Residents’ perception of the design factors affecting their sense of legibility and the subsequent degree and type of use and appropriation of communal outdoor spaces was investigated. The specific relationships, which might suggest the way spatial behaviour can be supported or inhibited by the level of clarity of physical and social space definition, are explored. There is an analysis of the relationships between the orientation pattern of buildings, spaces and the circulation system provided by design, and the effects of these relationships on user perception of space hierarchy, territorial definition and spatial behaviour. The results allowed the identification of the more important elements affecting and conveying user perception of physical and social definition of spaces.

**Keywords**: social housing, site layout, degree of legibility, spatial behaviour, physical definition of spaces, social definition of spaces.

**INTRODUCTION**

This paper is about the communal open spaces provided in mass housing schemes and the life they do or do not support. It is argued that public open spaces, specially those provided for low-income residents, are the common ground where people can carry out the functional and social activities that bind a community in the normal routines of daily life. “Open spaces are the stage upon which the drama of communal life unfolds, providing the channels for movement, the nodes for communication...” (Carr et al., 1992, p.3); these dynamic spaces provide an essential counterpart to the more settled places and routines of homelife. These claims, according to Carr et al. reveal the value of public space.

The research rests on the assumption that buildings and spaces ought to be designed above all to serve the needs and wishes of their users, just like any study concerned with user evaluation of design solutions (e.g. Cooper, 1975). However, mistakes have been detected in the design of social housing in several countries. According to Clare Cooper’s findings, the designers’ most frequent mistakes are due to their lack of information about low-income residents. It is assumed that user oriented studies can help correct their lack of knowledge in order to learn how to create and maintain places that are responsive and meaningful to their users and appropriate to the context. It is the aim of this research to help provide the necessary understanding of the fundamentals mentioned by Carr et al. (1992) — the “human dimensions” of residential open spaces — that is needed to design and manage housing schemes more creatively and effectively. It is argued that, despite the fact that sites can be perceived differently by people, a common connected web of physical factors and required activities exists in every site, which can impose limitations on and offer possibilities for behaviour. It aimed to identify this common web of factors which might help eradicate some limitations of the site and positively influence behaviour. Therefore, it focused on the identification of design factors that might positively or negatively affect the ways residents perceive, evaluate and use the outdoor spaces provided in low-income housing schemes, causing some residential environments to be perceived as more or less successful than others. This paper presents an overview of the results of this research related to specific design factors that affect legibility of site layout as experienced by the residents, their perception of territory definition and spatial behaviour.

The results obtained from the post-occupancy evaluation of case studies carried out, accounted, inter alia, for the attested influence of the built environment on spatial behav-
RESEARCH PROBLEM

Amongst the various deficiencies that Brazilian housing schemes present today is the inability of promoting successful open spaces, which is mainly reflected by patterns of use and maintenance. Nonetheless, despite the poor building and design quality of these housing schemes commonly built in Brazil as part of the social housing program, dissimilar environmental performance was identified (e.g. Lay, 1992; Reis, 1992): it was observed that while some housing schemes were neglected and abused, others were positively used and maintained. This seemed to be related to occasional differences in the site layout.

It is known that the purpose of site layouts is to organise the external physical environment in order to accommodate, facilitate and, in some instances, constrain human behaviour — i.e. by locating objects and activities in spaces, arranging structures on the land, and shaping the spaces between structures (Lynch & Hack, 1984). Therefore, the importance of site layout legibility is that it limits the degree of understanding of visually perceived cues in the environment, which may subsequently affect the ways in which the site is used and evaluated. In addition, it is further assumed that legibility of site layout can be constrained by the clarity and sharpness of spatial organisation of the site, which appear to be limited by how clearly spaces are physically and socially defined.

Moreover, legibility of site layouts — that is “the ease with which the site can be recognised and organised in a coherent pattern” (Lynch, 1960) — appears to be affected, inter alia, by how fit the site layout is in providing adequately or not for patterns of activity, suitable circulation, and acceptable physical form.

