From academic research on museum galleries to practice-based research for planning shopping malls

Ipek Kaynar Rohloff

The University of Michigan, Ann Arbor, Michigan

ABSTRACT: This paper explores how findings obtained from case study research on museum gallery layouts provide insights for shopping mall planning and design. The case studies investigated the effects of gallery layouts on visitors' movement patterns in museums, drawing upon the Space Syntax methodology. In the case studies, the local visual cues are considered as important as global spatial structure, and the effects of spatial layout on pedestrian movement are investigated on the basis of both top-down and bottom-up characterizations of space. The case studies analyzed two exemplary museum gallery layouts, the Yale Center for British Art (New Haven, CT) and the Museum of Modern Art (New York, NY). This exploration was able to explain the prediction of movement patterns by different visibility properties that shaped in morphological characteristics of these museums. In this study, understanding the impact of local visual information such as visual cues perceived in space aids understanding possible effects of attractors (i.e. popular displays) on movement. This paper argues that the results obtained from the museum case studies research can provide insights on how pedestrian movement is distributed with the effect of layout and attractors in shopping malls, and aid formulating further research on movement in shopping layouts. The two museum layouts analyzed can be illustrative of two types of shopping mall layouts. Our results suggest that type of shopping layout illustrated by YCBA may be more desirable for visitors as it facilitates encounters and offer clarity in grasping the layout, and the latter may be more advantageous for manipulating visitors with strategically placed attractors.

Conference theme: Building case studies
Keywords: case study research, effects of spatial layout, visibility relationships, spatial experience, and pedestrian movement

INTRODUCTION

Museums and shopping malls have similar design objectives and share some characteristics in their layouts. Both are designed to be experienced through movement, and their design objective is to facilitate visitors' contact with displays. In museums, visitors' exploration of space and their contact with displays can be important to convey the exhibition narratives. In shopping malls, exploration of the entire space is desired for more critical reasons: pedestrian access to the stores should be equalized to optimize rent rates (*Shopping Center Development Handbook*, 1999). Previous studies focusing on space-use in shopping malls and museum layouts have investigated the influence of spatial layouts on pedestrian movement by considering the effects of displays as attractors. This paper discusses how a research study exploring the influence of spatial layout on pedestrian movement in museums can explain the potential of spatial layout together with attractors, and thus informs design and planning of shopping malls.

1. STUDIES ON PEDESTRIAN MOVEMENT IN SHOPPING MALLS AND MUSEUMS

1.1. Theoretical Explorations on Movement and Buildings

Museums and shopping malls are interesting environments to understand how a spatial activity, in particular pedestrian movement relates to built environments. This relationship between movement and layouts is the central argument of the Space Syntax methodology. The theory of Space Syntax argues that "buildings are fundamentally about movement, how it is generated and controlled" (Hillier, 1996; Hillier & Penn, 1991; Hillier, Penn, Hanson, Grajewski, & Xu, 1993). On the basis of this argument, the Space Syntax methodology conceives of buildings as systems that consist of spatial units and the local and global relationships between them. Accordingly, buildings can be represented as configurations consisting of nodes corresponding to spatial units and links corresponding to topological relationships between the nodes. This graph representation of buildings, called *justified graphs*, is used to represent

these relationships within the logic of network. In graphs representing spatial configurations as nodes and links, nodes refer to the spaces which are characterized by occupation, and links refer to potential movement from one node to another.

By analyzing the patterns of movement through spatial analysis techniques, the Space Syntax methodology relates space and human activity to each other in two ways: spatial layouts may either (1) *reflect* the existing social structures, or (2) *generate* new structures in society. In the former case, a spatial layout can reflect or embody culturally or programmatically given pattern of usage, such as layouts of vernacular houses or a law court building. In such layouts, potential movement through spatial units is determined by building program. In a law court building, entries and exits to certain court rooms are predetermined before the spatial layout is conceived. In the latter case, movement patterns are not predetermined by a culturally given structure or a building program, and thus space can shape a social pattern by facilitating new encounters through permeability relationships. For example, settings like office buildings are designed for more flexible usage, and do not impose a strict usage pattern determined by a program.

On the basis of these definitions, Space Syntax distinguishes settings that reflects existing social structure from the settings that generates new encounters by calling the former "strong program" and latter as "weak program" (Hillier & Penn, 1991). According to Space Syntax, in "weak program" buildings movement is determined by the structure of the urban or building configuration itself rather than by the presence of specific attractors or magnets." (Hillier, 1996).

