Privacy in the Dwelling: Attitudes, Visual and Functional Connections
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Abstract
The paper examines resident’s attitudes concerning adequacy of visual privacy in 374 dwellings in twelve housing estates in the metropolitan region of Porto Alegre. Aspects associated to visual connections, such as areas of isovists, relationships between the mean number of visualised spaces and the mean number of spaces in the dwellings and type of visualised spaces are investigated. Moreover, aspects associated to functional connections, such as type of connected spaces, type of topological spaces in the dwelling, degree of integration of spaces and the difference factor are further explored. Data was collected through questionnaires, structured interviews and physical measurements, analysed by non-parametric statistical tests and space syntax. Results indicate that the greater the homogenisation of spatial configuration, the greater the tendency for visual privacy related problems. Additionally, it was found that certain quantitative methods could be more appropriate than others to predict the adequacy of visual privacy in the dwelling.

Introduction
The concept of privacy invokes the possibility of controlling, in different degrees, interactions among people and/or with internal or external spaces, and so the interruption or reduction of information flow, as already revealed by some authors (i.e. Kupritz, 2000; Rapoport, 1985). Privacy is a universal concept, although the means used to regulate it may vary accordingly different social systems (Kupritz, 2000).

The importance of privacy can be revealed, for example, in the American culture, through the inclusion made by Kaplan of the item privacy in the item safety, considered as second in the hierarchy of human needs established by Maslow in 1943, soon after the physiologic needs (Kupritz, 2000). Moreover, the importance of privacy has been revealed in studies about social housing in the United States (i.e. Francescato et al., 1979) and in Great Britain (i.e. Darke, 1982; Department of the Environment, 1981). Although some studies were not specific about the privacy dimensions considered, enough privacy in relation to other people inside the house tended to be important for resident's satisfaction.
with the housing unit, as exemplified by Cooper (1975) in 'Easter Hill Village', a study with North American families of medium and lower incomes. Internal visual privacy has also been revealed as an important aspect in the design of social housing in Brazil (i.e. Reis, 1997; Reis & Lay, 1995). It was relevant for such residents to be able to control interaction with other people inside the dwelling. Moreover, as already emphasised by some authors (i.e. Kupritz, 2000; Hall, 1966), environmental mechanisms, physical elements or space related aspects play a fundamental role in controlling or regulating privacy. However, visual privacy inside housing units has not been explored in a systematic way, at least in relation to social housing in Brazil, concerning aspects relative to attributes of visual and functional connections inside the units. Additionally, it has not been established relationships between the quantification and qualification of what has been visualised and residents’ attitudes concerning visual privacy inside the housing unit.

Internal visual privacy implicates in the consideration of what is visualised from certain spaces and in the possibility of controlling visual integration, that is, of blocking or not visual connections. Therefore, visual privacy inside the housing unit is affected, besides visual connections from certain observation points, by movement possibilities and control through the existing functional or physical connections. Accordingly, spaces can be classified as topological spaces (that keep position and not metric relationships) $a$, $b$, $c$, and $d$, (Hillier, 1996) with different implications for movement, control and visual privacy. Spaces of the type $b$ and, in a smaller degree, of the type $c$ control movement more strongly than spaces of the type $a$ or $d$. Hence, these types of spaces allow and condition residents' and visitors’ movement to specific sequences of spaces, differently affecting the potential of occupation of such spaces, and the adequacy of internal visual privacy.

Additionally, an important configurational property (relationships between three or more spaces), with consequences for visual privacy inside the dwelling, is the integration measure. It’s calculation is based in the minimum number of intervening spaces that one should cross in order to reach all the spaces of the configuration. An integrated space in the housing unit allows a more direct access to the remaining spaces and less visual privacy than a space less integrated or segregated (Hillier, 1996; Hillier & Hanson, 1984). Yet, the extension of the variability of integration values of different spaces in one housing unit, namely the difference factor, can be measured considering the maximum, medium and minimum integration values of the spaces or functions, and the sum of these values (Orhun, Hillier, & Hanson, 1995; Hillier, Hanson, & Graham, 1987). The more differentiated the integration values are, the more differentiated the spaces are in terms of visual privacy, indicating greater configurational differences and greater internal visual privacy.

Hence, this article examines the adequacy of visual privacy inside the housing units and aspects associated to visual connections, such as the areas of
the isovists or visual fields, the relationship between the mean number of visualised spaces and the mean number of spaces in the housing units in each housing estate, and types of visualised spaces. Aspects associated to functional connections are also investigated, such as types of connected spaces concerning function, topological spaces or types of existent spaces in each unit considering movement possibilities for residents and visitors, integration levels of spaces and difference factors. Through these different methods of quantifying aspects of internal visual privacy, it is also intended to verify their potential in reflecting the adequacy of internal visual privacy.

