PAPER REF # 8121 - SHORT PAPER
Proceedings: Eighth International Space Syntax Symposium
Edited by M. Greene, J. Reyes and A. Castro. Santiago de Chile: PUC, 2012.

VULNERABILITY ON THE WAY TO SCHOOL

AUTHOR: **Danilo Wanderley Matos DE ABREU**
Faculdade de Ciências Sociais Aplicadas (FACISA/PB), Brazil
e-mail: abreudanilo@hotmail.com

Edja Bezerra Faria TRIGUEIRO
Universidade Federal do Rio Grande do Norte, Brazil
e-mail: edja_trigueiro@ct.ufrn.br

KEYWORDS: *Vulnerability, School, Urbanism, Space Syntax*

THEME: Public Urban Space

Abstract

This research aimed at identifying localities which are considered as vulnerable to the practice of anti-social actions in the surroundings of municipal schools by examining quantitative and qualitative data aided by Space Syntax analysis (Hillier and Hanson, 1984). The sample was comprised by two schools with 700 students each, in the city of João Pessoa (Paraíba-Brasil). We sought to verify morphological correlates to movement and anti-social behaviour (or fear of it) by examining: (1) accessibility in the spatial structure of roads; (2) the way building façades relate to the public spaces; and (3) the routes more or less favoured by students on their way to and from school. The road structure was modelled by means of line representation and inequalities in accessibility were quantified by applying UCL Depthmap (Turner); morphological attributes considered as inhibitors or facilitators of anti-social actions were identified and mapped up; and the flow of students on the main roads around the school premises was assessed through a gate-type counting. It was verified that fewer students walked on roads devoid of sidewalks, or that were not flanked by buildings containing doors and windows overlooking the street, even if these were fairly well-integrated into the overall road structure. Furthermore, the location of some of these apparently critical areas concerning vulnerability (or hotspots) coincided with accounts of anti-social practices. Findings also suggested that although students had faster route options to go to school, many preferred to use longer ones provided they had some morphological qualities lacking in others. The outcomes of this pilot study – which may be developed into a larger research to form the basis of a doctoral thesis – indicate that the articulation of space configuration analysis to building morphology in the light of data about the location of anti-social actions may be useful instruments for planners regarding accessibility and safety in open public spaces, particularly in school surroundings, an issue closely associated to quality of life in contemporary cities.

1. SCHOOL VULNERABILITY

In some schools, the report card and the school year are no longer parents', pupils' and teachers' major concern. Holdups, thefts and aggression towards students have become common in the media and crime statistics have appeared as relevant for education managers as learning issues.

According to the ELOS Project (2010) which was conducted by the Prefeitura Municipal (the town authority in João Pessoa) with the aim of developing activities that stimulate the culture of peace and inclusive education, students have been frequent victims of anti-social actions, appearing in 26% of robbery, theft and holdup cases. It was also perceived that the number of crimes against children and adolescents in poorer areas has risen and occurred at a higher frequency on their home-to-school walks in points regarded by many as dangerous, difficult to access, dark or lacking animation.

The fear of violence on the school routes have turned, for some students, into a greater obstacle and even more worrying than the existence of criminality itself, leading them to seek security either in motor transportation or on busier roads, sometimes making their journey considerably longer. Although recent studies have shown that metric distance between origin and destination is not always the most important factor in the choice of routes (Hillier et al., 2010), pedestrians tend to select the shortest distances between places, at least when going about their daily businesses, so as to spend as little time as possible on those journeys. The search for identifying the shortest metric, topological and temporal distances is primordial for understanding route choices (Curtis, 2008). Therefore, violence or the fear of it, added to poor physical conditions in some routes, turn out to be obstacles, reducing the pedestrian presence there and contradicting to a certain extent, the power of the space structure to generate movement as proposed in the Natural Movement Theory (Hillier et al., 1993).

