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A PROSPECT-REFUGE APPROACH TO SEAT PREFERENCE:

Environmental psychology and spatial layout

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ABSTRACT

The interplay between mind, behaviour and world has been extensively examined by the field of environmental psychology. This approach investigates the ways in which environment furnishes human spatial behaviour as well as individual's responses to information retrieved by his or her immediate stimuli. Despite the fact that scholarly work in this field has provided valuable conclusions about social functioning in various spatial settings, the spatial context is usually conceptualised as if unstructured and without distinctive physical or organisational properties as a spatial whole. For these reasons several approaches from the built environment tried to address this gap by combining space syntax theoretical and methodological tools with key concepts from the field of environmental psychology and examined spatial cognition, movement, wayfinding, navigation and visual perception. This paper aims at contributing to this existing body of literature by drawing on Appleton's (1975) prospect-refuge theory and examining stationary activities such as seat preference. The coffee shop like settings of three customer lounges in the UK serve as empirical case studies to investigate customers' seat preferences. The methodology implemented for this study combines a consistent analysis of spatial structures captured by space syntax analytical tools with behavioural data retrieved by detailed onsite observations of space usage. Furniture settings were mapped and classified according to orientation of seats ('directness'), presence or absence of attractors (such as windows, TV, coffee bar) and furniture types (armchairs, sofas, booths, etc.).

This study found that there is no linear relationship of occupancy with spatial variables and that various contributing factors determine seat selection. In essence, seat preference is rendered as a rather complex phenomenon which depends on the degree of control that is given to the occupant, furniture type as well as furniture directness. At the same time, the paper develops joint metrics that aim at tackling Appleton's concept of prospect-refuge. In summary, this research by adopting a more empirical and behavioural approach centred on seating preferences presents an innovative way of jointly analysing spatial variables alongside space usage preferences for the examination of stationary activities.

KEYWORDS

Environmental psychology, space syntax, occupancy patterns, seat preference, prospect-refuge theory

1. INTRODUCTION

Environmental psychology was defined by Proshansky et. al. (1970) as the field that focuses on human behaviours in relation to physical settings defined and ordered by man. The authors argued that physical settings "evoke complex human responses in the form of feelings, attitudes, values, expectancies and desires" (ibid.: 28) and in this sense, environmental psychology examines the relationship of physical settings with human behaviours. However, as argued by Peponis and Wineman (2002) studies of environment and behaviour are often problematic in describing environment, since they are mainly dealing with a wide array of social, psychological, cultural and organisational parameters. It is exactly on that point that space syntax is considered to hold potential as an important contributor towards a comprehensive theory of environmental psychology, since it offers a quantitative approach able to characterise the structure of the spatial layout (Montello, 2007).

Therefore, in an effort to jointly examine internal processes and external environment various studies have been conducted to this date, investigating a wide range of human spatial behaviours with a particular focus on movement choices, spatial cognition, navigation and wayfinding performance. Unlike existing scholarly work, this study focuses mainly on stationary activities, attitudes and seat preferences by theoretically and methodologically elaborating on Appleton's theory of prospect-refuge which described the psychological need of tucking oneself away from others, but at the same time maintaining an oversight of the environment around oneself.

Thus, this research is designed to examine micro-dynamics of social behaviour in relation to social and physical stimuli by combining space syntax with key concepts from environmental psychology (Appleton's prospect-refuge theory). In essence, this research sets out to investigate customers' seat preference by considering spatial variables, furniture type, furniture directness and attractors. As a result, an empirical methodology is adopted for this study that combines a consistent analysis of spatial structures captured by space syntax analytical tools with social functioning data retrieved by detailed on-site observations of space usage.

In detail, the paper starts with a review of literature (chapter 2) relevant to this study by examining concepts by environmental psychology (2.1.), space syntax theory and its possible contribution towards a comprehensive theory of environmental psychology (2.2), while it also considers approaches that combine both perspectives for the examination of prospect-refuge theory (2.3). The case studies and the research methodology are then described in chapter 3, followed by an extensive analysis of the data structured in three chapters which aim to explain occupancy patters based on spatial metrics alone (chapter 4), spatial metrics and seat characteristics alongside each other (chapter 5) and finally a multi-factorial regression analysis (chapter 6). The research's main findings, conclusions and suggestion for further work are then developed in a final chapter 7.

2. THE STUDY OF INDIVIDUAL PREFERENCE IN SPACE AS BOTH INDIVIDUAL AND COLLECTIVE PHENOMENON

This chapter will review existing research under three broad categories: 1) Environmental Psychology: The study of individual preferences in space usage – how individuals' behaviour is related to their immediate physical setting; 2) Space Syntax Approach: Considering collective patterns – to what extent space syntax theory and methodology contribute to a comprehensive theory of environmental psychology taking into account the wider spatial environment; 3) Existing scholarly work bridging between space syntax and environmental psychology for the empirical and methodological investigation of prospect-refuge theory.