Methodology
The investigation of visual privacy was accomplished inside housing units in 12 housing estates in the metropolitan area of Porto Alegre, characterised by the following housing types and samples sizes (number of units): four storey blocks of flats (Loureiro-45, Angico-30, Guajuviras Block-32, Cavalhada-33 and Sapucaia-30), semi-detached houses (Restinga-36), row and detached houses (Costa and Silva-32), detached houses (Guajuviras-32), and terraced houses (Vale Verde-30, João Vedana-30, São Jorge-20 and Santo Alfredo-24). Residents' attitudes concerning the adequacy of visual privacy inside the housing units (Table 1) were identified through questionnaires applied to a total of 374 units, analysed in the software SPSS/PC through non-parametric statistical tests, such as Kruskal-Wallis and Spearman, besides structured interviews accomplished to about a third of this number. The number and type of spaces, besides the existent visual and functional connections were observed and registered through physical measurements accomplished in the housing units. The areas and perimeters of isovists, as well as the integration levels and difference factors, were calculated through the software Spatialist, developed at Georgia Institute of Technology, by Peponis et al. (1998). In the case of the integration levels and difference factors, only the results related to one representative of each three housing types are presented, namely: Angico (blocks of flats), Santo Alfredo (terraced house) and Restinga (houses).

Results
Attitudes related to visual privacy in the housing units
Visual privacy among people in different rooms tends to be satisfactory for approximately 50% of residents from different housing estates. However, a statistically significant difference exists (K-W, chi2 = 67.6277, sig. = .0000) among the satisfaction levels with visual privacy among people in different housing estates. The most satisfied are those in the flats of Angico, with 76.7% of residents evaluating internal privacy as good or very good, followed by those in the houses in Guajuviras, and in the flats of Loureiro. The most dissatisfied are those in São Jorge, with 75% of residents evaluating internal
privacy as bad or very bad, followed by those in Santo Alfredo, whose housing type is identical (Table 1). Therefore, residents of blocks of flats (Angico, Loureiro and Guajuviras) tend to be satisfied with internal visual privacy, while residents of terraced houses (São Jorge, Santo Alfredo and Vale Verde) tend to be dissatisfied. Satisfaction with internal visual privacy was found to be positively correlated with satisfaction with the housing unit (Spearman, \( r=0.1247, \) sig.=0.016), when all the cases were considered as one sample, supporting the importance of internal visual privacy in social housing, already mentioned in the Introduction of this paper.

**Table 1.** Attitudes concerning visual privacy in one room in relation to other rooms in the dwelling.

<table>
<thead>
<tr>
<th>HOUSING ESTATES</th>
<th>very bad</th>
<th>bad</th>
<th>not bad nor good</th>
<th>good</th>
<th>very good</th>
<th>mean rank</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angico blocks</td>
<td>0</td>
<td>3 (10%)</td>
<td>4 (13.3%)</td>
<td>21 (70%)</td>
<td>2 (6.7%)</td>
<td>243.82</td>
<td>30</td>
</tr>
<tr>
<td>Guajuviras houses</td>
<td>1 (3.1%)</td>
<td>0</td>
<td>8 (25%)</td>
<td>21 (65.6%)</td>
<td>2 (6.3%)</td>
<td>241.44</td>
<td>32</td>
</tr>
<tr>
<td>Loureiro blocks</td>
<td>2 (4.4%)</td>
<td>6 (13.3%)</td>
<td>4 (8.9%)</td>
<td>31 (68.9%)</td>
<td>2 (4.4%)</td>
<td>228.42</td>
<td>45</td>
</tr>
<tr>
<td>Guajuviras blocks</td>
<td>0</td>
<td>5 (15.6%)</td>
<td>8 (25%)</td>
<td>17 (53.1%)</td>
<td>2 (6.3%)</td>
<td>217.80</td>
<td>32</td>
</tr>
<tr>
<td>Restinga houses</td>
<td>0</td>
<td>10 (27.8%)</td>
<td>3 (8.3%)</td>
<td>23 (63.9%)</td>
<td>0</td>
<td>207.11</td>
<td>36</td>
</tr>
<tr>
<td>Cavilhada blocks</td>
<td>2 (6.1%)</td>
<td>9 (27.3%)</td>
<td>7 (21.2%)</td>
<td>15 (45%)</td>
<td>0</td>
<td>176.44</td>
<td>33</td>
</tr>
<tr>
<td>Sapucaia blocks</td>
<td>0</td>
<td>8 (26.7%)</td>
<td>11 (26.7%)</td>
<td>11 (36.7%)</td>
<td>0</td>
<td>175.10</td>
<td>32</td>
</tr>
<tr>
<td>João Vedana terraced h.</td>
<td>1 (3.3%)</td>
<td>13 (43.3%)</td>
<td>1 (3.3%)</td>
<td>15 (50%)</td>
<td>0</td>
<td>172.48</td>
<td>30</td>
</tr>
<tr>
<td>C. e Silva houses</td>
<td>2 (6.3%)</td>
<td>14 (43.8%)</td>
<td>3 (9.4%)</td>
<td>13 (40.6%)</td>
<td>0</td>
<td>156.56</td>
<td>32</td>
</tr>
<tr>
<td>Vale Verde terraced h.</td>
<td>4 (13.3%)</td>
<td>13 (43.3%)</td>
<td>4 (13.3%)</td>
<td>8 (26.7%)</td>
<td>1 (3.3%)</td>
<td>136.98</td>
<td>30</td>
</tr>
<tr>
<td>Santo Alfredo terraced h.</td>
<td>2 (8.3%)</td>
<td>13 (54.2%)</td>
<td>3 (12.5%)</td>
<td>6 (25%)</td>
<td>0</td>
<td>125.44</td>
<td>24</td>
</tr>
<tr>
<td>São Jorge terraced h.</td>
<td>1 (5%)</td>
<td>14 (70%)</td>
<td>3 (15%)</td>
<td>2 (10%)</td>
<td>0</td>
<td>99.40</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15 (4%)</td>
<td>108 (28.9%)</td>
<td>59 (15.8%)</td>
<td>183 (48.9%)</td>
<td>9 (2.4%)</td>
<td>374 (100%)</td>
<td></td>
</tr>
</tbody>
</table>

