Spatial Configuration and Social Life for People Experiencing Dementia

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ABSTRACT: In this paper, we will focus on the important, facilitating role architectural design plays in social interaction within long-term care facilities. Social interaction is considered an essential therapeutic intervention for people with Dementia of Alzheimer's Type (DAT). Here we apply space syntax as an objective measure of environmental characteristics and whose body of knowledge shows that the physical environment affects social interaction, in turns affecting individual well-being. Two key characteristics related to social interaction are proximity and visibility and yet studies involving these concepts in Long-term Care Facilities (LTCF) are almost absent. This research hypothesizes that proximity and environmental visibility in social spaces—dining rooms and living rooms—found within LTCF-DATs may affect social interactions among residents.

Almost 150 rounds of behavioral observations utilizing a field observation protocol including a behavior-mapping technique were collected in the social spaces of three local LTCFs with different spatial configurations. By using the visibility and proximity metrics of space syntax, the locations of occurrence of various social activities in relation to the furniture layout on architectural floor plans has been identified. The observed data of the dementia residents that particularly related to the social activity, visibility and proximity metrics of space syntax were then analyzed.

The results of this study show that the residents of the facilities were engaged in very low to low level of social interactions in locations with better visibility and accessibility. However, for very high-level of social interactions, they preferred locations with less visibility and accessibility. This is an important, nuanced finding as it suggests that architectural configuration factors impact the type of conversations likely to occur in certain locations. A more enriched and differentiated spatial layout of social spaces in care facilities could generate positive consequences for social interactions, positive affect and overall well-being.

KEYWORDS: long-term care, social interaction, space syntax, elderly

INTRODUCTION

The relationship between the physical environment and the prevalence of social interaction has been a core topic of inquiry within environmental gerontology (Cioffi et al. 2007; Davis et al. 2009; Kang 2012; Kovach et al. 1997; Lawton et al. 1984; Lawton & Simon 1968), where, social interaction is considered an essential therapeutic intervention for people experiencing dementia of the Alzheimer's type (DAT). Lawton (1980: 14) suggested quite eloquently "a small improvement in environmental quality could make all the difference in the world to a person with major limitations on his competence." A growing body of literature shows that the physical environment affects social interaction, in turn affecting individual, group, organizational outcomes and even quality of life (Burton 2012; Calkins 2009; Ulrich et al. 2008). Although for the past fifty years it has been accepted that the physical setting plays a salient role in the quality of life for persons with dementia, we have not found any literature that objectively and quantitatively measured such environmental settings.

Space syntax is an analytical tool that can objectively measure the spatial layout of physical settings. According to space syntax literature, spatial layout generated by spatial configuration plays an important role in the communication patterns, space use and movement (Penn et al. 1997). Spatial interconnectedness is another factor affecting observed levels of interaction (Grajewski 1992) that can be measured by visibility, accessibility, openness and connectivity. Therefore, the aim of this paper is to understand the impact of spatial configuration on social life for people experiencing dementia and as an analytical technique we used space syntax. In order to accomplish the research aim, our hypotheses are that spatial configurations characterized as having greater visibility and proximity should promote greater occurrence of low-level social interaction, but that high-level social interaction, often viewed as the most therapeutic, will most likely occur in locations with less visibility. This paper seeks to explore these hypotheses in relation to dining rooms and

living rooms within long-term care facilities for people experiencing dementia of the Alzheimer Type (LTCF-DAT). However a comprehensive model to understand the relationship between social interaction and spatial configurations is still missing in the research literature and therefore we begin with such a model.

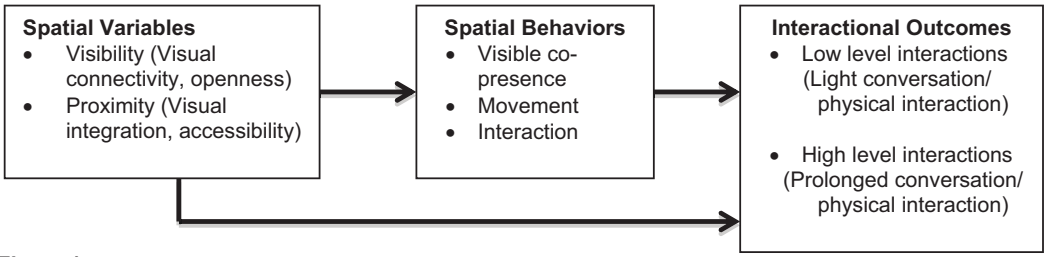

Figure 1: Spatial behaviour-interaction model.