2.1. ENVIRONMENTAL PSYCHOLOGY: THE STUDY OF INDIVIDUAL PREFERENCE IN SPACE USAGE

Environmental psychology is a varied field. An early example of a typical approach of environmental psychology was Osmond's (1957) hypothesis that seating arrangements can influence social interaction. Osmond noticed that some places tended to discourage interaction, while others tended to bring people together and encourage social interaction; he coined them

"sociofugal" and "sociopetal" places respectively. Elaborating further on Osmond's hypothesis, Sommer (1965) proposed that there are distinct seat preferences depending on the type of action each group is executing (i.e. interacting casual groups preferred corner-to-corner arrangements, cooperating groups preferred to sit side-by-side etc.). Additionally, Sommer (1965) through his studies in library environments claimed that the ecology of interaction appeared to be particularly different from non-interaction in terms of seat positioning, since most stressful encounters were mainly avoided through spatial segregation.

Such explorations revealed the concept of personal space (Sommer, 1969) which is usually addressed as the area around an individual that creates an invisible boundary between an individual's self and others. Specifically, this 'bubble' around the individual describes the distance that individuals maintain in order to eliminate most stressful encounters. Therefore, it has a primarily protective role, while it also controls the sensory information offered or received by means of visual contact, visual directness as well as spatial segregation (Siggolitou, 1997).

The role of interpersonal distance in human conversation was examined empirically by Sommer (1962) who studied the distance for comfortable conversation in lounge areas. Sommer concluded that when the distances between pieces of furniture were greater than 1 metre, people preferred to sit side-by side on the same sofa instead of across from one another on different sofas. By adopting the opposite starting point, Bachelor and Goethals (1972) assumed that changes in the instruction given to a group (i.e. to decide individually or as a group) can affect their formation. Their investigations highlighted the fact that interpersonal distance appeared depending on both the activity (in this case decision making) and the nature of the activity (individually or as a group).

What is implicit though in these approaches is the perceptual availability of one person to others – what Mehrabian (1969) coined immediacy. Immediacy is addressed as the direct orientation of individuals that in turn enhances the conversation between "interactants". Elaborating more on this hypothesis, Mehrabian and Diamond (1971) suggested that individuals in closer positions and more directly orientated towards each other tended to converse more. Interestingly, Mehrabian and Diamond (1971:282) by measuring "directness according to how many degrees one must turn to face another" highlighted that 0° orientation indicates face to face communication, while 180° orientation is the least direct and the most detrimental to conversation.

Elaborating more on the fundamental importance of visibility, Appleton (1975) argued that place preference is based on the behavioural and psychological need of human beings to find places from where they can observe without being exposed. In essence he claimed that the right combination of prospect and refuge that an environment can offer influenced individuals' seat preference. However, despite the fact that some studies have been conducted elaborating on Appleton's ideas they remained firmly anchored in the study of spatial characteristics, whereas perspectives of an empirical behavioural investigation are not as well established (Dosen & Ostwald, 2012)

2.2. SPACE SYNTAC APPROACH: CONSIDERING COLLECTIVE PATTERNS

As concluded by the previous section, existing knowledge on the interplay between the physical environment and human behaviour in the field of environmental psychology remains somewhat limited to the examination of the immediate socio-physical environment (Stokols, 1995) of an individual, since there is no attempt to explore the role of physical barriers in regulating interaction (Sommer, 1965). Therefore, according to Montello (2007) space syntax can constitute an important contributor towards the development of a comprehensive theory of environmental psychology, since it can provide a rich set "of quantitative indices for characterising places in many ways that are potentially relevant to a variety of psychological responses" (ibid., p. 1).

However, unlike environmental psychology which studies the individual preference in space, space syntax suggests that "the relation between space and social existence does not lie at the

level of the individual space, or individual activity [but rather] it lies in the relations between configurations of people and configurations of space" (Hillier, 1996, p. 31).Therefore, space syntax theory suggests that "by analysing space rigorously and observing human activity carefully" (Hillier and Vaughan 2007: 207) space is not seen as a background to social activity but as an intrinsic aspect of human behaviour.

As summarised by Peponis and Wineman (2002) social and psychological studies of environment can be valuably benefited by analytical theories of spatial configuration. More specifically, by means of isovist analysis and Visibility Graph analysis, space syntax can promise important insights to the field of environmental psychology (Montello, 2007). In fact, according to Turner et. al. (2001) the concept of the isovist is a promising way of thinking about spatial environments due to the fact that it provides a description of space from the point of view of individuals, since it illustrates the way people perceive, interact and move through space. Space syntax theory used isovists to derive visibility graph analysis of mutually visible areas in a spatial layout which according to Turner et. al. (2001) seems related to an individual's perception of the built environment.

