legibility becomes the degree of distinctiveness that enables the viewer to categorize the surroundings (Kaplan, 1979). Furthermore, the person/surrounding relationship is generally neglected and the research focuses on the paradigm of environmental personality. When studies respect the relationship between individual and the surroundings, they focus on the influence of behaviour on cognitive mapping (Appleyard, 1970; Lee, 1976; Zannaras, 1976; Gärling *et al.*, 1981; Abric *et al.*, 1985).

Only a few researchers, according to Evans *et al.* (1980*a*), have shown that legibility, as a measure of spatial quality, has a consequence on behaviour, particularly on travelling. In response to this last viewpoint, Weisman (1981) formulated a second definition of legibility, describing it as the degree of

facility with which finding one's way is possible in a given built environment. This is, in effect, a behavioural dimension of legibility. However, Weisman also observes that this concept is strongly dependent on the spatial structure of the surroundings. As such, O'Neill (1991*a*) considers that 'behavioural legibility' can be estimated objectively. He suggests standardizing the measurement of the spatial structure, computing the density of interconnections (ICD) between choice points in a building floor plan. This, however, ignores the fact that the built environment is part of the social dimension, with codes or signs socially defined, produced and shared. As such, legibility draws upon ideas within ecological psychology and the concept of 'behaviour setting' where the environment is viewed as being socially marked (Barker, 1968, 1979, Wicker, 1987). However, this theory does not take account of the mechanisms that modulate the influence of surroundings on behaviour (Gärling *et al*., 1984), because the surrounding is seen as having meaning in itself, rather than meanings coming purely from the person/surrounding relationships. Indeed, Canter (1969) demonstrated that the relationship between individuals and surroundings does have a powerful influence on the evaluation of physical elements. Finally, legibility, just measured as a spatial or functional form, fails to analyse the influence of social meanings on spatial cognition because investigations generally isolate the social or cultural context of the relationship between individuals and surroundings. As a consequence, there is a need to frame legibility within a social perspective.

The importance of the environmental situation

Ignoring the symbolic meaning of physical elements and focusing on spatial or behavioural legibility, the danger is to build boring surroundings that might affect the cognitive representation of the setting (Kaplan, 1983; Evans, 1980*a*). Recently, Abu-Ghazzeh (1996) observed that uniformity of environmental characteristics and the consequent lack of landmarks have both influence on the image of surroundings and on wayfinding behaviours, because people have difficulties in learning spatial information. Thus, behavioural legibility depends on environmental information rather than simple physical stimuli. This corroborates results obtained by Evans *et al.* (1980*b*), who have shown that colour-coding improves the legibility of a university building, whether on a behavioural (finding the way), or a cognitive (cognitive mapping) level. At the city scale, familiar buildings are those which have strong symbolic meanings (Appleyard, 1969). The meanings are important in the elaboration of landmarks and they organize the spatial layout of cognitive maps (Milgram & Jodelet, 1976). The term of 'anchor point' (Wapner, 1981; Couclelis, 1987) or 'reference point' (Sadalla *et al*., 1980; Holding, 1992) reflect these meaningful physical elements. The meanings can be individualized and the result of individual experiences (Gauvain, 1993) or personal projects (Gärling *et al*., 1981, 1984; Ward *et al*., 1988; Magliano *et al*., 1995). They can also be collective and consensual (Ellis, 1982; Jodelet, 1982; Lazlo & Masulli, 1993; Stamps & Nasar, 1997).

Gärling *et al*. (1984) consider a spatial representation as being constructed in two parts: first, it is experience and individual meanings that organize the cognitive map of the city; and second, that spatial representation relies on general knowledge, socially shared, and stored in the semantic memory. Thus, the cognitive representation of the city is not only an analogical image of the setting. Within a computational model (Golledge *et al*. 1985; O'Neill, 1991*b*), the representation takes on a semantic or propositional form. A process of translation allows sensory stimulation to be encoded in symbolic information, and the processes of categorization and hierarchy organize this symbolic information in long-term memory according to a hierarchical network structure of reference points (Hirtle & Jonides, 1985; Hirtle & Mascolo, 1986). However, the symbolic information produced by these cognitive processes probably also depends on the environmental situation. For example, what happens when people evolve in a new urban environment where codes and physical signs do not have particular meanings because they are socially elaborated and shared by another social group?