Urban inhospitable environments have been found to reinforce urban areas degradation and lead to increasing crime rates, followed by region desertion and property devaluation (Newman, 1996). This situation has, unfortunately, taken place around schools in Brazil. The "Caminho do Conhecimento" Project (Way to Knowledge Project) developed by professionals from the Education Bureau (SECJP, 2010) in João Pessoa, aimed at improving an all-inclusive education practice by encouraging field activities around schools. Four municipal schools were chosen as objects of their experiments. It was soon found out that walking routes towards these activities were difficult to follow due to many decrepit and abandoned pieces of land.

The idea that urban accessibility may be a factor to reduce social inequality, as advocated by Curtis (2008) in his work "Planning for Sustainable Accessibility", the school-equality concept has been adopted as a guideline for education reform policies in João Pessoa. One of the measures resulting from this was that schools must be located within a radius of up to 800 meters to students' dwellings. However, little seems to have been done in relation to the spatial properties and to the physical conditions of the access roads and their buildings. Routes that could be more used by students appear to be, in reality, inaccessible, dangerous and particularly vulnerable to anti-social practices.

Given the amplitude of the urban violence theme and the interest in contributing to debate the issue, a pilot study was carried on in order to assess whether spaces containing attributes considered highly vulnerable to anti-social actions or fear-inspiring could be found on routes surrounding municipal schools. Bearing in mind that schools may be seen as a social-life structuring urban gear, and that safe accessibility may contribute towards rising quality of life, we expect that this study will be extended into a larger research piece in the future so that its outcomes may contribute technical knowledge to the issue, and provide subsidies for future design guidelines for school facilities.

2. OBJECT OF STUDY

This article summarises findings from a pilot study developed in João Pessoa, capital city of the state of Paraíba, located in the northeast of Brazil (Figure 01 and 02). The city's climate is inter-tropical, being warm and humid, with average annual temperatures of 26°C, an approximate 20-kilometer coastline, rivers, and an urban population of over600 thousand inhabitants (IBGE, 2007).

Fig. 01: Brazil, in South America.
Source - IBGE (2007)

And: Paraíba, in the Brazilian Northeast.
Source - IBGE (2007)

Fig. 02: Aerial view of João Pessoa.
Source – Quizz Image (2010)

The study focus on the built environment surrounding two medium-sized municipal schools located in the neighbourhoods of Jardim Cidade Universitária and Bessa (approximately 700 students each, studying in two shifts, morning – 8:00h-11:30h – and afternoon – 14:00h-17:30h).

The reason for choosing these cases was information availability, found in the ELOS Project (2010) and in the "Caminho do Conhecimento" Project (SECJP, 2010). In ELOS, data concerning crimes committed against students is presented and the two schools addressed here were mentioned, among a sample of ten, as having the largest number of students who arrive and leave on foot. SECJP displays information on route accessibility and on buildings located alongside these roads, and singles the selected schools, out of a group of four, as having interesting natural attractions for external and field classes in their surroundings. The school in Jardim Cidade Universitária its next to a huge green area (Figure 03) and the one in Bessa is near a beach suitable for swimming (Figure 04).

Fig. 03: The school (1) and de green area (2).
Source: Google Earth (2011)

Fig. 04: The school (1) and de beach (2).
Source: Google Earth (2011)

3. THEORETICAL BACKGROUND

Hillier et al (1993) assert that the spatial structure by itself is enough to create a movement pattern and that this pattern is the main definer of other urban factors such as land use. This idea, at the base of the "Natural Movement Theory" (Hillier; et al., 1993) is the underlying notion in this study.

A set of modelling tools offered by Space Syntax Analysis – the operative bridge from theory to empirical exploration – makes it possible to represent, quantify and relate space structure and urban phenomena, allowing for the visualization of spatial properties that are translated into variables such as: connectivity (the number of spaces directly linked to a certain space), depth (the number of changes in direction to go from space "a" to space "b"); integration (the topological proximity of one space in relation to all other spaces in a structure), deemed as the universal correlate of movement, one of the most widely used syntactic measurements.