The review of the literature on the attribute legibility of layout stressed the importance of functional and behavioural elements in affecting user ability to operate efficiently and effectively on the site. It is thus assumed that there is a relationship between spatial behaviour and legibility of layout, where spatial behaviour can be supported or inhibited by the level of clarity of physical (e.g. Lang, 1987; Cooper-Marcus & Sarkissian, 1986; Newman, 1972; Rapoport, 1977; Darke & Darke, 1982) and social space definition (e.g. Newman, 1972; Becker, 1977; Edney, 1976; Appleyard & Lintell, 1972), variations in degree of accessibility (Barker, 1976; Cooper & Marcus, 1971; Carr & Lynch, 1981; Francis, 1989), visibility (e.g. Gehl, 1987; DoE 1971, 1972), fitness and adequacy of spaces provided (e.g. Gehl, 1987; Cooper-Marcus & Sarkissian, 1986), and the relationship between buildings (e.g. Alexander et al., 1977; Rapoport, 1980; Michelson, 1968).

These major site features relate to space definition and are more frequently claimed to affect user perception of the adequacy of spatial capacity and efficiency of communication and circulation as analyzed in the literature. The identified effects, which clear and unclear physical and social space definition might have on the social functioning of the community, illustrate the necessity of examining in more detail the relationships between the environmental elements affecting legibility of site layout and promoting or constraining the use and appropriation of outdoor spaces by the residents.

The intention of the study was to examine the validity of these underlying assumptions and to ascertain the extent to which the design of housing schemes produced in Brazil reflect the requirements of their users.

METHODS

The model chosen to guide the research was the psycho-social model of environment: behaviour which assumes an interactive relationship between human behaviour and the quality and composition of the physical environment (Cantor, 1977). The survey was designed with the purpose of:

1. identifying and analysing the most frequently perceived design factors and attributes affecting physical and social definition of the sites, further affecting user perception of legibility of site layout;
2. identifying and analysing the effects of user perception of legibility of layout on spatial behaviour; and
3. identifying and analysing the effects of user perception of space definition on sense of territoriality.

In addition, it should be possible to measure and compare the level of usage, modifications and maintenance of outdoor spaces across residential environments having different layouts and to develop a behavioural portrait of each of these residential environments, including both the range of activities that occur in the outdoor spaces and an identification of the environmental features that support these activities.

The means and methods of measuring the variables were investigated and tested through a detailed comparative study of outdoor spaces in a sample of two low-income housing schemes in the city of Porto Alegre, Brazil.

A form of stratified sampling was utilised for the selection of the sample of schemes, which
was based on diagnostic explorations conducted in 19 housing schemes provided by governmental housing policy for low and low–middle income groups located within different inner-city neighbourhoods. This preliminary sample selection did permit a coarse selectivity to be applied, in this case to select the most obvious disliked and liked housing schemes. That is, of the sites selected, the Jardim Salomoni housing scheme represented projects with positive resident evaluation and a high degree of usage of outdoor spaces, while the Parque Cristal housing scheme represented projects indicating negative resident evaluation and a low degree of usage of outdoor spaces.

The projects were comparable in age (10 years old), in the quality of design of buildings and in their form, following the modernist approach of buildings placed in continuous open space. All accommodation consisted of flats in blocks up to four floors in height. Both sites presented a standardised shape and yet had peculiar characteristics in the site layout, as shown in Figures 1 and 2.

Residents on both sites were comparable along three dimensions: ethnic (multi-racial), socio-economic level and length of residence. Moreover, the two housing schemes, as part of the subsidised housing provided by governmental housing policies, were privately owned, which means that the maintenance of buildings and open spaces is the owners’ responsibility, that is, the residents.