In ignoring social or cultural characteristics of a person/surrounding relationship, the danger is to build a meaningless environment for many social groups of town dwellers that might also affect their cognitive representation of setting, and consequently their behaviour. Anthropologists have shown that the cognitive operation of categorization depends on people's value-systems (Berry *et al*., 1992). Thus, depending on the culture or subculture in question, differences appear in categorized contents. This leads individuals or groups to refer to different aspects of the environment on the one hand, and to build urban space differently on the other. Consequently, each city is culturally marked (Rapoport, 1972; Altman & Chemers, 1980; Paquot, 1990). As Rapoport writes (1980, p. 26), 'environ-

ments are physical expressions of cognitive schemata, that are thought before they are built'. Therefore, from the transactional perspective we can make the necessary distinction between surroundings, or setting, and environment. The surroundings are a physical entity, culturally-marked but distinct to the individual. The environment cannot be dissociated from the individual because it is defined as a physical entity endowed with meanings that the individual attributes to it (Penning-Rowsell & Lowenthal, 1986; Zube, 1992). In other words, the environment is a product of the transaction between the individual, as a social subject, and the culturally-marked surroundings. The environment and the subjects are mutually defined (Ittelson, 1973; Altman & Rogoff, 1987). Thus, the person/surrounding system constitutes a unit of analysis since the social dimension and meanings are at the core of investigations into spatial cognition.

The theoretical approach adopted in the study reported here is computational in form. Nevertheless, according to Evans (1980*a*,*b*) we consider that environmental knowledge is both in analogical and propositional forms. The symbolic information of the propositional representation allows an elaborate analogical representation of the city to be built in working memory. Consequently, the spatial representation is subordinate to the propositional representation. Information is thus stored as propositions and manipulated analogically (Kosslyn & Pomerantz, 1977). The spatial representation then is a cognitive tool with the function of solving daily spatial problems (Briggs, 1973; Downs & Stea, 1977). We would therefore formulate a general hypothesis that propositional representation has incidence on urban activities because it initially influences the spatial representation of the city.

Focusing on the propositional representation of the city and investigating the relationship between town dwellers and surroundings, we suggest a social acceptance of legibility that modulates the influence of the surroundings on behaviours. The social legibility corresponds to the facility with which individuals use the socio-physical characteristics of their surroundings to produce or to internalize environmental meanings. From the transactional perspective, social legibility depends on cultural distance between the entities of the person/surrounding system. Therefore, cross-cultural comparison is a possible way to investigate social legibility. Previous cross-cultural studies show that Afro-American sketch-maps are different and less spatially accurate than those of an Anglo-American group (Maurer & Baxter, 1972). Most researchers note the difficulty in separating social class from cultural variables (Evans, 1980*a*; Fisher *et al*., 1984) and explain the differences in reference to cultural cognitive style (Appleyard, 1976). However, the environment mapped is invariably imbued with North-American culture. Consequently, the environmental situation differs too. The cultural distance between the entities of the person/surrounding system is closer for Anglo-Americans than for Afro-Americans. We can then formulate the hypothesis that this variation entails important differences on propositional representation of the city because codes and physical signs are not equally accessible and significant. Therefore, controlling for experience of the city (familiarity) and social class, we can use the cultural origin of individuals as an indicator of the cultural distance of the person/surrounding system to operationalize social legibility.

Lastly, if the investigation of social legibility is focused on propositional representations, we do not need to analyse the content of meanings, but the structure of the propositional representation. As Rokeach (1960) explains, it is not so much what one believes that is important but the manner in which one believes in it. It is then possible to analyse the structure of the environmental characteristics underlying the propositional representation because the environment is multi-dimensional (Ittelson, 1973, 1978; Ledrut, 1973; Stokols, 1978). Indeed, Ledrut (1973) distinguishes values from the character of meanings and suggests the following categorization of the environmental meanings: use (utilization), functional (usefulness), physical, sociological and landmark characters. The use character reflects individual experience and egocentric meanings whereas the other dimensions depend on socio-physical characteristics that are socially produced and shared.

Comparing African and European students about their representation of Paris, guided by the following research hypotheses, allows an investigation of both social legibility and its effect on spatial cognition and urban behaviour:

(1) Individuals that come from Africa support a propositional representation of Paris essentially based on use, whereas European subjects employ equally the whole range of meaning because codes and physical signs have more significance.

(2) If the structure of the propositional representation is egocentric (predominance of the use

character of meanings), then the map-drawing of Paris is spatially less accurate and there are less leisure practices in the city than when the propositional is structured without predominance of one character of meanings.

(3) When there is no difference between African and European individuals about their structure of the propositional representation, then there is no difference both in spatial accuracy of the map-drawing and in leisure practices in Paris.