Within this framework, shopping malls (as well as museums) can be considered "weak program" environments where visitors' movement is not dictated by a program. Yet, the way in which attractors or specially designated stores are positioned within the program consideration may manipulate movement and movement can be shaped with the effect of attractors as well as the layout. Depending on the dominance of attractors, shopping malls can be closer to being strong program buildings.

1.2. Studies Examining Movement in Shopping Malls

As discussed in literature, one of the motivations behind developing retail environments is to create a space with *sense of place* which attracts suburban inhabitants and enlivens commercial activity (Kliment, Barr, & Jerde Partnership International., 2004). *Sense of place* in shopping malls is associated with opportunities to encounter others in space. A more programmatic concern of retail developers is the rent yield due to the attraction of visitors to certain stores, as movement is an index on which rent increases are estimated (Fong, 2003). Therefore, planning and design of shopping malls can be guided by creating opportunities of encounter between people, and with the intent to equalize the pedestrian movement

exploiting the placement of certain retail groups. However, the spatial hierarchy engendered by design, such as the more central location of some retail groups, may attract higher number of people and thus have a strong influence on pedestrian movement.

The dynamics between spatial layout and potential attractors in shopping mall layouts have been explored by a number of studies. Analyzing visitor's perception of shopping mall environment, Dennis and Newman (2005) argue that general layout is one of the attributes that can be influential on shopping activity. Another study suggests that pedestrian flows and presence in a public market can be explained by layout and visual stimuli (Zacharias, 1997). In a study focusing on the in-store environments, Newman et al (2002) discuss that customers often look for clarity in shopping environment. In ambiguous environments, frequent and unexplored changes in the merchandise can be detrimental to shopping activity. This implies a negative effect of the visual cues that bring ambiguity to retail environments.

A number of other researchers use the Space Syntax methodology to explore to what extent the space-usage in shopping environments, in particular pedestrian movement, is influenced by spatial layout versus attractors. One of these studies, Hossain (1991) analyzes a case where attractors are deliberately created by profit motivated developers by inserting special types of retail. That study suggests that in shopping environments created with programmatic concerns, strategically positioned stores can manipulate pedestrian movement to spatially segregated areas, and thus the effects of spatial layout and attractors on movement would complement each other. Another study, Fong (2003) considers main attractors of the shopping mall layouts, and explores whether placing these attractors to the polar ends of mega-shopping mall blocks would really attract pedestrians over the influence of spatial layout, and thus they would equalize the movement rates in the shopping environments. This study reports reasonable evidence that that spatial configuration has a direct relationship with the distribution of movement within planned, artificial shopping centre environments, however, spatial layout is not a single isolated factor that would explain the movement alone; but overlapping effects of spatial layout and attractors should be considered. According to Fong, the inevitably created spatial hierarchy can be balanced using the attractors (Fong, 2003).

Parallel to these explorations focusing on the shopping malls, a fair number of studies focusing on museum galleries explore the effect of spatial layout on visitor movement as an independent property and suggest that the gallery layouts predict visitors' movement (Choi, 1999; Psarra, 2005; Psarra, Wineman, Xu, & Kaynar, 2007). Only a few of these studies consider the effect of attractors, and they report stronger association between spatial layout and movement by excluding the attractors (Psarra, 2005).

The studies focusing on museums and retail have an interest in understanding the effect of spatial layout on the basis of global and local syntactical layout properties, such as *integration* and *connectivity* measures. In the Space Syntax methodology, *Integration* as a global property describes the extent to which spatial units in a layout is physically or visually connected to the every other units in that layout *Connectivity* as a local property measures the extent to which spatial unit is connected to the other units in the neighbourhood. Theoretically speaking, the integrated spaces are those that can be reached (or seen) by crossing the least number of spaces from all other spaces, and therefore those spaces are likely by visited most frequently. In a similar way the highly connected spaces are in direct relationships with a higher number of spaces and therefore they are more likely to be used. In the research investigating the influence of spatial layout on the movement, the collected data of users are compared and correlated with the integration and connectivity measures of the spatial units. The studies investigating these correlations in the museum layouts found strong evidence that the visitors' movement is associated with integration and connectivity properties (Choi, 1999; Psarra, 2005).