The multi-method techniques used for data collection consisted of a combination of observation of physical traces, observations of behaviour, interviews, questionnaires and record analysis, so that each technique could be used as much as possible to check on the others’ completeness, yet be able to contribute to the total outcome. The data from behaviour mapping, the survey of the sites, interviews and the questionnaires were analysed primarily on the basis of frequencies of various responses. The statistical analysis (cross tabulations and correlation tests) of the data from questionnaires (sample size approx. 10%: 102 dwellings in Jardim Salomoni and 65 dwellings in Parque Cristal) provided measures to assess how strongly reactions among residents to living in such housing schemes were related to their perception of legibility due to design differences in site layout.

Figure 1: Jardim Salomoni site layout

Jardim Salomoni consists of 960 units of flats, distributed in 30 four storey blocks, with a population of approx. 4,800 residents. The site design provided repetitive spaces, produced by the systematic formal orientation pattern of buildings, suggesting well-defined semi-private (spaces “belonging” to groups of residents) and semi-public spaces (spaces “belonging” to all residents). The relationship between buildings was predominantly that of buildings facing each other and sharing the same path to enter the buildings, the orientation of the entrance of most of the buildings, with the backs of buildings also related to each other.
RESULTS AND DISCUSSION

An investigation of design factors which seemed to be affecting the ways residents perceive, evaluate and use outdoor spaces was undertaken, and the specific relationships which might suggest the way spatial behaviour can be supported or inhibited by the level of clarity of physical and social space definition provided by site layout, were explored.

The measures employed enabled objective comparisons between the alternative design proposals provided in the two housing schemes in terms of the effects which variations in the perceived legibility of site layout had on user spatial behaviour and sense of territoriality. The degree of site layout legibility was assessed through analysis of the relationships between the physical definition of spaces determined by the orientation pattern of buildings and circulation system of the site layout, and the way spaces were subsequently socially defined, used and maintained by its residents. The effects of these relationships on user perception of accessibility, space hierarchy and territorial definition were measured by the level of maintenance and control of spaces and the frequency and type of use given to these spaces.

User perception of physical definition of space

The degree of space definition, that is, how clearly and sharply spaces were physically defined, was assessed through the analysis of relationships between buildings and open spaces, determined by the formal pattern orientation of buildings on the site and the circulation system provided and/or modified.

The adequacy of physical definition of spaces determined by site layout was assessed by its effects on social interaction among residents and user-environment interaction, mainly manifested and investigated through the level of maintenance and use of common open spaces. The major associations investigated were based on the data collected on the two sites, which suggested the following:

Orientation pattern of buildings on the sites

It was found that variations in the orientation pattern of buildings on the site affected maintenance, use and level of social interaction among residents in semi-private spaces.

This indicates that maintenance and social interaction in semi-private spaces which were sharply defined and clearly perceived by users were noticeably more positive than semi-private spaces resulting from unclear space definition. The results obtained allowed the summation to be made in Table 1.
Figure 3: Poor maintenance of semi-private space in P.C. (between front and fence)

Figure 4: Good maintenance of semi-private space in P.C. (between two fronts)

Figure 5: Blind facades in Parque Cristal

Figure 6: Provision of Benches In Jardim Salomoni
## Table 1: Effects of variations in orientation pattern of buildings

<table>
<thead>
<tr>
<th>ORIENTATION PATTERN OF SPACES</th>
<th>MAINTENANCE</th>
<th>FREQUENCY OF USE</th>
<th>VARIATION IN FUNCTION</th>
<th>CLASSIFICATION</th>
<th>LEVEL OF DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space between two fronts</td>
<td>very good</td>
<td>high</td>
<td>meeting playing traffic</td>
<td>front semi-private space</td>
<td>very good</td>
</tr>
<tr>
<td>Space between two backs</td>
<td>vary according to type of use</td>
<td>vary according to clarity of clues suggesting type of use</td>
<td>non-use playing traffic</td>
<td>back semi-private space (depending on functions)</td>
<td>generally very good</td>
</tr>
<tr>
<td>Space between front and back</td>
<td>poor</td>
<td>regular</td>
<td>traffic playing</td>
<td>indefinite</td>
<td>unclear</td>
</tr>
<tr>
<td>Space between front and sides</td>
<td>poor</td>
<td>regular</td>
<td>traffic playing</td>
<td>indefinite</td>
<td>unclear</td>
</tr>
<tr>
<td>Space between front and street</td>
<td>J.S. P.C J.S P.C.</td>
<td>traffic meeting (J S)</td>
<td>front semi-public space</td>
<td>clear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>good reg.</td>
<td>good reg.</td>
<td>traffic playing</td>
<td>front semi-private space</td>
<td>clear</td>
</tr>
<tr>
<td>Space between front and fence</td>
<td>good</td>
<td>regular</td>
<td>traffic playing</td>
<td>front semi-private space</td>
<td>clear</td>
</tr>
<tr>
<td>Space back and fence</td>
<td>poor</td>
<td>low</td>
<td>drying area playing gardening</td>
<td>back semi-private space</td>
<td>clear</td>
</tr>
</tbody>
</table>