Currently there is a growing body of research which recognises the potentials of combining the advantages of both approaches to study the interplay between internal processes and external environment (either real or virtual). Specifically, existing research has analysed human navigation (Penn, 2001;2003) and wayfinding performances along with spatial properties (Peponis, Zimring and Choi, 1990; Convoy Dalton, 2001; Haq & Zimring, 2003; Convoy Dalton, 2003); influence of familiarity and spatial complexes on movement (Hölscher and Brösamle, 2007; Hölscher, Brösamle, and Vrachliotis, 2006); mental representations along with actual properties of space (Tversky, 2003); mental map representation and integration of real spatial layouts (Kim and Penn, 2004); and spatial predictors for people's orientation performance with a map (Davies, Mora, & Peebles, 2006). A second strand of research has analysed visual fields, perception and embodiment (e.g. Psarra and McElhinney, 2014; Turner et al., 2001, Zamari and Peponis, 2007) in relation to morphology and layouts, while a last approach examined various aspects of human spatial behaviour in various building types by adopting a more empirical and behavioural point of view (Sailer, 2007; Sailer and Penn, 2009; Chan, 2007).

Therefore, it is clear that there are numerous areas of interest and degrees of overlap between the analytical description of spatial layout and psychological studies of environment. In fact, space syntax seems to provide a coherent framework for describing spatial layouts and thus can assist in achieving what Proshansky (1974: 553) stated as the major task for environmental psychology, the exploration of the physical "setting as [it] is" and the physical "setting as experienced". Existing research bridging space syntax with psychological studies of environment constitutes a growing field which can potentially be enriched by incorporating other aspects of human spatial behaviour such as stationary activities and occupancy behaviours.

2.3. EXISTING SCHOLARLY WORK BRIDGING BETWEEN SPACE SYNTAX AND ENVIRONMENTAL PSYCHOLOGY: THE EMPIRICAL INVESTIGATION OF PROSPECT-REFUGE THEORY

This section reviews key studies that elaborated on prospect-refuge theory by effectively combining space syntax methodological tools with concepts form environmental psychology. This exploration therefore sets the ground for further methodological advances, while it fruitfully furnishes the exploration of seat preference.

The relationship of prospect-refuge is usually examined through associations of the perceptual properties of space along with the geometrical properties of an isovist (Dosen & Ostwald, 2015). Prospect is usually conceptualised as spaciousness, openness and outlook and thus maximum radial length of isovist area. On the other hand, refuge is associated with enclosure and safety and thus with the geometry of occlusion and minimum radial length.

Franz et al. (2004) for instance examined prospect-refuge theory in fictive gallery environments by considering jointly perceptual and geometrical properties of space with human responses. Specifically, several isovists and visibility graph measures (i.e isovist area, jaggedness and symmetry) were produced and tested as predictors of experiential spatial qualities. Those

characteristics were then correlated with average affective appraisals of the responders (i.e. pleasingness, spaciousness etc.). As argued by the authors, spatial properties were significantly correlated with affective appraisals, while perceptual qualities of spatial environment were effectively described by isovist analysis and its measures. Likewise, Wiener et al (2007) explored prospect-refuge criteria by asking participants to navigate within a virtual art gallery in order to find the best location to hide and simultaneously observe. Participants then rated the selected location in terms of spaciousness, complexity etc. Those results were then examined in relation to isovist area, number of vertices and jaggedness. Results suggest that selected locations were characterised by the smallest and largest areas.

More recently, Dosen, Ostwald, & Dawes (2013) by reviewing existing scholarly work argued that isovist measures as well as the ratio of isovist area to room size can allow spatial dimensions to be correlated with perceptual features (i.e. openness, enclosure etc.). Specifically, they assumed that refuge can be captured when the isovist area is smaller than the room area, while prospect can be identified when the isovist area is larger than the room area. They also argued about the potential of virtual stimuli to be used for the empirical exploration of prospect-refuge theory.

To summarise, as already argued by Dosen & Ostwald (2015) despite the fact that some studies have been conducted elaborating on prospect-refuge theory the findings only provide limited support to the validity of the theory. In essence, there is no clear determination which measures are the most relevant to this investigation but only some indication that ratios or proportional values of isovists perform better with spatial dimensions than simple measures. Generally, the built environment is more broadly considered in the existing literature and thus the spatial conditions that create the ideal balance between prospect and refuge are still unclear (Dosen & Ostwald,2013).

3. CASE STUDIES AND RESEACH METHODOLOGY

The coffee shop like settings of three customer lounges in the UK will serve as case studies to explore the spatial conditions of seat preference. The selected case studies constitute lobby-style areas where customers can spend time, come with their guests into relaxing surroundings and enjoy free amenities provided. The lounges are also suitable for informal business meetings, for community meetings and charity events. All lounges comprise of living areas, low and high tables with chairs, areas equipped with plug sockets and refreshment bars. However, the three lounges differ in their size, layout arrangements, number of floors, interface with the street, and functional allocation.