In the body of architectural research, most of the studies exploring effects of layouts on movement (using the Space Syntax methodology) explain the impact of a layout on the basis of a top-down characterization of space, such as the likelihood of movement paths in highly integrated parts of a layout. As discussed by some recent studies, a peripatetic observer can only absorb a limited amount of information and entire syntactical relationships may not be apparent to the observer at any point. If one considers that the visual cues perceived at individual spaces can work as a reference for a peripatetic observer's navigation (Psarra & Grajewski, 2000), visual information may be in effect at a local level on the distribution of movement. Therefore, exploring the effect of layout on the basis of a bottom-up characterization of space referring to visual cues is also valid to understand how spatial activity is formed. As a result, investigating the effect of layout on the basis of both top-down and bottom up characterizations through investigating the syntactical and non-syntactical properties can provide a more concrete explanation of how and to what extent observers use visual information in their explorations. This method of investigation can potentially illustrate whether movement is predicted by layout or by attractors, or else the way in which attractors are exposed to observers.

2. A CASE STUDY RESEARCH EXPLORING THE EFFECTS OF MUSEUM GALLERY LAYOUT'S ON MOVEMENT

2.1. Scope of the case study
We now discuss our case study research focusing on museum layouts and exploring their effect on visitor movement. The aim is to see what insights can be obtained from the findings that would inform the

planning and design of shopping malls, or shape further research exploring distribution of movement in shopping malls.

The motivation of the research study focusing on museums was to explore to what extent the layout properties influence the space use patterns and thus to understand how morphological characteristics of museum galleries may shape the museum experience (Rohloff, Psarra, & Wineman, 2009). This study examined the effect of visibility relationships as a layout property, and addressed this investigation in two art museum gallery layouts selected for a case study. These gallery layouts are the main galleries of the Yale Center for British Art (YCBA) and the Museum of Modern Art (MoMA). These two cases presented contrasting results due to the variation in their morphological characteristics that reveal different local and non-syntactic visual cues to visitors.

2.2. Anecdotal Observations
As can be seen from their floor plans (Fig. 2), the MoMA and the YCBA gallery layouts share key spatial attributes such as having atria voids visually linking galleries across space and room configurations allowing multiple routes. The gallery layouts also show variations in their morphologies which are determined by the location of atria voids in the gallery space and their relationship with the gallery rooms in third dimension, such as openings to the rooms and their relationship with periphery and centre.

The YCBA and the MoMA's galleries exhibit paintings and sculptures from different art history contexts by utilizing various display strategies. The YBCA's gallery layout exhibits British painting and sculpture from sixteenth to mid-nineteenth centuries, which include mostly figurative works such as portraits. The works of art are installed somewhat strategically in the gallery by exploiting some of the architectural properties, such as

Figure 1. Interior views from the YCBA (on the right) and the MoMA (on the left) galleries.

symmetrical arrangements, parallel promenades and framed views through atria openings. During the observations in the gallery, these works did not appear to attract visitors or modulate their movement patterns. Yet, it is observed that the works placed to be seen through atria openings captured visitors' view from a distance. The MoMA's fourth floor exhibits on painting and sculptures of the Late Modern and Pre-Contemporary art. Among the displayed objects are well-known masterpieces such as late Post-Cubist works of Picasso, and mural paintings of Jackson Pollock and critically acclaimed examples of Pop-Art

such as Andy Warhol's *Campbell Soup Cans.* The displayed objects have an iconic power due both to their fame and their geometric and non-figurative appearance in space. In fact, this potential is recognized by the curatorial team and the paintings are placed at the end of visual axes through gateways in order to attract visitors to the adjacent rooms. The anecdotal observations suggest that this strategy worked and visitors are attracted towards the displays viewed through doorways.