Method

Subjects

The 55 subjects employed in the experiment were foreign students studying in a university or higher education establishment in Paris. All lived in the same place: the 'Cité Internationale Universitaire de Paris'. All were men and had been living in Paris for approximately a month. None of the subjects were studying architecture, town-planning or arts. By interviewing only students we maintained a uniform social status and socio-economic class among the subjects, as well as the main motive for residence in the city. All these variables are known to have a powerful influence on the propositional and spatial representation of a city. The average age of the sample was 28·58 (S.D. = 6·01).

We constituted two experimental groups on the basis of the cultural origin. 24 students came from southern Europe (Spain, Italy, Portugal) and 31 from sub-Saharan Africa. The Europeans were in a cognitive situation of strong legibility while the Africans were in a situation of weak legibility, because Paris is a city imbued with European culture. In both experimental groups, subjects were French-speakers and were interviewed in French. Sixty-five per cent of the sample had never stayed in Paris for more than 15 days. This percentage was higher for the European students (70·8%) than for the Africans (61·3%), but the difference between the two groups was not significant (Chi-square = 0·544, df. = 1, $p = 0{\cdot}460$, $n = 55$). Nevertheless, the African sample was signicantly older ($M = 31{\cdot}22$) than the European sample ($M = 25{\cdot}16$), $t = 4{\cdot}25$, df. = 53, $p = 0{\cdot}000$. In addition, 91% of the total sample used the Métro to travel around Paris.

Procedure

All the data was collected through an individual interview conducted by the same interviewer. The objective was to collect semantic and spatial information on physical elements which had relevance for the subject. First, we asked subjects for a graphic production in order to obtain their spatial representation of Paris. Then we asked them to remember the characteristics of 15 elements in their graphic production. Finally, a questionnaire was issued to obtain information on urban practices, and also socio-demographic information, previous urban experiences, mode of travelling in and out of Paris, and use of a geographical map, to ensure that there were no significant differences between the two experimental groups.

For the graphic production we asked subjects to draw a map of Paris, combining all the elements known about Paris. We gave a definition of elements, specifying that these concern all the physical particularities that enter into the composition of the city. In other words, elements are material and permanent particularities and we excluded all physical particularities like noise, smell, etc. Thus, we asked subjects to quote all the elements that came to mind, even elements which seemed personal, anecdotal or those they had difficulty localizing. Consequently, we asked subjects to avoid selecting the elements they represented on their graphic production. This task was not, therefore, given a time limit. However, we told subjects to focus their production on Paris *intra muros* and we insisted they represent their knowledge spatially, like a map. This first stage was stopped when the interviewer noticed the subject looking for elements to complete his graphic production.

The structure of the propositional representation of Paris was analysed using 15 elements drawn by the subject. We collected discursive data about the characteristics of the five first, the five median and the five last elements of the graphic production. At this stage, material was collected on one sheet where the subject could read the main characters we found in our first open exploratory interview with 20 foreign students. These covered Ledrut's character: the physical character (shape, size, colour, etc.), the social character (population or social relationship associated with the physical element), the functional character (usefulness), the use character (utilization) and the landmark character of meanings. Subjects could mention several characters for each element. In addition to these five characters, subjects were allowed to formulate other characteristics that included posteriori marginal dimensions, such as an affective character (I like it, it's beautiful, etc.), a geographical

character (this element is closer than that one, ...), and a historical or temporal character of meanings. Finally, through the questionnaire, we noted how many times the subject went out into the city to see shows, visit restaurants, go shopping and/or walking, to visit friends in their homes, go to drugstores and cafés, pubs or night-clubs.

Measurement

The analysis of the graphic productions consisted of measuring the accuracy of the spatial representation of Paris. We then measured the topological and topographical accuracy of the three elements most frequently selected by the experimental group to which the subject belonged, and of three other elements the subject declared as important to his map. In order to make the measurement more complete, we analysed accuracy at a local level and at a general level to be able to calculate an overall accuracy score. We used a 1/10,000 map to determine measurements of spatial accuracy.

At the general level, we examined topographical accuracy. Indeed, we compared the location of each selected physical element of the graphic production to its location on the geographical map by allocating locations to a 6×5 grid based on administrative boundaries. Each grid was a square representing 3·7 km^2 (1·9 $\times$ 1·9 km). This grid was reproduced for each graphic production, respecting their scale. This was possible because boundaries of Paris were legible with 80% of the individuals drawing it. The other respondents' grid was determined by the boundary of the sheet. Respecting the 6×5 structure, the unit of area of most map-drawing grids did not have a square shape because we respected the distortion of the sketch-map boundaries. Using the grid we calculated the number of units that separated the two locations. Diagonal differences were recorded as two units. Finally, a score of inaccuracy was computed which corresponds to the mean of differences observed.