The methodology implemented for this study combines on-site observations of customers' behaviours with spatial analysis using space syntax methodological tools. Overall 3 different cases (across 6 floors) were observed in 9 days of observation. The methods implemented for the onsite observations were designed to capture occupancy patterns, to create a detailed image of individuals and groups' behaviours as well as to reveal customers' preferences. Therefore, the observation methods combine mainly two techniques:

a) ***'Time-lapse' observations of customers' behaviours*** that counted occurrence of behaviours by recording the changes of main customers' activities. Specifically, every individual or group of individuals who arrived together in the lounge were recorded with their seat selection, an estimation of their age, their gender, the sequence of their activities as well as the duration of their stay. In total 526 people were recorded.

b) ***Snapshots*** that captured occupancy patterns, stationary and moving activities of customers and staff members as well as interactions in space. A total of 17 snapshots were conducted for every seat. Occupancy was extracted by calculating the number of times a seat was used in relation to the total number of observation rounds (n=17). According to Koutsolampros et al (2015) occupancy is reasonably representative with around 15 snapshots, since for a majority of cases a variation of around 5% could be expected.

The data retrieved by the on-site observations were then examined along with the spatial analysis of the three layouts across all the floors. Due to the fact that this study focuses on local patterns of behaviour and preferences each floor was analysed separately and visibility graph analysis (Turner et al. 2001) was applied for permeability, which in space syntax terms is a VGA in which the furniture is included in the floor plans and modelled as obstacles. Simultaneously, in small quasi-synchronic environments (Peponis and Bellal, 2010) which are instantly perceived like the selected case studies, permeability offers potentials in exploring Appleton's prospect-refuge theory by considering individuals' control of accessibility and not visibility. Simultaneously, furniture settings were mapped (n= 158) and classified according to their type (figure 1), their spatial attribute, their orientation as well as the presence or absence of attractors (visual contact with a TV, a window view, or plug sockets facilities as well as proximity to refreshment bars were considered).

Figure 1 - Furniture type classification

4. SEAT PREFERENCE: SINGLE FACTOR ANALYSIS OF SPATIAL METRICS

Drawing on existing research in the field of environmental psychology and elaborating more on space syntax methodological tools, this section aims to shed light on parameters defining seat preference. Occupancy patterns, as captured by the snapshot method (figure 2) were examined in relation to different attributes assigned to every seat (i.e. furniture type, spatial properties) hypothesising that:

H1: Occupancy differs by furniture type, since particular furniture types might be more popular than others.

H2a: Occupancy is higher for seats that are less integrated (using connectivity and integration). Connectivity as a local measure describes the relationship of a space with its immediate neighbours (Haq 2003) and therefore size of the accessible area, while integration as a global measure describes space as a pattern of global connections. It is tested whether people place themselves in locations of strategic local and global permeability respectively.

H2b: Occupancy is higher for seats that offer larger visual fields for a seated individual. Isovist area captures the size of the visual field of a static individual (Benedikt, 1979) from the centre of each seat, and thus measures the ability to see and observe others. A partial 180° isovist was used to better depict the directionality of human experience.

H2c: Occupancy is higher for seats that offer higher spatial eccentricity. Drift Angle, Drift Magnitude offer information about the asymmetry of access, and thus can give insights whether people prefer higher eccentricity for places of sojourn, while Max Radial can describe best the maximum of the farthest distance that people in a given environment can accesses from the vantage point.

H2d: Occupancy is higher for seats that maximise an individual's prospect while minimising others' accessibility (providing refuge). Three different ratios were calculated combining properties of the partial isovist (prospect) with overall accessibility measured by connectivity (refuge): isovist area / connectivity (ratio 1), drift magnitude / connectivity (ratio 2) and maximum radial / connectivity (ratio 3).

Figure 2 - Density maps for overall occupancy patterns produced by snapshot method - denser shade represents more popular seats

Firstly, the distinct furniture types (figure 1) were plotted against seat occupancy to investigate differences in popularity by furniture type. The analysis of variance (ANOVA) illustrated a moderate and significant correlation of variance ($R2=0.29$ $p<0.001$), which indicates that furniture type plays a role for seat selection but is not the main driver. The analysis highlighted that people preferred more comfortable seating; specifically, a distinct preference for individual armchairs emerged since this type of furniture recorded the highest mean occupancy (46% for type 2 and 46% for type 4). Sofas as well as booth areas illustrated average occupancy levels close to 40%. The least preferred furniture type was the entrance bench.