Note: The housing estates are ordered from the higher to the lower degree of residents satisfaction with internal visual privacy; terraced h. = terraced houses; mean rank values were obtained through Kruskal-Wallis statistical test.

**Isovists areas**

Isovists areas reveal the amount of space visualised from central points generated in the main living-room in each housing unit. Although the mean isovists areas in semi-detached houses in Restinga (17.7 m²) and terraced houses in Santo Alfredo (15.1 m²) are similar, the relationship between isovist area and the total housing unit floor area shows that, proportionally to the area of the unit, the residents of the terraced house in Santo Alfredo visualize from
the living-room a much larger amount of internal space (isovist area/housing unit floor area=index=0.668) than those in the semi-detached houses in Restinga (index=0.244) and those in the flats in Loureiro (index=0.301). This suggests that there is less visual privacy in Santo Alfredo than in Restinga and Loureiro, as already shown in Table 1.

Additionally, those more satisfied with internal visual privacy (Table 1) live in housing units where the indexes (isovist area/housing unit floor area) tend to be the smallest ones (Angico – 0.313, Figure 1a; houses in Guajuviras – 0.263; Loureiro – 0.301, Figure 1b), while those more dissatisfied live in housing units where the indexes tend to be the largest ones (São Jorge – 0.681; Santo Alfredo – 0.668, Figure 1c; Vale Verde – 0.618). Therefore, the index that indicates the relationship between isovist area and the total floor area of the housing unit reveals, with certain reliability, the adequacy of internal visual privacy. This implies that such index might be used to predict the adequacy of internal visual privacy.

Figure 1. Isovists areas.

![Isovists areas](image)

Note: 1=living-room; 2=living and dining-room; 3=bathroom; 4=bedroom; 5=kitchen; 6=kitchen/laundry; 7=laundry; 12=circulation; 18= dining-room/sewing room; plans show isovists areas representative of the mean isovists areas of housing units in the respective housing estate.

**Mean number of visualised spaces and of spaces in the housing units**

Analysing the indexes produced through the relationship between the mean number of visualised spaces and the mean number of spaces in the housing units in each group, it can be concluded that these indexes don't reflect the levels of internal visual privacy, showing a variation that doesn't follow the variation in the satisfaction levels with visual privacy in the housing unit. This can be explained by the fact that in many units, only a small part of certain spaces is visualised, which does not appear to affect internal visual privacy. Hence, this index does not appear to be an appropriate predictor of adequacy of internal visual privacy.
Type of visualised spaces
Concerning the type of visualised spaces (regarding its function or use), one cannot establish a direct relationship between the type of visualised space and the level of internal visual privacy, due to intervening factors as the visualised area of such space, its distance and the number and area of existent spaces among the observation point and observed or visualised space. For instance, although in the flats of Loureiro the two bedrooms (4 in Figure 1b) can be visualised from the generated isovist in the central point of living-room, the visualised areas are reduced, besides the existing circulation (12 in Figure 1b) between the bedrooms and the living-room (2 in Figure 1b). Terraced houses of São Jorge and Santo Alfredo also illustrate the problems of privacy provoked by the lack of physical barrier among the two bedrooms in the original second pavement (Figure 2a) and for the need of passing through the living-room (2 in Figure 2a) to go to the bathroom (3 in Figure 2a) in the first pavement, that are not detected by the analysis of the type of spaces visualised from the generated isovist in the central point of main living-room. Therefore, this analysis, concerning the type of visualised space, also does not appear to be a suitable predictor of adequacy of internal visual privacy.