At the local level we calculated topological accuracy. We noted the orientation of each selected physical element in regards to its four closest elements in the map-drawing. Thus, we did not calculate the Euclidean distance. Orientation was calculated by locating each selected element in the centre of a circle cut out in eight sectors of 45° to observe the relative location between each pair of elements. We then compared the topological accuracy with the relative location observed in the geographical map, using the same tool.

In relation to the propositional representation, we computed, for each subject, the rate of utilization of each of the main characters of meanings (use, functional, physical, social and landmark). Consequently, this individual rate allowed us to homogenize the sample by eliminating inter-individual differences relative to the total number of characteristics formulated by the subjects, and to assimulate this individual rate into a score.

Results

The structure of the propositional representation of Paris

All five characters of meanings (use, functional, physical, social and landmark) were equally mentioned by African (74·98%) and European (75·82%) students. However, the results prove that Africans employ the use character more than the other characters to describe the physical elements of their graphic production whilst Europeans use the physical character as much as the use character (Table 1). The other characters are mentioned less frequently by subjects, irrespective of the cultural origin. The inferential analysis confirms that there are no significant differences between experimental groups with regard to the functional, social, and landmark characters. Also, the differences between the cultural groups are significant for the physical character, $t = -2{\cdot}95$, df. = 53, $p = 0{\cdot}005$, and the use character, $t = 2{\cdot}18$, df. = 46·83, $p = 0{\cdot}034$.

In addition, the African group mentioned the use character significantly more often than the physical character, $t = 3{\cdot}13$, df. = 30, $p = 0{\cdot}004$, social character, $t = 3{\cdot}15$, df. = 30, $p = 0{\cdot}040$ and landmark character, $t = 2{\cdot}05$, df. = 30, $p = 0{\cdot}049$. In other words, the propositional representation of Paris was essentially instrumental for the African sample, its structure characterized by the predominance of the use character. For the European group, the only

TABLE 1
Average individual score for each dimension by cultural group

Meanings characters	African group	European group
use	22·23	16·48
physical	11·80	17·95
social	12·40	13·24
functional	17·04	14·45
landmarks	11·51	13·70
Total	74·98	75·82

TABLE 2
Average individual score for use and physical meanings characters by cultural group and by row of elements

Row of elements	Characters	African group	European group
Five first elements	use	13·67	18·70
	physical	6·58	4·39
Five median elements	use	11·18	17·76
	physical	24·57	17·19
Five last elements	use	9·65	15·45
	physical	26·38	20·83

difference found was between the physical (17·95) and the social character (13·24), $t = 2{\cdot}48$, df. = 24, $p = 0{\cdot}021$. In other words, this group's propositional representation seems to be characterized by the co-dominance of the use, functional, physical and landmark characters. Nevertheless, the difference between the experimental groups, as regards the structure of the propositional representation, depends essentially on use and physical characters. The following analysis is limited to these two characters.

In both experimental groups, these two characters of meanings are strongly and significantly correlated. Indeed, the more the physical character is mentioned, the less the use character is quoted. This result is to be observed for the African group, $r = -0{\cdot}642$, $n = 32$, $p = 0{\cdot}000$, as well as for the European group, $r = -0{\cdot}749$, $n = 24$, $p = 0{\cdot}000$. The other correlations are weak and insigificant. Moreover, in both experimental groups, the physical character is more important for the first elements of the graphic production whilst the use character is more important for the last elements (Table 2).

In conclusion, the first hypothesis is partially confirmed. The use character of meanings is predominant in the representation of Paris by African people, while European people employ equally all the characters of meanings in their representation of Paris. Nevertheless, the direct comparison between cultural groups shows that significant differences appear only about use and physical characters of meanings. Besides, this difference does not depend on cultural cognitive style because each group employs these characters in the same way.