ONEWAY ANALYSIS OF OCCUPANCY BY FURNITURE TYPE

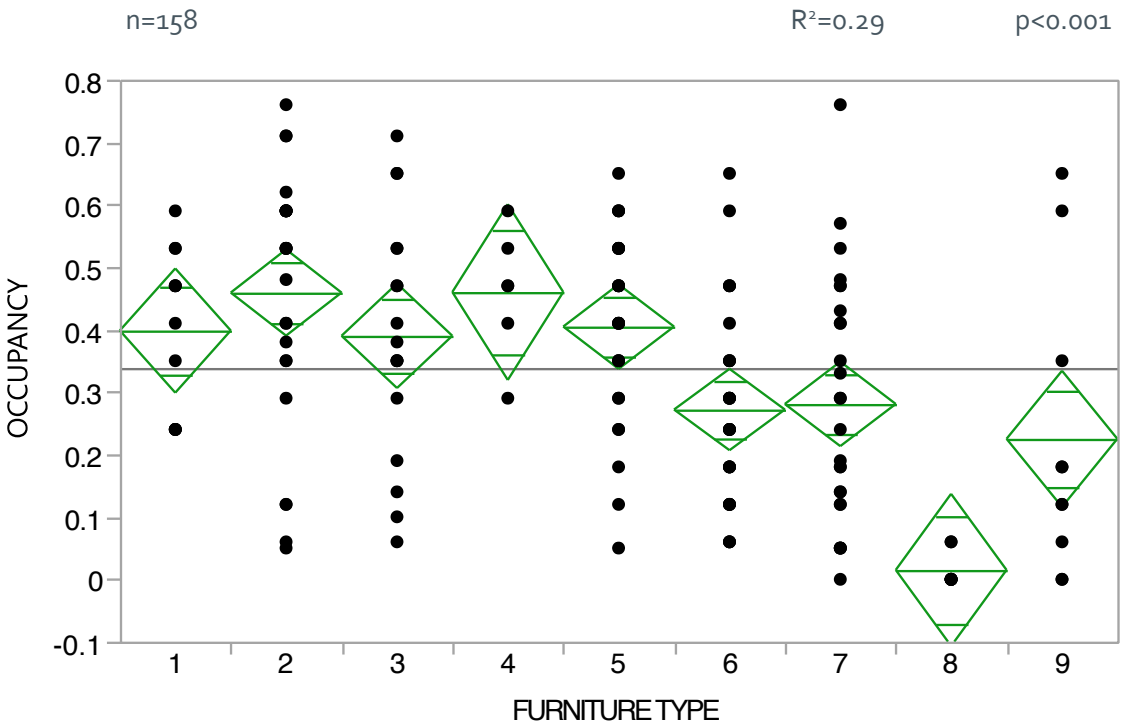

Figure 3 - Mean (ANOVA) of occupancy with furniture types

In order to investigate the second set of hypotheses (H2a-2d) occupancy was correlated with several space syntax metrics. Table 1 summarises R2 and p values for all spatial variables tested. All spatial variables tested apart from the isovist area, drift angle and drift magnitude illustrated significant positive correlations but with very small size effects. This means that occupancy rose for instance with rising connectivity, pointing to the fact that space users preferred larger areas to sit in, however, in this case just under 10% of the variance in occupancy is explained by connectivity. This warrants further investigation.

	H2a		H2b	H2c			H2d		
	Integration (HH)	Connectivity	Isovist Area	Isovist Max Radial	Isovist Drift Magnitude	Isovist Drift Angle	Ratio A (Isovist Area/Connectivity)	Ratio B (DriftMagn./Connectivity	Ratio C (Max-Rad./Connectivity
R^2	0.03	0.10	0.00	0.00	0.002	0.00	0.06	0.075	0.038
p	0.04	<0.001	0.63	0.99	0.610	0.77	<0.001	<0.001	0.015

Table 1 - R^2 and p-values for correlation of spatial variables with occupancy

5. SEAT PREFERENCE: SPATIAL METRICS ALONG WITH SEAT ORIENTATION AND 'ATTRACTIVENESS'

The relationship between occupancy and spatial variables was tested further in combination with seat orientation and seat 'attractiveness'. More specifically, based on insights from environmental psychology (Mehrabian and Diamond 1971, Sommer 1962) this research tested the role of 'directness' in seat preference. Therefore, four categories of furniture directness were defined (Figure 4). Categories for directness were classified as 0, 1, 2 and 3, where (0) directness refers to pieces of furniture that face away from a corridor (and thus movement flow); directness (1) is assigned to seats that have direct, straight ahead visual contact with the main corridor; directness (2) represents immediate side-by-side directness; and directness (3) refers to seats that have a distanced side-by-side directness with corridors.