Types of connected spaces
The existent functional connections between the main rooms in the flats, terraced houses and houses, show that the main explanations for satisfaction with visual privacy in the housing unit are related to connections from living-room or living-room/dining-room to the circulation, from the bedroom to the circulation, from the kitchen to the circulation, from the laundry to the kitchen and from the bathroom to the circulation space (Figure 2c). On the other hand, the main explanations for dissatisfaction with visual privacy in the housing unit are related to connections from the living-room or living-room/dining-room to the bathroom and bedroom, from the bedroom to the bedroom, staircase, laundry and to the living-room, from the kitchen to living-room/dining-room, from the laundry to the bedroom and to the kitchen/dining-room, and from the bathroom to the living or living-room/dining-room (Figure 2a/e/b). Precisely, the lack of visual privacy inside the terraced house (Figure 2a) is a consequence of the location of the bathroom, physically connected to the living-room and to the kitchen, besides the location of the staircase in the second pavement, usually in one of the bedrooms (after addition of a partition wall), and of the compulsory circulation through the living-room to go from the bedrooms to the bathroom. Therefore, the identification of the types of connected spaces tends to confirm the results presented in Table 1 related to level of residents' satisfaction with visual privacy inside the housing unit and to aid in the explanation of such results.
**Figure 2. Plans of housing units.**

a) Modified plan of terraced houses in Santo Alfredo - negative connections - living-room and bathroom, kitchen and living-room, laundry and kitchen, bedroom and bedroom

b) Original Plan of house in Restinga - negative connections - living-room/dining-room and bathroom, living-room/dining-room and bedroom, kitchen and living-room/dining-room, kitchen and bedroom

c) Original Plan of flat in Loureiro - positive connections - living-room and circulation, bedroom and circulation, bathroom and circulation, laundry and kitchen

Note: 2 = living-room/dining-room; 3 = bathroom; 4 = bedroom; 5 = kitchen; 7 = laundry; 8 = kitchen/dining-room; 12 = circulation.

**Internal accessibility – topological spaces**

All the housing estates with blocks of flats investigated, present topological systems of the type \( b \), indicating larger control of movement and, therefore, greater visual privacy, than topological systems of the type \( c \) or of the type \( d \), that offer more possibilities of passage. Considering that spaces of the type \( a \) present greater privacy than spaces of the type \( b \), since the first are spaces without exit, not allowing the passage to other spaces, it is observed that the internal visual privacy in the terraced house is negatively affected by the fact that an expressive number of bedrooms are type \( b \) spaces, allowing passage to other bedroom or to the staircase (Figure 2a). Although the terraced houses predominant system is the same of the blocks of flats, the former has internal visual privacy negatively affected by the expressive number of bedrooms as type \( b \) spaces.

The results obtained from the analysis of the topological systems of houses, initially reveal a variation on types of topological systems non-existent in flats and terraced houses. The existence of type \( c \) systems in the three housing estates with houses indicates a smaller degree of control on movement and so, lower privacy in the houses where space configuration is characterised by such system, comparing with flats and terraced houses, where movement is more restricted, implicating in greater privacy. Yet, houses in Costa e Silva are those that offer larger control of movement, while the houses in Guajuviras offer smaller control, suggesting less problems related to privacy in the first ones than in the last ones, taken into account only the types of topological
spaces constituent of the configurations. Though, analysing the functions in different types of topological spaces it can be seen that while in Guajuviras the bedrooms are, almost in the totality, type $a$ spaces, in Costa e Silva, the number of bedrooms that are not in this category is more expressive. Therefore, this fact suggests that the greatest privacy problems would be in Costa e Silva and not in Guajuviras. Hence, the analysis of the topological spaces constituent of the configuration tends to substantiate the explanations for the results presented in table 1, revealing its potential as a predictor of adequate internal visual privacy.