Studies associated to Crime Prevention through Environmental Design (CPTED) point out morphological conditions considered to be inhibitors or facilitators of anti-social actions (i.e. Chiaradia and Trigueiro, 2005), which can be mapped as attributes that conform the interface between buildings and the public spaces. Such attributes found on the frontage of buildings added to other factors such as environmental conservation may be used to define *hotspots* or critically vulnerable localities along a route or within an open space.

The number of pedestrians on roads may be measured by an observer who stands static in a middle point on the road, counting people as they pass through an imaginary point or line, known as 'Gate' (Desyllas and Duxbury, 2003). This type of measurement is relatively simple and was applied to account for the students movement to and fro schools in this research.

In this study, spatial properties of connectivity and integration concerning the structure of open spaces around the examined schools, and attributes of accessibility and visibility on building frontages were explored in the light of the observed pedestrian movement. Data relating anti-social actions reported in the ELOS Project was considered as complementary information.

4. METHODOLOGICAL PROCEDURES

Linear representations of the spatial structure containing the studied schools were worked out over scanned maps of part of the city of João Pessoa, within a perimeter of about three kilometres around each school. Axial maps were processed by UCL Depthmap (Turner) software into colour and numerical scales displaying connectivity and integration values (Global - Rn - and Local - R3) to form a visual chart of how accessibility is distributed throughout the spatial system used by the students.

The survey of the building frontages was carried out during the day, when students were about to leave each school. Eleven attributes of accessibility and visibility were registered on maps that displayed representations of blocks and plots. The recorded attributes are:

1) Door(s);
2) Window(s),
3) Door(s) + Window(s);
4) High Window(s);
5) Opaque Wall (blank wall or fence);
6) Active Frontage (a building that is open to the public – i.e. shop);
7) Blind Frontage (a building façade – usually at the back or side - with no openings or whose openings have been walled or permanently shut);
8) Active Frontage Closed (a building that opens to the public at times other than that when students are leaving school – i.e. restaurant);
9) Translucent Fence (see-through wall or fence);
10) Very Low Limit (just high enough to demarcate territory); and
11) Low Limit (easy to jump over).

Ten days were needed to work on the main roads and record the attributes on the map. At the end, the attributes were scanned in a graphic file coloured according to a scale of interface (more to less – hot to cold colours) for later comparison with values resulting from the syntactic analysis and the counting of pedestrian flows.

For measuring the students' flows on the roads leading to the studied schools, we adopted the counting technique in which the observer stands static in the middle point of each axial line, counting people. The students were identified by their school uniforms. Five Gates were observed twice a day, from 11:15h to 12:30h and from 17:15h to 18:30h on Tuesdays and Thursdays for 3 weeks (a total round of 6 observation days - Table 01 and 02).

The pilot study was carried out between the months of April and May, 2011, a period without major holidays or calendar events in Brazil that could interfere in the pattern and volume of pedestrian movement in the schools surroundings. At the end, maps were worked out to articulate the information resulting from stages 1 (Spatial Syntax modelling), 2 (frontage survey), and 3 (pedestrian counting) so that particularly vulnerable points on the way from home to school could be estimated.

5. RESULTS AND DISCUSSION

Despite the effort by João Pessoa's Education Authorities to ensure proximity between schools and the students' homes as a means to foster social inclusion morphological analysis of the urban environment revealed that many spaces can be considered as urban obstacles or facilitators of anti-social actions. It was verified that even on well-integrated streets (marked as "A" in Figure 05 and as "D" in Figure 06), the existence of façades without an opening towards the road, low accessibility and tall vegetation makes it vulnerable to anti-social actions. Therefore, as was acknowledge in the pedestrian count survey, even though students had options of faster routes to go to school, many of them preferred to face longer distances, perhaps to avoid possible dangers.