The anecdotal observations in the galleries suggest that visitors' exploration in the YCBA is at a slower pace and is synergized by experiencing the architecture. In contrast, the visitors' exploration in the MoMA was at a faster pace and seemed to be more akin to experience in shopping malls motivated by finding and viewing well-known masterpieces. In other words, explorative movement in the MoMA seemed to be more manipulated by displays than in the YCBA.
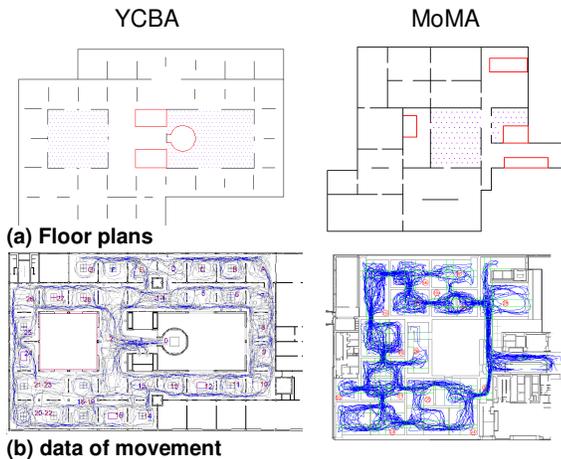
YCBA   MoMA

(a) Floor plans

(b) data of movement

Figure 2. Floor plans of the analyzed layouts and the movement data collected.

2.3. Methodology of the Study

To investigate the potential influence of gallery layouts on visitors' patterns of explorations in the YCBA and the MoMA, this research study analyzed movement patterns and compared measures of those patterns with visibility relationships in the gallery layouts. Data of visitors' explorative movement was collected through detailed observation studies conducted in the YCBA's and the MoMA's fourth floor galleries. The visitor data samples include the records of 35 randomly selected individuals' movement paths. The patterns of spatial exploration were observed in paths of movement entering the gallery rooms and the proportion of movement lines directed to the available directions at the choice points.

In this study, visibility relationships engendered by the gallery morphologies are described and visualized through computer aided spatial analysis techniques developed within the Space Syntax methodology. These techniques apply a visibility polygon, "isovist," to the syntactical analysis methods. An isovist (visual field) is a polygon that defines the visible area from a

vantage point in 360 degrees; in other words, the boundaries of an isovist are descriptive of the region where the radials of sight projected from a vantage point can permeate until they meet physical boundaries (Benedikt, 1979) (Fig. 3). In order to describe visibility relationships syntactically in a configuration, the Space Syntax methodology devises computational applications to generate isovists (visual field) from points of a grid designated in floor plans (Dalton, 2001; A. Turner, Doxa, O'Sullivan, & Penn, 2001). Using this technique computer applications calculate visual fields overlapping throughout the space and obtain syntactical measures that describes visibility relationships (A. Turner, 2003, 2004; J. Turner, Wineman, Psarra, Jung, & Senske, 2006). The resulting graphs are able to demonstrate "visibility structure" in floor plans of a configuration through colour rendered graphs and quantified measures (Fig. 3). These applications enable researchers to compare visibility structure with potential movement and other human spatial activity in built environments.
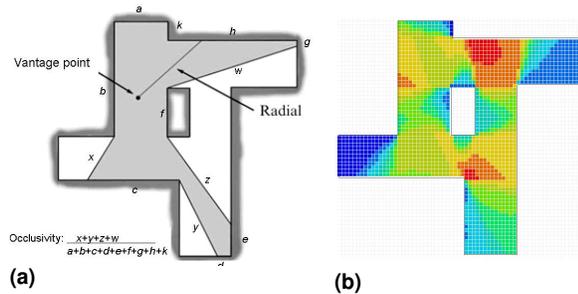

(a)   **(b)**

Figure 3(a). Visual field polygon and occlusivity measure (Source: Benedikt, 1979), **(b)** A sample visibility graph analysis by *Depthmap*.

One of these computer applications, *Depthmap* creates visibility graphs by calculating visibility relations between grid points on the basis of various syntactical analysis measures. Among these, visual connectivity and integration measures are most meaningful to examine the visibility structure in museum gallery layouts and shopping malls. Visual connectivity is based on the mutual visibility of the assigned grid points and represents the degree to which pairs of grid points can see one another. The areas that have a higher degree of connectivity are considered advantageous areas in terms of visual access, which is the information reached from a particular location (Archea, 1977). For museum buildings, visual access indicates the degree to which observers have direct interaction with pieces of art in their neighbourhood. Visual integration as a global measure indicates the extent to which an entire gallery layout would be visually accessible using the fewest number or steps (or through the shortest paths) (Hillier & Tzortzi, 2006). For museum layouts, visual integration is a significant measure as it indicates through which areas an observer might capture a vision of the entire exhibition and spatial layout with minimal effort.
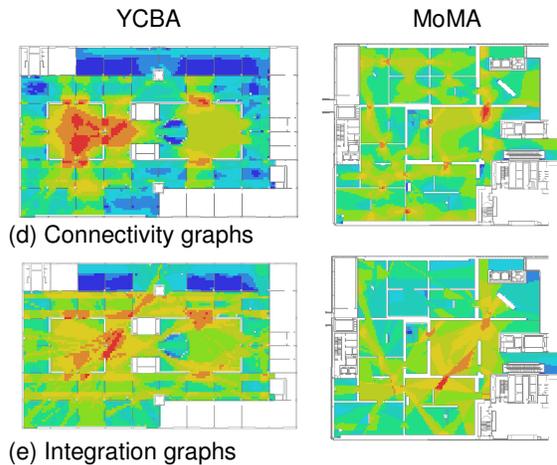
YCBA   MoMA