### User perception and use of circulation routes

It was observed that the configuration of circulation routes provided in Jardim Salomoni set the stage for interaction among adults and youngsters, while in Parque Cristal streets and pathways were essentially used for traffic. The elements which might provide more or fewer opportunities for residents to casually interact were identified. When analysing the circulation system in Jardim Salomoni and in Parque Cristal, two major differences related to the type of relationship between buildings and streets, and between buildings and pathways were apparent:

1. The relationship between building and streets differed markedly in each scheme in terms of visual access: while all facades in Jardim Salomoni had windows, all lateral facades in Parque Cristal were blind (that is, the street was visually secluded);

2. The provision of benches and places (clues) which denoted the purpose of performing social activities (i.e. sitting and talking to neighbours) in all semi-private spaces located at the entrance to buildings in Jardim Salomoni, and the visible access residents had to these spaces from their flats (which, according to Gehl, might encourage other residents to participate in the activities), were missing in Parque Cristal, where the lack of criteria to define location of buildings and access to them, created unappealing routes.

### Accessibility

The location of buildings on the site and the situation of flats in the building, which determined the level of visual and physical accessibility to behaviour settings, confirmed this: the findings indicated that the functional distance between spaces — i.e. the proximity to playgrounds — affected the frequency of use of those outdoor spaces and territoriality. In addition, correlation tests indicated that respondents who used outdoor spaces and participated in recreational activities expressed greater satisfaction with their living environment than non-users.

However, functional accessibility from the dwelling to the outdoor spaces was perceived differently to the assumptions made in the literature. The locational requirements mentioned by Cooper (1975), DoE (1973) and others,
about households with small children preferring to live in ground-level units did not correspond to the findings.

This appears to be influenced by the lack of security and privacy perceived by those living at the ground-level and was correlated to the prospect of private use of the external areas adjacent to those flats (the private use of outdoor spaces was not predicted by the design of the sample schemes). This finding strongly suggests that households’ preferences for living at ground-level might change if the adjacent areas were formally converted into private open spaces.

Another important finding, contrary to the suggestions made in the literature (e.g. Cooper-Marcus & Sarkissian, 1986), is that no evidence was found to suggest that those who lived at the ground floor used outdoor spaces more frequently than those who lived above ground level. It was also found that visual accessibility was more important than functional accessibility in affecting the use of the spaces. That is, the importance of locating behaviour settings that are visibly accessible was distinct in its effect on the use of visibly accessible outdoor spaces and the non-use of non-visibly accessible outdoor spaces. The self-reinforcing process mentioned by Gehl (1987), when referring to the importance of visual accessibility to spaces, was also identified.

**Social definition of space**

The social definition of space was assessed through the investigation of territorial behaviours in common and semi-private spaces, by analysing the means used by residents to demarcate their territories, and the effectiveness of the means used on denoting territories.

The importance of design factors in marking territory, such as the sharp delineation of semi-private spaces, was clearly shown by the observed differences in maintenance between condominiums with and without clear semi-private space definition, which did or did not imply which “territories” belonged to whom and fell under whose responsibility.