Fig. 05: Integration (Rn) map of the Jardim Cidade Universitária school. Source: Depthmap Software (2011)

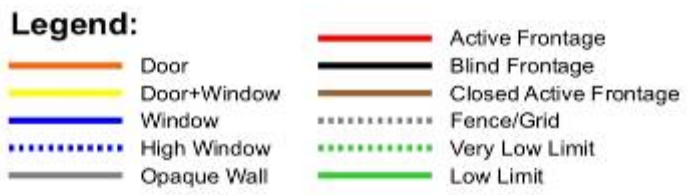
Generally speaking, pedestrians tend to choose routes that are topologically more accessible (with higher integration values). However, the axial map displayed in Figure 05, shows that the site marked as "A", even being on a road of great importance in the spatial network around the school (integration value 2.54), is little used by students. The route chosen by most of the students heading southwards passes through the spot marked as "C" (integration value 3.37), where the presence of a large number of people and vehicles was verified. This detour increases the distance to their homes in approximately 400m, exceeding in more than 50% the maximum distance recommended by the education board guidelines. In sites "A" and "B", paving is poor, there are no sidewalks and buildings with high blank walls flank the road, giving reasons to suppose that these conditions affect movement, which was seen to be very low (Table 01).

Fig. 06: Integration (Rn) map of the Bessa school.
Source: Depthmap Software (2011)

Fig. 07: Connectivity map of the Bessa school
Source: Depthmap Software (2011)

In the school located in Bessa, the street site marked “D” (Figure 06 and 07) is an unpaved road even though fairly well integrated (2.56) and connected (14) a fact that seems to reflect directly on the route choice made by students (Table 02) who live in the west and northwest direction and prefer to go home through “E” (integration value 2.61 and connectivity 11).

The predominance of buildings with blank façades, termed here as “blind frontages” (Figure 08), in points “A” and “B”



Legend with the frontages type

Fig. 09: Frontage map of the Jardim Cidade Universitária school; Source: Author (2011)

Fig. 10: Street view Camera nº01 (Fig. 09)
Source: Author (2011)

Fig. 11: Street view Camera nº02 (Fig. 09)
Source: Author (2011)

It is thus understandable that students choose longer routes (through “C”) as they seem to seek the feeling of safety granted by the movement of other pedestrians (Figure 09), being also unwilling to pass by the frontages besides “B” and “A”. Corroborating with this fact, in accordance with the ELOS Project (2010), four holdups occurred in the year 2010 in these locations.

In addition to that, field observation showed that in the area around “A” there are very few commercial and service facilities (Figure 09), blank walls being the only thing to be seen by students approaching the entrance to the school that occupies approximately 5 hectares.