The spatial representation of Paris

Globally, the European sample provided a more accurate graphic production than the African group, $t = 4{\cdot}80$, df. = 38·47, $p = 0{\cdot}000$. This observation only confirms the results hitherto obtained in cross-cultural research. We observe the effect of the cultural origin on accuracy as much as the local level, $t = 4{\cdot}94$, df. = 43·84, $p = 0{\cdot}000$, as the general level, $t = 2{\cdot}82$, df. = 38·6, $p = 0{\cdot}007$. In other words,

TABLE 3
Correlation between characters of environmental meanings and spatial accuracy by cultural origin

Group	Error of spatial accuracy by cultural group	Environmental meanings characters mentioned	
		use character	physical character
European ($n = 24$)	local	0·522**	−0·440*
	general	0·145	−0.119
	total	0·502*	−0.421*
	local (with low general error; $n = 16$)	0·650**	−0·580*
African ($n = 31$)	local	−0·026	0·081
	general	0·010	−0·136
	total	−0·115	0·066
	local (with low general error; $n = 13$)	0·578*	−0·358

*$p < 0{\cdot}05$.
**$p < 0{\cdot}01$.

the spatial accuracy of graphic productions was better for the European group than the African group, whatever the level of accuracy. However, we found that the difference between the two experimental groups is greater for local (topological) than for general (topographical) accuracy, $F(2, 51) = 11{\cdot}34$, $p = 0{\cdot}000$.

Furthermore, it is only for the European group that we observe a direct relationship between the characters of meanings and the accuracy of spatial products. Indeed, for this experimental group, the more the use character is mentioned, the greater the error in spatial accuracy, $r = 0{\cdot}502$, $n = 24$, $p = 0{\cdot}012$. However, this correlation is significant at the local level, $r = 0{\cdot}522$, $n = 24$, $p = 0{\cdot}009$. Moreover, in logical correspondence with the previous correlation between physical and use characters, we observe the following correlation: the less the physical character was mentioned by European subjects, the greater the error in local accuracy, $r = -0{\cdot}440$, $n = 24$, $p = 0{\cdot}031$ (Table 3).

It is only when the graphic production is sufficiently accurate at the general level that we observe the same phenomenon in the African group. Indeed, on the one hand, when the analysis focuses on African subjects, whose general accuracy error score is inferior to the median of the total sample, it proves that the more the use character is mentioned, the greater the error in local accuracy, $r = 0{\cdot}578$, $n = 13$, $p = 0{\cdot}038$ (Table 3). On the other hand, the opposing correlation between the physical character and error in local accuracy is strong ($r = -0.358$) but not significant. Finally, in both experimental groups, if there is a high degree of error in general accuracy, then we observe no correlation between the physical or use character and the local level of spatial accuracy. Henceforth, we will centre the analysis on subjects that have a general error of accuracy inferior or equal to the median distribution of this variable ($n = 29$).

To ensure that the relationship between characters of meanings does really influence spatial representation, we built two groups on the basis of the physical and use character scores. In one group we placed subjects that mentioned the use character more than the physical character ($n = 15$), and in the other, subjects that mentioned these two characters in equal proportion or those who used the physical character more than the use character ($n = 14$). Where the general level of accuracy was sufficiently high, the first group had a graphic production significantly less accurate than the second group at the local accuracy level, $F(1, 28) = 4{\cdot}751$, $p = 0{\cdot}039$; the cultural origin was introduced as a covariable in this statistical analysis. Consequently, when subjects mentioned mainly the use character, there was no observable difference between the African sample ($n = 8$) and the European sample ($n = 7$) at the local accuracy level, $t = 1{\cdot}06$, df. $= 13$, $p = 0{\cdot}310$. Similarly, when the physical character is privileged or mentioned equally with the use character, there was no observable difference between European ($n = 9$) and African ($n = 5$) subjects at the local accuracy level, $t = 1{\cdot}98$, df. $= 4{\cdot}53$, $p = 0{\cdot}110$.

In conclusion, the first part of the second hypothesis is partially confirmed. The effect of the structure of meanings characters on spatial product appears only at the local level of accuracy and when the general level of accuracy is high. Also, the first part of the third hypothesis is confirmed in the same condition. We do not observe differences between European and African students on their spatial product, at the local level of accuracy, when the structure of meanings characters is identical.

Urban practices

Globally, when we added up all the various activities undertaken in Paris in one given month, there were more activities undertaken by the European sample than for the African sample, $t = 4{\cdot}24$, df. $= 28{\cdot}45$, $p = 0{\cdot}000$. When the analysis focused on the different activities quoted, some of them, like going to shows, $t = 3{\cdot}73$, df. $= 27{\cdot}61$, $p = 0{\cdot}001$; going to drugstores and cafés, $t = 3{\cdot}21$, df. $= 28{\cdot}01$, $p = 0{\cdot}003$; going to pubs or night-clubs, $t = 3{\cdot}26$, df. $= 28{\cdot}46$, $p = 0{\cdot}003$; shopping or walking, $t = 2{\cdot}75$, df. $= 53$, $p = 0{\cdot}008$, were more frequent for the European than for the African group. There was no significant difference between the two groups for visiting friends at home and going to restaurants (Table 4). For the subsample whose spatial production was sufficiently accurate at the general level, where subjects mainly mentioned the use character, there was no significant observable difference between the two cultural groups, and this irrespective of the kind of activity (Table 4).