(d) Connectivity graphs

(e) Integration graphs

Figure 4: Comparison of Gallery Layout in terms of their Spatial Layout Properties

In addition to the examination of the gallery layouts with syntactical measures (visual connectivity and integration) the study discussed here also investigated the role of non-syntactical visibility properties on the prediction of space use patterns. To this end, visual field measures are used to demonstrate the extent of visibility from vantage points. The extent of visibility can be described in various ways through visual field polygon measures such as *area*, *perimeter*, *occlusivity*, and *compactness*. *Area* denotes the size of visible region and *perimeter* is the total length of the edges of a visual field. *Occlusivisty* is the ratio of the length sum of the occluding portion of the perimeter to the entire perimeter (Fig 3.). This interesting measure describes the occluding portion of the visual field perimeter that is not defined by real walls, and thus denotes the information behind the corner that could be seen as moved further. *Compactness* is the ratio of area to perimeter, and describes the degree to which edges of a visual field meanders.

2.4. Analysis

If we examine visual integration and connectivity graphs of the YCBA and the MoMA, we can see how visibility structure in each layout is characterized through their morphologies. In the YBCA, two atria voids are largely open to the gallery space with atrium openings at their four sides, higher visual connectivity values are around the atria openings. The atria openings enhance the capacity of seeing neighbouring locations around the atrium. The two atria spaces also concentrate the visual integration in the diagonal direction through the west atrium towards the southeast direction inside the Main Galleries. The room configuration around the two atria defines physical and visual continuity along the longitudinal direction, and moderately high integration values are extended through the gallery doorways in that direction (Fig 4).

In the MoMA, central regions and doorway areas of the gallery rooms are moderately connected to due to visual access to neighbouring locations through doorways. The relationship of gallery spaces to atrium space is very limited; atrium is more generously open to the circulation space than gallery space. This enhances the capacity of seeing neighbouring locations only in the circulation hall, and brings high integration to the south gallery room which is likely visited last in most visitors' itinerary. The interrelationship between the rooms and atrium locate the other visually integrated spaces along the east-west and northwest-southeast (diagonal) directions in the south galleries. As a result, half of the gallery rooms are poorly connected to the rest of the layout.

To investigate the gallery layout's influence on exploratory movement, the visibility properties of each room is correlated with the number of movement lines crossing the rooms. The analysis comparing and correlating the space-use measures with syntactic and non-syntactic properties provided interesting results that explain the influence of the gallery layouts on the space use. The results suggested that in the YCBA's gallery layout movement is strongly associated with visual integration property whereas less strongly related to connectivity. In the MoMA the results are opposite: visual connectivity has a stronger role on the prediction of exploratory movement, but the effect of visual integration is quite weak. These results suggest that the gallery layout of the YCBA predict the exploratory movement through the gallery rooms' capacity of being seen from every other space in the layout. In contrast, the MoMA guides visitors through the visual access to neighbouring spaces, in other words by revealing the visual information step-by-step to visitors (Table 1).

Another interesting result obtained from the analysis of the MoMA is that visitors' explorative movement in scale of visitors' individual space is influenced by minor variations of visibility in gallery rooms. In other words, they are sensitive to changing levels of visual information.