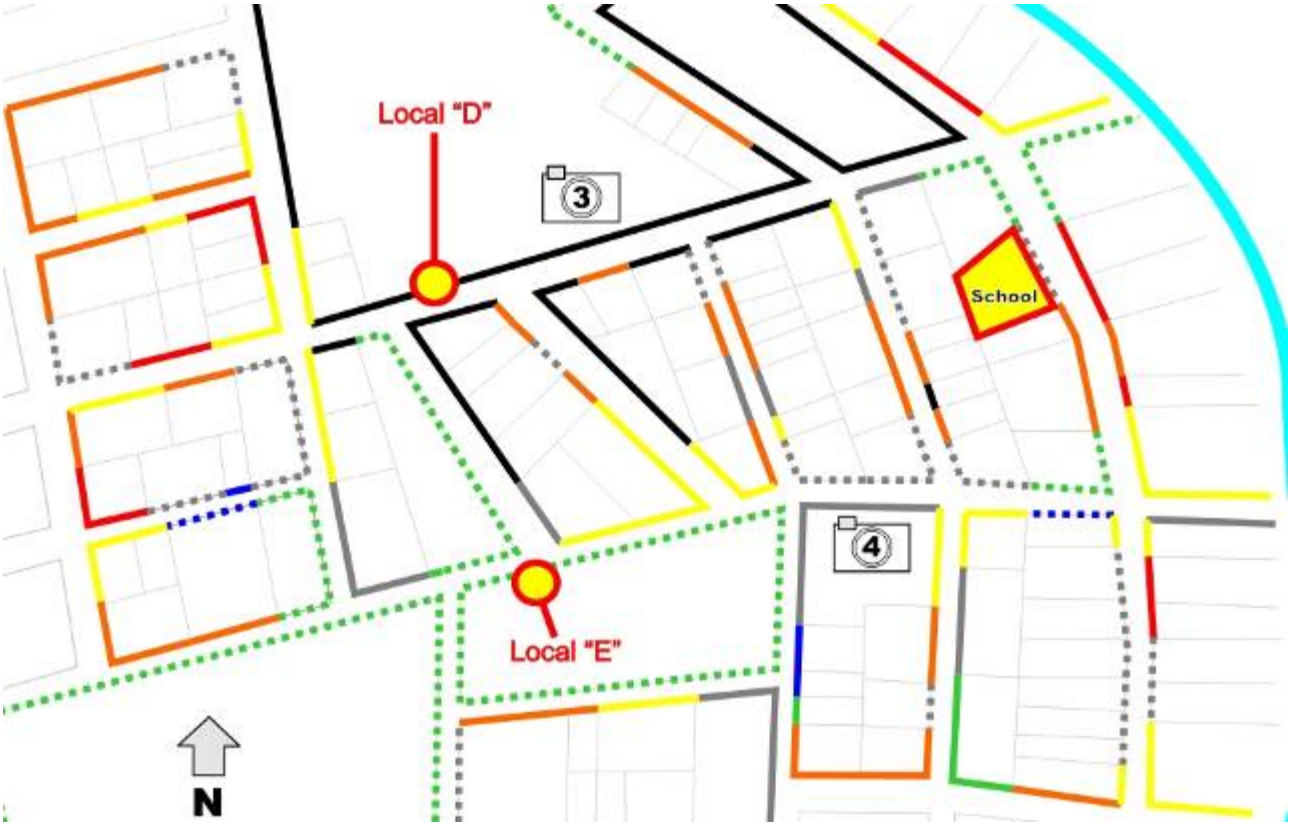


Fig. 12: Frontage map of the Bessa school; Source: Author (2011)

Fig. 13: Street view Camera nº03 (Fig. 12)
Source: Author (2011)

Fig. 14: Street view Camera nº04 (Fig. 12)
Source: Author (2011)

In “D” (Figure 12), bland frontages, no sidewalks and high vegetation equates with the lowest count of students movement. The route option westwards was found to concentrate on “E”, where there are open areas, two squares and wide angles of visibility (Figure 14).

In Cidade Universitária, large low-density plots around the school are occupied by sparsely located public institutions surrounded by blank walls. Very little movement of people was observed there as were signs of environmental degradation. The students count suggests that they choose gate 4 (“G4” in Figure 15) as an alternative route.

Fig. 15: The Gates used in the Region of Jardim Cidade Universitária school; source: Google Earth (2011)

Table 01: Gates count in Jardim Cidade Universitária school

Gate	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Gx/Day
G1	215	211	214	214	205	209	**211,3**
G2	121	119	119	125	118	122	**120,7**
G3	74	74	76	72	77	74	**74,5**
G4	3	2	2	4	2	2	**2,5**
G5	2	2	0	2	0	0	**1,0**

Most of the crimes recorded in 2010 (ELOS, 2010), occurred in the sites marked as “G4” and “G5”. This may be a reason for avoiding routes which would visibly be regarded as faster and shorter. It seems reasonable to expect that the number of students passing through Gate 3 (“G3”, average 74,5), would be equivalent to that passing through Gate 4 (“G4”). However, these were a meagre 2,5, on average daily, thus indicating a strong detour trend from that route.