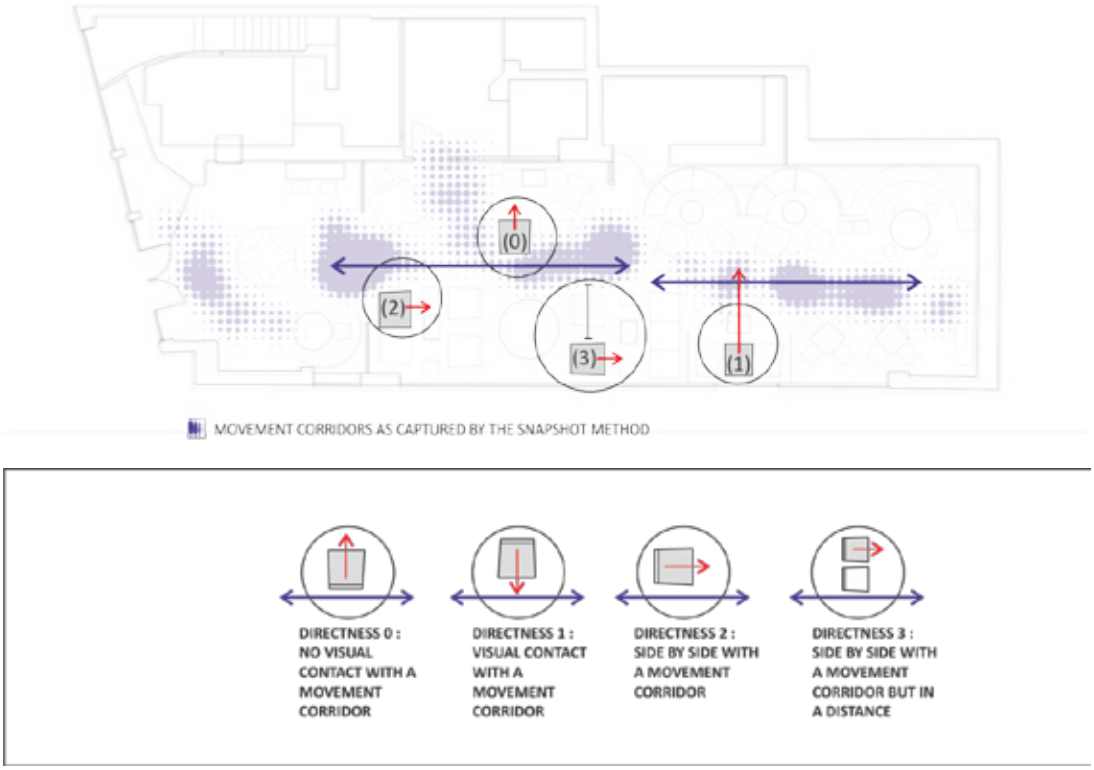

Figure 4 - Categories of furniture directness

The table below summarises the results of the correlation of occupancy with the spatial variables that produced significant results earlier, now clustered by all types of directness. At first sight, it can be seen that in some cases the introduction of the directness factor resulted in better correlations of variables which indicates the fact that directness of the visual field of a seated individual along with spatial variables might be worth considering jointly in the exploration of seat preference. In detail, seats with directness 3, i.e. those with corridors to the side in some distance away show larger effects for connectivity and integration (up to 27% of variance explained), meaning that users more clearly prefer highly integrated and larger areas in this case.

OCCUPANCY – SPATIAL VARIABLES (GROUPED BY DIRECTNESS)			
Variables Tested	R2	P value	n
Occupancy – Connectivity	0.09	<0.001	158
Occupancy – Connectivity (D0)	0.09	0.049	32
Occupancy – Connectivity (D1)	0.19	0.002	41
Occupancy – Connectivity (D2)	Insignificant results		
Occupancy – Connectivity (D3)	0.27	0.003	31
Occupancy – Integration	0.03	0.046	158
Occupancy – Integration (D0)	Insignificant results		
Occupancy – Integration (D1)	Insignificant results		
Occupancy – Integration (D2)	0.15	0.013	33
Occupancy – Integration (D3)	0.24	0.005	31

OCCUPANCY – SPATIAL VARIABLES (GROUPED BY DIRECTNESS)			
Joint Variables Tested	R2	P value	n
Occupancy – Ratio (sovist Area / Connectivity)	0.06	0.002	158
Occupancy – Ratio A (D0)	Insignificant results		
Occupancy – Ratio A (D1)	0.22	0.001	41
Occupancy – Ratio A (D2)	Insignificant results		
Occupancy – Ratio A (D3)	Insignificant results		
Occupancy – Ratio B (Drift Magnitude / Connectivity)	0.08	<0.001	158
Occupancy – Ratio B (D0)	Insignificant results		
Occupancy – Ratio B (D1)	0.16	0.006	46
Occupancy – Ratio B (D2)	Insignificant results		
Occupancy – Ratio B (D3)	0.19	0.015	31
Occupancy – Ratio A (Max Radial / Connectivity)	0.04	0.015	158
Occupancy – Ratio C (D0)	0.15	0.014	40
Occupancy – Ratio C (D1)	0.15	0.014	40
Occupancy – Ratio C (D1)	Insignificant results		
Occupancy – Ratio C (D2)	0.1	0.004	41
Occupancy – Ratio C (D3)	0.11	0.022	31

Table 2 - Correlations of occupancy with spatial metric clustered by furniture directness

Secondly, the role of attractors in seat preference was explored, since customers' qualitative feedback revealed that there are different seat preferences depending on attractors.