The comparison of movement lines with non-syntactical properties helps understand through which aspects of local visual information, movement might be modulated in layouts. The results show that in both YCBA's and MoMA's layout, *occlusivity* and *perimeter* measures are correlated with movement lines. *Occlusivity* measure denotes the occluding portion of the entire perimeter, and implies the hidden regions behind the corners. The correlation between movement and *occlusivity* suggests that visitors are drawn to the potential to discover the hidden places. The correlation with *perimeter* at the same time suggests that visitors are drawn to exposed wall surfaces (Table 2). These results suggest that the wall surfaces that include displays, along with hidden regions have important roles in modulating movement. These results are quite consistent with the results reporting the influence of visual properties on the direction of movement that standing visitors would choose (Table 3). According to the results, in both YCBA and the MoMA, the potential to explore hidden regions is still an important property that attracts visitors. Along with this property, in the MoMA the exposed wall surfaces attract visitors.

Table 1: Correlation of movement lines & syntactic visibility measures in each gallery in the YCBA and the MoMA

		Visual Integration	Connectivity	
Number of movement lines crossing each gallery	YCBA	0.76	0.60	R
		0.000	0.000	p-
		0.58	0.36	R^2
	MoMA	0.43	0.68	R
		0.047	0.000	p-
		0.18	0.46	R^2

Table 2. Correlation of movement lines & non-syntactic visibility measures in each gallery in the YCBA and the MoMA

		Occlusivity	**Perimeter**	
Number of movement lines entering each gallery	YCBA	0.67	0.69	R
		0.000	0.000	p-
		0.45	0.48	R^2
	MoMA	0.64	0.72	R
		0.001	0.000	p-
		0.41	0.52	R^2

Table 3. Correlations between Path Ratio and Isovist Division Ratios in the Available Movement Directions at the Choice Locations

		Peri.	**Occl**	**Compac.**	
Movement line ratio in available Directions	YCBA	-	0.58	0.40	R
			0.002	0.044	p-
			0.33	0.15	R^2
	MoMA	0.45	0.39	-	r
		0.012	0.031		p-
		0.20	0.15		R^2

3. DISCUSSION

3.1. Implications of the Results obtained from the Museum Case Study

The results provide strong evidence that both the YCBA's and the MoMA's layouts predict the space use patterns through visibility relationships. However, the visual integration as a global property that describes relation of spaces to every other space is not the absolute property that would predict the movement. Instead, the way in which the spatial layout predicts the space-use is very much related to how the morphological properties reveal the visual information in those spaces. These results can be understood further by comparing the YCBA and the MoMA in terms of visual intelligibility and the ways in which local and global visibility properties are distributed.

In the theory of Space Syntax, spatial *intelligibility* is described as the degree to which a gallery layout can be understood through its individual units (Hillier, 1996). This description technically refers to the degree to which global spatial properties of a layout (described by integration measure) can be grasped by an observer through local spatial properties (Hillier, 1996; Hillier & Tzortzi, 2006). With this definition, the spatial

intelligibility of a layout is measured by the correlation between its global and local measures. Thus, visual intelligibility of a layout could be described by correlating its visual integration and connectivity values. With this in mind, visual intelligibility values of the YCBA and the MoMA are described by correlating their visual integration and connectivity graph values. The correlation values indicate that in the YCBA's fourth floor, 67% of visual integration values are predicted by visual connectivity values, whereas this value is 56% for the MoMA's fourth floor (Table 4). The stronger correlation found in the YCBA's layout suggests that this layout is visually more intelligible than the MoMA. In addition to intelligibility we can compare the YCBA and MoMA in terms of mean connectivity and integration values along with the number of grid cells designated in each floor that indicates the analyzed
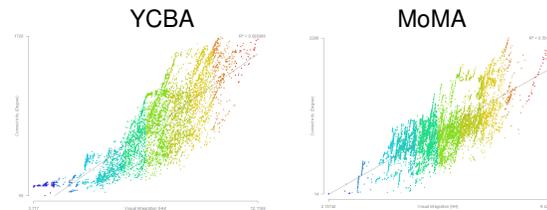

YCBA   MoMA

Figure 4. Scatter grams of visual connectivity and visual integration measures in the three gallery layouts

Table 4. Comparison of visual Intelligibility, Mean Connectivity and Mean Integration measures along with the gallery areas measured by number of grid cells