Fig. nº16: The Gates used in the Region of Bessa school; Source: Google Earth (2011)

Table 02: Flow through the Gates of Bessa school

Gate	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Gx/Day
G1	204	205	207	203	205	208	**205,3**
G2	143	144	140	145	143	144	**143,2**
G3	123	120	121	119	121	121	**120,8**
G4	111	112	113	114	114	112	**112,7**
G5	16	18	16	14	15	16	**15,8**

Accordingly, in Bessa, urban obstacles such as wasteland and unpaved roads with no sidewalk in Gate 5 (“G5”) seem to have led to a pedestrian displacement towards Gate 3 (“G3”).

6. FINAL CONSIDERATIONS

Taking into account that easy and safe movement to and from schools is of fundamental importance for the elaboration of educational inclusion projects, this study sought to explore ways in which knowledge concerning the morphology of the school surroundings might add to that aim. By articulating information resulting from the analysis of accessibility and visibility properties in the space structure of roads and in the envelope of buildings flanking these roads, to patterns and number of pedestrians moving through them, this brief pilot research indicated that fear-inspiring places may be identified and mapped out, serving as a decision resource for creating or redeveloping school sites in future projects. We thus believe that the availability of analytical tools that may help to improve accessibility by preventing displacement of shorter routes to longer ones caused by fear of crime and anti-social behaviour can go beyond raising the quality of school surroundings, adding to the quality of life in our cities.

7. REFERENCES

Chiaradia, A.; Trigueiro, E. (2005). Towards and Interface Index. *Space Syntax Limited.* United Kingdom.

Curtis, C. (2008). Planning for Sustainable Accessibility: The Implementation Challenge. *Transport Policy, 15*, 104-112.

Cuthbert, A. R. (2005). A Debate from Down-Under: Spatial Political Economy and Urban Design. *Urban Design International, 10*.

Desyllas, J.; Duxbury, E. (2000). *Planning For Movement: measuring and modelling pedestrian flows in cities.* (R. I. Surveyors, Ed.) Retrieved 2011, from Intelligent space: www.intelligentspace.com

Desyllas, J.; Duxburt, E.; Ward, J. (2003). Pedestrian Modeling of Large Cities: An Applied Example from London. *CASA – Centre for Advance Spatial Analysis, UCL – University College London* .

ELOS (2010). *Por uma Cultura de Paz na Educação*. Retrieved 2011, from Prefeitura Municipal de João Pessoa, Relatório Anual de Gestão Municipal: www.joaopessoa.pb.gov.br/acoes/relatorios/#educacao

Hillier, B. (1996). *Space is the machine.* Cambridge: Cambridge University Press.

Hillier, B.; Hanson, J. (1984). *The social logic of space.* Cambridge: Cambridge University Press.

Hillier, B.; Penn, A.; Hanson, J.; Grajewski, T.; Xu, J. (1993). Natural movement: or, configuration and attraction in urban pedestrian movement. *Environment and Planning B,* V20 , pp. 29-66.

Hillier, B.; Turner, A.; Yang, T.; Park, H. (2010). Metric and topo-geometric properties of urban street networks: some convergences, divergences and new results. *Journal of Space Syntax* 1,(2) , pp. 258-279.

Jacobs, J. (1961). *The Death and Life of Great American Cities.* New York: Vintage Books.

Jeffery, C. R. (1977). *Crime Prevention Through Environmental Design.* Beverly Hills: Sage Publications.

Litman, T. A.; Burwall, D. (2006). Issues in Sustainable Transportation. *Global Environmental Issues Vol. 6* , pp. 331-347.

Newman, O. (1996). *Creating defensible spaces.* New York: U.S. Department of Housing and Urban Development.

Ryley, T. J. (2008). The Propensity for Motorists to Walk for Short Trips: Evidence from West Edinburgh. *Transportation Research Part A* , 50-62.

SECJP. (2010). *Projeto Caminho do Conhecimento, Relatório Anual de Gestão da Educação*. Retrieved 2011, from Secretaria de Educação e Cultura de João Pessoa: www.joaopessoa.pb.gov.br/acoes/relatorios