For the subsample with a high general level of accuracy, no direct influence of the structure of meanings characters on the total number of activities can be observed, and the hypothetical interaction between the cultural origin and the structure of meanings characters on all activities combined is not significant. However, the impact of the cultural origin on the combined activities indicator is particularly important, although not significant. In fact,

TABLE 4
Average of activities by cultural origin of subjects

Activities	Total sample		Subsample:			
			High general level of accuracy			
			characters: use > physical		characters: -physical > use	
	European ($n = 24$)	African ($n = 31$)	European ($n = 7$)	African ($n = 8$)	European ($n = 9$)	African ($n = 5$)
shows	2·54	0·40	1·00	1·00	3·33	0·10
restaurants	2·50	1·67	3·00	2·87	3·00	1·40
drugstores & cafés	6·75	1·45	3·57	1·12	8·33	0·80
pubs/night-clubs	2·02	0·32	2·14	0·87	1·27	0·20
visiting friends	3·33	1·74	3·57	2·75	2·44	1·00
shopping/walking	10·12	5·71	5·42	8·25	8·88	3·80
All activities added	28·81	11·95	18·71	16·87	27·38	8·90

it is going to shows, $t = 2{\cdot}15$, df. = 21·02, $p = 0{\cdot}044$, and going to drugstores and cafés, $t = 2{\cdot}47$, df. = 16·50, $p = 0{\cdot}025$, that is more frequent for the European sample than for the African sample.

In order to evaluate the influence of spatial accuracy on activities undertaken in the city, we split the 55 subjects into two groups using the median distribution of the local accuracy level: one group had a high level of local spatial accuracy and the other group was defined as having a low level of local spatial accuracy. This procedure was repeated for the total accuracy level (local level + general level). If the general level of accuracy is high, then the total or the local accuracy levels have no significant effect on activities, irrespective of the kind of activity. Consequently, neither the characters of meanings nor the accuracy of spatial products have a direct influence on urban practices. Elsewhere, when the cultural origin is controlled, there is no significant observable correlation between the number of activities in Paris and the accuracy of the graphic production, except when visiting friends (Table 5). Indeed, the more this practice is frequent, the more the error of local accuracy of the spatial product, $r = 0{\cdot}56$, $n = 26$, $p = 0{\cdot}002$, and also, the less the physical character is used by subjects, $r = -0{\cdot}38$, $n = 26$, $p = 0{\cdot}042$.

Moreover, when the visiting friends activity is statistically controlled, a strong correlation between activities and the level of local accuracy or

TABLE 5
Partial correlation between type of urban activity and error of local accuracy, or the structure of environmental meanings character, only on the subsample with a high general level of accuracy

Activities	Controlling for cultural group ($n = 26$)		Controlling for visiting friends ($n = 26$)	
	local accuracy error	structure meanings' characters[1]	local accuracy error	structure of meanings' characters[1]
shows	−0·057	0·023	−0·451*	0·312
restaurants	0·119	0·009	−0·041	0·124
drugstores/cafés	0·037	0·160	−0·399*	0·478**
pubs/night-clubs	0·200	−0·232	−0·223	0·062
visiting friends	0·561**	−0·38*	—	—
shopping/walking	−0·176	0·257	−0·241	0·299
All activities added	0·110	0·064	−0·421*	0·463*

1: score computed as following: physical character − use character.
*$p < 0{\cdot}05$.
**$p < 0{\cdot}01$.

the structure of meanings character can be observed. Indeed, the more the error of local accuracy, the less the subjects go to shows, $r = -0{\cdot}45$, $n = 26$, $p = 0{\cdot}016$, or drugstores and cafés, $r = -0{\cdot}40$, $n = 26$, $p = 0{\cdot}035$. Furthermore, the correlation remains strong, significant and in the same direction when all the activities are added together, $r = -0{\cdot}42$, $n = 26$, $p = 0{\cdot}026$. In addition, the more the difference between the use and the physical characters is in favour of the physical character, the greater the total number of activities, $r = 0{\cdot}46$, $n = 26$, $p = 0{\cdot}013$, especially when visits to drugstores and cafés are frequent, $r = 0{\cdot}48$, $n = 26$, $p = 0{\cdot}010$ (Table 5).