	YCBA	**MoMA**
r	0.82	0.75
R^2	0.67	0.56
Mean connectivity	782.58	916.46
Mean integration	8.24	6.08
N. of grid cells	6466.00	11033.00

gallery area. Accordingly, the YCBA layout has lower mean connectivity value in a smaller gallery area than the MoMA has. This is consistent with the gallery layout area denoted by the number of grid cells; the bigger gallery layout would have higher connectivity values in general as the cells would see a higher number of cells. When the mean integration values are compared, we see that the YCBA is generally more integrated than the MoMA. Together with lower visual integration, the weaker visual intelligibility in a larger gallery area indicates that in the MoMA's fourth floor gallery observers would need to explore a larger amount of space in order to grasp the entire layout, as the local properties do not reveal the global properties. In contrast, the highest mean value of the YCBA and highest visual intelligibility makes the YBCA's fourth floor layout can be much easily grasped.

These observations indicate that the YBCA's high capacity to visually link most of the spaces to every other space guides visitors in their exploration. The richness of visual interrelationships between the galleries and the ability to grasp the layout enable

visitors to read the displays by visually comparing them with the others across distance and understand the layout without confusion. In this spatial exploration, exposed wall surfaces as well as hidden regions behind the corners attract visitors. In other words, spatial layout can be grasped by visitors through local properties which include directly available and hidden regions. The MoMA's poor capacity to reveal visual information through global properties reinforces the importance of visual information of neighbouring locations. Thus, in the MoMA, the galleries are explored by being guided by visual information revealed step-by-step.

The results concerning the effects of visibility on movement in smaller scale suggest that visitors are sensitive to minor variations in visual information in the scale of their personal space. This can be explained by higher variation of visibility levels in the MoMA's bigger gallery rooms as well as preciousness of visual information within crowded spaces. In the MoMA, exposed wall surfaces seem to be an important aspect of local visual information to guide visitors. This property may explain the potential of displays on the walls to be attractors modulating visitors' movement.

This investigation exploring the effects of syntactical and non-syntactical visibility properties in two illustrative museum layouts confirms that the effects of attractors and layout on movement can be inseparable and synergistic. The layouts can be distinguished in the ways in which they reveal displays which can work as attractors. This difference between the two layouts stems from the layout's capacity of releasing visual relationships from central locations to peripheral ones through atria spaces and room configurations.

3.2. Insights for Planning Shopping Malls

In the case study research discussed above the YBCA's and MoMA's gallery layouts are illustrative of two shopping mall layout types. The YCBA corresponds to a layout where the shopping environment is legible through local visual information to visitors and layout can be grasped without much effort. Opportunities to relate the visited space to every other space help recognize other displays and facilitate encounters with other people. The MoMA illustrates a layout that would guide visitors by revealing the visual information through a temporal progression, grasping only the parts a few steps away during navigation in space.

Both shopping layouts have different advantages depending on design objectives of a retail developer. The former type can be advantageous to offer users opportunities to grasp the space in its totality and feel a stronger sense of community through encounters. In this case, there might be higher chance to be aware of attractors across distance. In the analysis of the YBCA, it is not explicitly observed that the British art displays have effects as attractors. However, if a similar potential of grasping and understanding the space was available in a shopping mall layout, the result could have been different. Visitors in such a shopping mall layout might be attracted to a number of stores of their

interest by seeing the iconic store signs from distance. This may create highly explorative behaviour weakening the likelihood of attention to stores in visited locations. On the other hand, visitors in such shopping layouts might be less likely overwhelmed and tired due to easier way-finding and less confusion in the orientation. As can be understood from these potentials, a shopping layout similar to the YBCA's fourth floor gallery might be advantageous for visitors' experience of space as it may evoke the sense of place and motivate exploration, but could be less advantageous for individual retailers to manipulate pedestrian movement to particular stores.

In shopping malls that show properties similar to the MoMA, the layout may reveal only the attractors in the neighbourhood, and global properties may not be grasped until an entire tour is completed. This may provide visitors with opportunity of focusing on the displays in the visited rooms and recognizing mostly the stores in the neighbouring locations. As the total size of the layout gets bigger, limited capacity to view other spaces and the inability to grasp the entire layout may be more overwhelming and thus way-finding and orientation can be problematic. If a shopping mall like MoMA's layout has store units with sizable rooms visitors' movement in small scale can be manipulated with minor changes in visual information, such as visibility of certain displays within crowd or other visual obstacles. With these features the gallery layout with the potentials of the MoMA could be advantageous for retailers whose concern is to attract visitors and facilitate their attention to certain stores or displays, yet could be less advantageous for visitors who need good levels of orientation and who value getting a sense of place and community during a shopping experience.