Table 3 illustrates the correlation of occupancy with spatial variables clustered by seats with and without attractors. What becomes obvious at first sight is that correlations between occupancy and spatial variables for seats with attractors became insignificant or showed an even smaller R2 as compared to the already weak baseline of R2 =0.04 for all seats. In contrast, correlations for seats without attractors were strengthened (R2 up to 0.25). Thus, it could be argued that spatial variables appear to drive occupancy levels to a certain extent but only if no attractors are present. This illustrates the special role of attractors for seat positioning, since it illustrates that seats with attractors are chosen because of their attractiveness. This is consistent with previous studies in office environments which showed that movement not only evolves from spatial configuration, but also from strategic placement of facilities (Sailer, 2007). In fact, "movement in workplace environments actually evolves not only from spatial configuration, but also from levels of programming and strategic decisions on how to distribute functions and central resources" (Sailer and Penn, 2009, p. 095:5).

OCCUPANCY – SPATIAL VARIABLES (GROUPED BY ATTRACTORS)			
Variables Tested	R2	P value	n
Occupancy – Connectivity	0.09	<0.001	158
Occupancy – Connectivity (Seats with Attractors)	0.04	0.029	109
Occupancy – Connectivity (Seats without Attractors)	0.25	0.002	49
Occupancy – Integration	0.03	0.046	158
Occupancy – Integration (Seats with Attractors)	Insignificant results		
Occupancy – Integration (Seats without Attractors)	0.08	0.037	49
Occupancy – Ratio A (isovist/connectivity)	0.06	0.002	158
Occupancy – Ratio (Seats with Attractors)	0.04	0.049	109
Occupancy – Ratio (Seats without Attractors)	0.16	0.005	49
Occupancy – Ratio B (Drift Magnitude / Connectivity)	0.08	<0.001	158
Occupancy – Ratio B (Seats with Attractors)	Insignificant results		
Occupancy – Ratio B (Seats without Attractors)	0.23	<0.001	49
Occupancy – Ratio C (Max Radial / Connectivity)	0.04	0.015	158
Occupancy – Ratio C (Seats with Attractors)	Insignificant results		109
Occupancy – Ratio C (Seats without Attractors)	0.23	<0.001	49

Table 3 - Correlation of occupancy with spatial variables clustered by attractors

In summary, this section rendered individual preference as a rather complex phenomenon. Despite the fact that none of the tested variables were able to explain much of the variation in occupancy, the significance of their relationship illustrated that they are worthy of further exploration. Equally important, the fact that spatial metrics seemed to correlate better with occupancy when clustered either by furniture directness or by attractors revealed that various factors might work together in determining seat preference. Lastly, it can be seen that joint metrics (ratios) show promising results. This point seems to coincide well with Dosen & Ostwald's (2015) investigation on studies exploring prospect-refuge where they concluded that ratios or proportional values of spatial variables seem that relate better with spatial dimensions than pure metrics.

6. SEAT PREFERENCE AS A COMPLEX PHENOMENON: MULTIPLE REGRESSION ANALYSIS

Based on the insights retrieved by the previous section, this research assumes that a multiple regression analysis will be able to explore seat preference more precisely. Specifically, due to the fact that multiple regression considers all variables at once, it allows an explicit control of many factors that might affect a dependent variable and therefore the strength of each independent variable can be evaluated. In the multiple regression analysis conducted for this study the dependant variable was occupancy, while the explanatory variables were all spatial metrics, furniture types and furniture directness.

Multiple regression was first applied for spatial variables in order to examine the role of spatial configuration for seat preference. Spatial variables were first tested for collinearity, so as to identify whether some of them correlate with each other and thus cannot be considered together in a multiple regression. As expected none of the spatial variables was able to explain much of the variation of occupancy. Therefore various examinations of all contributing factors were conducted.

Table 4 illustrates the two best produced models that resulted in the best fit. In both cases spatial variables (integration and ratio A in first case and integration and ratio B in the second case) were examined along with furniture type and furniture directness. As it can be concluded by both models, 41% of variation of occupancy can be explained by considering simultaneously spatial variables and furniture's attributes (i.e. type and directness). In both cases, the joint spatial variable proved to be the most important factor in predicting occupancy, since they have a coefficient of 1.44 in first case (ratio A) and 12.19 in the second case (ratio B)[1] . This indicates the fact that first and foremost people prefer seats that allow them to maximise their own ability to access space while controlling for being accessible (low connectivity) (Appelton, 1975). More specifically, every 1 unit change in ratio A results in a 1.44 increase in occupancy, while every 1 unit change in ratio B results in a 12.19 increase in occupancy.[2]

In both cases, the categorical variables (i.e. furniture directness) were classified by considering D0 as the baseline. This means that the coefficient of each directness type (D1,D2 and D3) indicates its popularity in relation to D0. All directness variables were significant, while directness 2 was the least preferred and D0 the most popular since all other coefficients were negative. Regarding furniture types, low chairs (type 6) were considered as the baseline. It was found that furniture type (7) and furniture type (9) were not significant, while armchairs (type 2 and 4) appeared to have the highest positive influence on occupancy.

1 The much higher value of the coefficient of ratio B is due to the fact that numbers for drift magnitude are much smaller.