Consequently, for the total sample, when we control the general accuracy level of the spatial product as well as the visits to friends factor, this proves that subjects who have a propositional representation in which the use character predominates go out significantly less (17·44) than those with a propositional representation where the physical character predominates (21·38), $F(1, 53) = 4{\cdot}083$, $p = 0{\cdot}049$. However, it is the subject's cultural origin that remains the factor with the most influence on the overall number of urban activities. Nevertheless, a strong and significant interaction between these two factors and the total number of activities is observed. Whilst activities undertaken in Paris are more numerous for Africans that have a propositional representation in which the use character predominates (13·50) than for those whose representation is based on the physical character (9·81). Conversely, the overall number of activities is higher for Europeans when their representation is based on the physical character (32·96) than when the use character is predominant (23·91), $F(1, 53) = 11{\cdot}583$, $p = 0{\cdot}001$ (Figure 1).

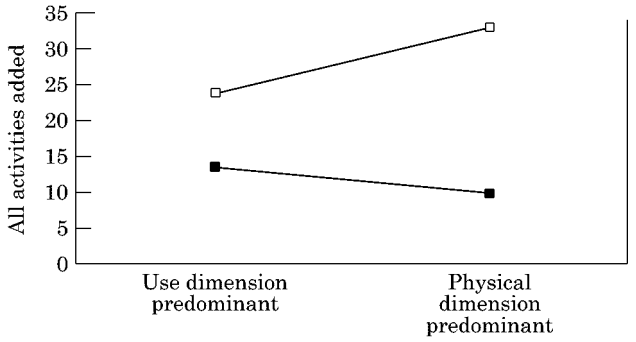

FIGURE 1. Interaction between cultural group and structure of propositional representation for the overall number of activities. (□), European group; (■), African Group.

In conclusion, the second part of the second hypothesis is also partially confirmed. Indeed, when the use character predominates the representation, subjects go out significantly less than when the physical character predominates. Nevertheless, this phenomenon appears only with regard to European subjects.

Discussion

The experimental results effectively show that the propositional representation of Paris relies essentially on the use character of meanings when the cultural distance of the person/surrounding system is great. On the other hand, when the cultural distance is not great, the propositional representation relies on both the use and physical characters. For the latter group, the physical characteristics are legible, or meaningful, while they are not, or only slightly, for the first experimental group.

It is only if the spatial representation is sufficiently accurate at the general level that we observe a relationship between the accuracy of the spatial representation and the structure of the propositional representation. In both experimental groups, the spatial representation is more accurate at the local level when both the use character is less quoted and the physical character more quoted in the propositional representation. Consequently, on the one hand, the legibility of the spatial structure of the city (Lynch, 1960) remains an important component of the environment, and on the other, we have the results of Holahan and Sorenson (1985), according to which the salience of physical elements influences the spatial representation only when the spatial structure of the city is legible. Thus, the social legibility of the surroundings essentially has an impact on the local accuracy of spatial representation. In addition, no difference between the two experimental groups is to be observed when the structure of the propositional representation is equivalent. Moveover, the physical character of meaning is as important for the African sample as for the European sample because both groups employ this character in the same way. In conclusion, it is effectively the cultural distance of the person/surrounding system that influences the accuracy of the spatial representation, rather than a possible cultural cognitive style. These experimental results confirm that spatial cognition relies on environmental meanings. However, although meanings produce systematic distortions

of the spatial representation (Lloyd & Heivly, 1987), this research shows that meanings contribute also to the elaboration of a coherent spatial representation. Beyond the Euclidean distortions that provoke the cognitive process of translation, it allows an element to be localized with greater accuracy when we lay aside all measurements in terms of distance. In other words, environmental meanings are both a limit and the only means of elaborating a spatial representation of the city.

There is no univocal relationship between the propositional representation and urban practices, although the number of urban practices is greater for the experimental group in a strong social legibility situation than the group in a weak social legibility situation. Here, the cultural origin of the individual seems to play an important role. Indeed, it is probable that cultural and social Parisian activities correspond more to the activities expected by Europeans than to those expected by Africans. Furthermore, one particular activity, visits to friends, seems to modulate the propositional and spatial representation of the city. Indeed, upon their arrival, individuals that visit their friends more frequently have a less accurate spatial representation, and a propositional representation focused on the use character. Consequently, this behaviour constitutes an obstacle to the social legibility of the surroundings. We can formulate the hypothesis that individuals who are guided by their friends are satisfied with a more abstract representation. Nevertheless, this result does not conflict with Orlean's result (1973) because it is neither the size nor the location of the social relationship that is in question here, but the frequency of social contacts.