How buildings were located on the site and the relationships originated by it, was confirmed to be an important factor in affecting residents’ perception of what their physical and social space was and their physical and spatial response to it. That is, spaces were used as behaviour settings, modified and maintained either to connote territoriality or to respond to user perception of territory, which demanded spaces to be used and users to behave in a certain way.

Territory has been analysed according to the definition given by ethologists as the expression of social organisation in spatial terms. Since social organisation takes place in a physical place, and is inevitably constrained by it, social activities involve not merely a two-way transaction between individuals or groups, but a three-way one between them and the environment. Territorial behaviour, therefore, was regarded as part of a system which enables social organisation.

![Figure 7](image7.png) Maintenance as marker of territory in Parque Cristal.

The findings indicate that the social definition of space was strongly affected by the more or less clear physical definition of spaces. The need to organise urban physical spaces socially,
in terms of categories (i.e. public, semi-public or semi-private) appeared to be an essential requirement among residents to enable them to understand the nature of their territory. The observations made indicate that residents tended to reinforce or modify the physical definition of spaces, either by developing strategies to clarify space definition and to make apparent who was responsible for what space, or by creating categories of social spaces which had not been suggested by design and consequently altered the relationships of the components of the settings.

In summary, residents evaluated legibility of layout on the basis of their perception of the design features and attributes that facilitated physical and social space definition, in addition to their perception of structure and territory. Evidence was found to support the assumption that spatial behaviour is a physical response users give to their evaluation of environmental features, which affect the environment in an iterative manner. The more important elements positively affecting user perception of physical and social definition of spaces were:

1. perceivable front and back relationship between buildings;
2. the good placement of buildings in relation to the pedestrian routes;
3. clear indication of space hierarchy;
4. adequate size and location of spaces;
5. good visual and functional accessibility of spaces;
6. territorial control.

The more important elements conveying user perception of physical and social definition of spaces were:

1. extensive landscaping;
2. maintenance;
3. use of formal or informal behaviour settings;
4. boundary demarcation.

Although site design did not determine user behaviour or satisfaction, it set physical and spatial qualities that supported or inhibited behaviour patterns. Territorial recognition, consistent order and maintenance were important aspects affecting user perception of adequacy of space and organisation of definite cues on the site. The type of relationships originated by the quality and location of structures, routes, and activity settings affected the user perception of fitness of site layout. Moreover, results indicate that physical and social space definition provided by site layout were the important elements in affecting user perception of (or lack of) security, sense of identity with the place, surveillance of common areas, and use and maintenance of spaces.

**CONCLUSIONS**

It has been shown in this paper that resident perception of legibility of layout was affected by the way spaces, determined by site layout, were more or less clearly understood: the more intelligibly spaces are physically and socially defined, the more legible site layout is, and the more frequent and appropriately spaces are used and maintained. The quality of maintenance created a particular ambience in each scheme and this appears to have affected social activities and resident perception of the entire setting. Besides, as maintenance is the residents’ responsibility, it depends on and further develops a sense of community among them.

The pragmatic aim of this study has been to bring together an organised awareness of some of the interrelations which affect the way outdoor spaces in mass housing schemes are used. Looking at the manifestation of behavioural patterns and at aspects and qualities of the environment that users distinguish, and providing a more realistic background to the development of predictive models of human response to residential outdoor environments, certainly will enhance designers’ ability to produce more responsive visual and functional forms, emphasising the identity and structure of residential environments.

Application of these findings can complement the development of design guidelines proposed by similar past research in this topic carried out in other countries (e.g. the great number of case studies investigated by Cooper-Marcus & Sarkissian in several English speaking countries, and DoE in Great Britain), which specify how residential open spaces can be programmed, designed or improved, and include a set of design guidelines more appropriate to the Brazilian context. This should stimulate more scientific inquiry into how aspects in the built environment can influence user perception of more or less successful environmental performance, subsequently affecting the ways housing schemes in Brazil are used, misused or abused.

**REFERENCES**