**Internal accessibility – integration levels of spaces**

The integration values for the flats in Angico offer new explanations for residents in these flats being the most satisfied with internal visual privacy. While the more integrated spaces, with greater movement and lower visual privacy, are actually the spaces that require lower visual privacy (circulation, kitchen and living-room or living-room/dining-room) when compared with the more intimate spaces of the dwelling, the more segregated spaces (bathroom and bedrooms) are in fact those that require greater visual privacy. In the houses of Restinga, among the most integrated spaces stand out the living-room, circulation and the kitchen, while among the most segregated are the bedrooms, bathrooms, laundries and yards. These results support the fact that 63.9% of the residents are satisfied with internal visual privacy in these houses (Table 1). However, integration levels of spaces in the terraced houses in São Jorge and Santo Alfredo don't show the existent problems with internal visual privacy (Table 1). Generally, the most integrated space is the living-room or living-room/dining-room, followed by the staircase and by the kitchen; the most segregated spaces present a larger variation, standing out one bedroom, laundry, kitchen/laundry and other bedroom. Hence, internal accessibility as represented by integration levels does not appear to be a reliable indicator of appropriate internal visual privacy.

**Difference factors**

Difference factor values in Angico reveal space configurations with a tendency to more homogeneous spaces (i.e. difference factor = 0.571, closer to 1 than to 0), with configurational differences not very expressive. However, existing differences indicate that those configurational aspects that guarantee an appropriate level of visual privacy are maintained. In Santo Alfredo no difference factor value is below 0.658, indicating that these terraced houses present more homogeneous space configurations than the flats in Angico. This reduction in the configurational differences of the spaces can be exemplified by the haphazard relationships of bedrooms and living-rooms with other spaces in the unit, provoking inadequate levels of visual privacy. Therefore, unlike the
previous analysis just involving the integration values of Santo Alfredo's different constituent spaces, the values of the difference factors reflect with greater clarity the inadequacy of visual privacy inside these terraced houses.

A variation on the difference factors also exists in the space configurations representing the houses in Restinga estate, although no value is below 0.699 and most values are above 0.816, indicating that these houses present more homogeneous space configurations than the terraced houses in Santo Alfredo and, mainly, than the flats in Angico. Therefore, considering that larger homogenisation implicates in fewer differences among the spaces, concerning their positions and functional connections, and more visual privacy problems inside the housing unit, these results don't sustain the previous ones related to the integration values. On the other hand, this apparent contradiction could be partially explained by the fact that an expressive number of residents in the houses in Restinga (27.8%) are dissatisfied with visual privacy inside their houses. Hence, difference factors appear to need further investigation in order to be used as a reliable indicator of adequate internal visual privacy.

Conclusion
The exam of adequacy of visual privacy inside the housing units manifested through residents' attitudes, reveals a clear tendency to residents of blocks of flats to be satisfied and to residents of terraced houses to be dissatisfied with visual privacy among people in different rooms. The main explanations for these differences are based on the configurational and physical characteristics of the architectural design of the housing units. The number of residents in each unit did not appear as part of such explanations.

Among the different methods used to quantify internal visual privacy, the index that indicates the relationship between the isovist area produced from a central point in the main living-room and the total floor area of the housing unit, reveals with certain reliability, the adequacy of internal visual privacy. On the other hand, this was not reflected in the indexes produced through the relationship between the medium number of visualised spaces and the medium number of spaces in the housing units in each estate, as well as the type of spaces visualised from the observation point in the living-room. Contrarily, the types of functionally connected spaces, as well as the topological types constituent of the space configuration, tend to contemplate and to explain the adequacy of visual privacy inside the housing unit perceived by residents. Still, the values of difference factors tend to be more effective than the integration values considered separately for each space, in reflecting the adequacy of internal visual privacy. Finally, concerning visual privacy among people in different rooms in the housing unit, it is recommended:

• to consider the existing visual and functional connections among the different types of spaces, since these determine the levels of visual
privacy inside the housing unit, and undesirable connections for the residents can be of difficult solution, since the original design layout, even in the houses where modifications happen in a more expressive way, tend to be maintained;

- to consider the relationship among the area of a visual field, generated from a central point of the main living-room, and the total floor area of the housing unit, with indexes closer to ‘0’ representing greater internal visual privacy;
- to consider as more integrated or connected spaces in the system of the housing unit the circulation (horizontal and vertical), living-room (also closer to the entrance), dining-room, kitchen, and as more segregated or less connected spaces, the bedrooms (moved away from the entrance), the bathroom and laundry, reflecting configurational differences that tend to assure a greater level of internal visual privacy, at least in the case of housing units in the Brazilian context.

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References