It is therefore by controlling the visits to friends that we were able to discover the relationship between the propositional representation and activities practised. We have since found results obtained in previous research on the relationship between behaviours and spatial representation: the greater the number of activities practised, the greater the accuracy of the spatial representation. On the other hand, the relationship between the propositional representation and urban behaviours is more complex. Indeed, it proves that individuals in a situation of weak social legibility practise more activities when their propositional representation is essentially composed of the use character. According to Gärling *et al.* (1984), at first, the representation of the city relies on experience and is essentially concrete. This result also corroborates research on the spatial structure of the cognitive map. Indeed, many authors have shown that the route-map structure appears before the survey-map structure (Lynch, 1960; Appleyard, 1970; Delvin, 1976; Gärling *et al.*, 1984). People elaborate a concrete representation of the city that allows them to go about their daily activities. This represents an adaptive stage for the individual during which codes and physical signs become increasingly meaningful. Urban practices nevertheless are limited in number, probably because they are limited in space due to the weak coherence of the spatial representation. It is only when codes and physical signs are legible, i.e. when the representation of the city is more abstract, that the spatial representation of the city becomes more coherent and urban practices more numerous. In this case, individuals can explore the city easily and visit unknown places. In other words, a more abstract representation of the city increases the number of activities practised because individuals are probably not limited to places they know since their spatial representation is more coherent.

In conclusion, the social legibility of the environment seems to reduce the adaptive stage of individuals to new surroundings. Besides the environmental personality factors, the social legibility of the surroundings seems to determine this qualitative bond between the adaptive stage and the exploratory stage. Finally, these results show that the cognitive process of translation strongly influences both cognitive map and urban activities of town dwellers. Thus, the quality of the spatial representation of a city and the frequency of the urban activity are the reflection of the propositional representation. In conclusion, even if the surroundings are the same, meanings can vary because the environment is the result of the transaction between the two entities of the person/surrounding system. Lastly, a longitudinal investigation of the propositional representation, with the same experimental conditions, would allow confirming that its structure evolves and reflects the social legibility of surroundings, and that there is no cultural differences in style of cognitive mapping, but only differences on conditions of cognitive mapping.

Current architectural and planning trends pay particular attention to meanings. However, forms and physical codes are often evocative for a particular social group because designers and planners generally think that surroundings in general and codes in particular are meaningful in themselves. But, this research shows that on the contrary, surroundings have no meaning in themselves. It seems to us, therefore, important to discover legible codes for each of the main social groups in a city. Thus, by proposing in each area of the city different architec-

tural constructions which have meaning for each of its groups, each citizen may appropriate the city in its totality. Consequently, the sociological or ethnic split of the city would probably be less great, and the imagibility of the city would depend on the spatial relationship between these urban elements. By paying particular attention to the social legibility of the city, the urban environment would certainly be an important factor of integration and cohabitation between ethnic or social groups.

Beyond this general consideration, the propositional representation of surroundings can be a tool with which we can measure the urban space appropriation. First, the investigation of its structure on town dwellers can be used to diagnose if social and vandalism problems (neighbourhood relation, tags, etc.) in a particular borough come from the unlegible design. In this way, we do not treat the problem either from the aesthetic viewpoint nor in terms of preference, but in terms of person/surrounding optimisation and compatibility (Kaplan, 1983). Second, using the propositional representation, we can identify the meaningful urban elements and those that are meaningless, and draw up a database of meaningful urban elements in accordance with the social characteristics of town dwellers. Following these observations, we can act on social legibility of the surroundings and reduce the adaptive stage of the future dwellers of a local town-planning or architectural project. Indeed, our results show that designers do compromise between art, which proposes new shapes, and social meanings, which refer to traditional shapes, if we want to reduce both the adaptive stage and the differences between designers and users expectations. Aesthetic and artistic design produce more individual than social meanings when cognitive mapping and behaviour rely on social meanings. Third, we can use the propositional representation as a tool in many conditions and on different populations when the spatial product is not easily comparable. However, in this perspective, we need now to standardize this tool and to improve its usefulness, because this study has only tested this effect on spatial products' accuracy and urban behaviour.

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