CONCLUSION

Good levels of legibility and sense of community in shopping mall space increase the popularity of those malls. These qualities may conflict with retail developer's objectives of attracting meandering visitors and thus achieving increase in sales. In shopping mall projects, architects may be asked to develop the shopping mall design fulfil both ends. Shopping malls as popular places increase the potentials for commercial activity, while attracting visitors to certain stores might be important to define the popularity of those stores and optimize rent rates. In order to achieve these ends, a shopping mall layout may need to integrate properties that would bring good levels of legibility, with other properties which limits the global information and makes easier to manipulate pedestrian movement. Our analysis suggests that layouts tend to prioritize one or another property. However, a further study taking the effects of specific attractors associated with certain retail groups into consideration within the methodology proposed in this paper may produce different results and bring a more in depth understanding of how effects of layout and attractors can be utilized to shape user behaviour.

REFERENCES

Archea, J. 1977. The place of architectural factors in behavioral theories of privacy. *Journal of Social Issues, 33*, 116-137.

Benedikt, M. 1979. To take the hold of space: isovists and isovist fields. *Environment and Planning B: Planning an Design, 6*, 47-55.

Choi, Y. K. 1999. The morphology of exploration and encounter in museum layouts. *Environment and Planning B: Planning and Design, 26*(2), 251-264.

Dalton, R. C. 2001. Omnivista: An Application for Isovist Field and Path Analysis, *3rd International Space Syntax Symposium*. Atlanta, GA.

Fong, P. 2003. *What makes big dumb bells a mega shopping mall?* Paper presented at the 4th International Space Syntax Symposium, London, U.K.

Hillier, B. 1996. *Space is the machine: a configurational theory of architecture*. New York: Cambridge University Press.

Hillier, B., & Penn, A. 1991. Visible Colleges: Structure and Randomness in the Place of Discovery. *Science in Context 4*(1), 23-49.

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: Planning and Design, 20*, 29-66.

Hillier, B., & Tzortzi, K. 2006. Space Syntax: The Language of Museum Space. In S. Macdonald (Ed.), *A Companion to Museum Studies*. Oxford: Blackwell Pub.

Kliment, S. A., Barr, V., & Jerde Partnership International. 2004. *Building type basics for retail and mixed-use facilities*. New York: Wiley.

Psarra, S. 2005. Spatial Culture, Way-finding and the Educational Message. In S. Macleod (Ed.), *Reshaping Museum Space: architecutre, design, exhibitions* (pp. 78-95). New York: Routledge.

Psarra, S., & Grajewski, T. 2000. Architecture, narrative and promenade in Benson+Forsyth's Museum of Scotland. *ARQ: Architectural Research Quarterly, 4*(2), 123-136.

Psarra, S., Wineman, J., Xu, Y., & Kaynar, I. 2007. Tracing the Modern - the Museum of Modern Art in New York and its Latest Expansion, *6th International Space Syntax Symposium*. Istanbul, Turkey.

Rohloff, I. K., Psarra, S., & Wineman, J. 2009. Experiencing Museum Gallery Layouts through Local and Global Visibility Properties in Morphology, *7th International Space Syntax Symposium*. Stockholm, Sweden: (paper under review).

Shopping Center Development Handbook. 1999.. Washington, D.C.: ULI- Urban Land Institute.

Turner, A. 2003. Analysing the visual dynamics of spatial morphology. *Environment and Planning B: Planning an Design, 30* (657 - 676).

Turner, A. 2004. Depthmap: The Researcher's Handbook. London, UK.: Bartlett School of Graduate Studies, UCL, London.

Turner, A., Doxa, M., O'Sullivan, D., & Penn, A. 2001. From 'isovist' to visibility graph: a methodology for analyzing the architectural space. *Environment and Planning B: Planning an Design, 28*(1), 103-121.

Turner, J., Wineman, J., Psarra, S., Jung, S. K., & Senske, N. 2006. Syntax 2D. Ann Arbor, MI: University of Michigan.

Zacharias, J. 1997. The impact of layout and visual stimuli on the itineraries and perception of pedestrians in a public market. *Environment and Planning B: Planning and Design, 24*(1), 23-35.