2 Due to the different order of magnitude values (drift magnitude ranges from 0.41 to 8.70, while isovist area ranges from 2.54 to 106.28), the coefficients appear different, but are in fact comparable.

1st Model		
Independent Variables	B(SE)	Beta
Ratio A (Isov./Connectivity)	1.44 (0.401)	0.28***
Integration	-0.01 (0.003)	-0.21***
F1	0.12(0.057)	0.15*
F2	0.22(0.047)	0.40***
F3	0.13(0.053)	0.21**
F4	0.23(0.077)	0.22**
F5	0.16(0.048)	0.30**
F7	0.10(0.053)	0.02
F8	-0.19(0.071)	-0.21**
F9	-0.74(0.060)	-0.90
D1	-0.14(0.047)	-0.32**
D2	-0.12(0.043)	-0.26**
D3	-0.19(0.050)	-0.372***

Notes:
Dependent Variable: Occupancy
R2=0.414
*p<.05, **p<.01, ***p<.001

2nd Model		
Independent Variables	B(SE)	Beta
Ratio B (Isov.Drift Magnitude/Connectivity)	12.19(3.541)	0.28**
Integration	-0.01(0.003)	-0.17*
F1	0.08(0.058)	0.11
F2	0.21(0.047)	0.39***
F3	0.12(0.053)	0.18*
F4	0.22(0.077)	0.21*
F5	0.15(0.049)	0.28*
F7	0.01(0.056)	0.01
F8	-0.20(0.070)	-0.22**
F9	-0.11(0.061)	-0.17*
D1	-0.12(0.046)	-0.28**
D2	-0.11(0.042)	-0.23**
D3	-0.18(0.049)	-0.35***

Notes:
Dependent Variable: Occupancy
R2=0.410
*p<.05, **p<.01, ***p<.001

Table 4 - Multiple Regression Analysis, 1st and 2nd Model

Overall, this section illustrated that seat preference is a complex phenomenon that cannot be fully explained by a single factor analysis, since there are various variables that contribute to the popularity of a seat in an entangled way. At the same time, it illustrated that joint metrics proved to be better predictors of prospect-refuge in small quasi-synchronic spatial environments. However, this investigation gives insights only into collective patterns, since it explains occupancy as a collective phenomenon without taking individuals and different responses to spatial layouts into consideration (Montello, 2007).

8. CONCLUSIONS

This paper aimed to provide a theoretical and methodological framework to conceptualise and quantitatively examine the way physical environment affects human preferences by drawing on concepts from the field of environmental psychology and space syntax theory. Based on the review of existing literature, this paper builds on existing research bridging the space syntax approach and environmental psychology studies by providing an additional point of exploration which proposes a more explanatory and empirical approach for the examination of stationary activities.

Evidence from the empirical case studies shed light on the conditions that affected seat occupancy patterns. In detail, the analysis has highlighted the critical role of the spatial layout, furniture types, furniture directness as well as attractors for seat selection. It was highlighted that 41% of the variation in occupancy can be explained by spatial control, furniture types and seat orientation. The most important factors in predicting occupancy were indeed spatial variables: the degree to which a seat allows accessibility control, i.e. seeking to maximise accessing while minimising being accessible by others. Both joint metrics (ratio A of 180° isovist area to connectivity and ratio B of drift magnitude to connectivity) relate to the psychological concept of the balance between refuge and prospect, first suggested as important to human behaviour by Appleton in the 1970s.

Limitations of the study include a restricted number of observations, yet the small sample size is large enough to draw conclusions. Ideally this study would be repeated in other lounges and thus provide a larger empirical base for the comparative examination of seat preference in space. Extending the approach into other related types of spaces where people are faced with decisions on seat choices would be worthwhile, for instance in airports, cafes and restaurants (building on the work of Chan 2007), but also in co-working spaces (building on the work of Kueasirikul 2014), since seat preference in other cases and conditions might differ. Further studies could also investigate the interplay between individual preference and identity, focusing more explicitly on the diversity of space users and their demographic differences. It would be interesting to see the effect of collective patterns and 'generic functions' of space (Hillier 1996) on individual preference and identity by investigating whether space works in the same ways for different types of users. A larger sample size would be an essential foundation for these questions. Exploring additional spatial conditions such as already occupied seats and spatial densities would be worthwhile too.

In summary, this paper has built on scholarly work bridging between space syntax and environmental psychology (Montello 2007, Franz and Wiener 2008; Peponis and Wineman 2002), but rather than exploring movement flows in the shape of cognition (Conroy Dalton 2005), wayfinding (Carlson et al 2010, Hölscher et al 2006 and 2012) and pathways (Dawes and Ostwald 2014), it investigated stationary activities and where people prefer to sojourn. Secondly, the work of Ostwald (2013) on the syntactic qualities and measurement of refuge-prospect balance has been extended by suggesting a new metric based on the ratio of 180° isovist area and connectivity, which seems to capture both psychological needs of refuge and prospect at the same time.

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