The spatial behavior-interaction model (Figure 1) can describe the relationships among spatial configuration, spatial behavior and social life for people within a setting. Visibility and proximity are two spatial variables that can influence spatial configuration. In this model 'visibility' represents visual connectivity or openness and 'proximity' represents visual integration or accessibility. Here visual integration and visual connectivity are analogue of axial integration and connectivity. Among spatial behaviors, visible co-presence (defined as the number of people visible from a path of observation), movement (defined as the number of people moving along a path of observation) and interaction (defined as the number of people engaged in any reciprocal exchanges in a space) are different variables that can influence the interactional outcome.

In this model it is assumed that spatial variables may have direct or indirect effects on social interaction. For example, an easily accessible and visible social area in LTCF may have direct positive effects on social interaction that could facilitate low level or high level interactions; a highly connected layout of LTCF may have indirect positive effects on social interaction by facilitating movement or by increasing visible copresence and so on. The model also shows that the relationship between space and social interaction are important because any increase in interactions may be influenced by the spatial configuration or behavior.

1.0 METHODOLOGY

This study used a three stage, multi-method research design including behavior-mapping and spatial analysis. In the first stage, to investigate the relationship between social interaction and the environmental variables of proximity and visibility in dining rooms and living rooms in LTCF-DATs, fieldwork was conducted by using behavior-mapping technique. The protocol of behavior mapping technique was suggested by the Bradford Dementia Group (1997), which provides detailed operationalized observational ratings of the activities that residents are engaged in, recorded every 5 minutes over a period of 6 hours. This particular behavior mapping instrument focuses on social interaction and has been utilized in numerous previous studies (Diaz Moore & Verhoef 1999; Van Haitsma et al. 2005).

In the second stage, the visibility and accessibility of all three LTCF layouts were analyzed using the techniques of the visibility graph analysis (VGA) of space syntax. The `Depthmap' software was used for this purpose. Space syntax is a set of descriptive techniques for representing, quantifying and modeling spatial configuration in buildings and settlements. To assess proximity and visibility to and from dining rooms and living rooms in LTCF-DATs, this study used the tools and techniques of space syntax, which researchers around the world employ to study and measure quantitatively the consistent effects of the configuration of space on behaviors at various scales of the physical environment (Hillier 1996; Hillier & Hanson 1984; Peponis & Wineman 2002). The innovation and advantage of space syntax over other analytical method is that, it could objectively suggest design recommendations based on existing architectural design layout that would help to improve the physical environment of LTCF and also the quality of life of people with DATs. Space syntax has several numerical measures for describing the configurational attributes of a spatial layout. One of the most commonly used spatial units in space syntax is the axial map, which is a measure of physical proximity. An axial map of a layout is comprised of the fewest number of axial lines needed to go to every space in a layout.

Among a number of spatial measures, the most important is 'integration', which is the relative depth or hollowness of any spatial system seen from any particular point within it. The integration value of axial lines is one metric of proximity and has proven a particularly good predictor of movement. Integration is therefore about syntactic not about metric accessibility (Hillier & Hanson 1984). Integration is an indicator of how

easily one can reach a specific line of the axial map. More specifically the higher the integration value of a line, the lower the number of axial lines needed to reach that line (Baran et al. 2008). In several studies of buildings and cities, integration is often correlated significantly with movement patterns at the level of 0.7 or above.

Space syntax studies also measure visibility as a correlate of spatial behaviors. Visibility can be measured using either visual field analysis or Visibility Graph Analysis (VGA) (Rashid et al. 2006; Turner et al. 2001). Visual field analysis provides the relational patterns of the visual fields drawn from all the spatial units of a setting (Haq & Luo 2012; Rashid et al. 2006; Rashid et al. 2009). In contrast, VGA involves the creation of a graph of mutually visible locations in a spatial system. Consequently, a location in a spatial system is characterized based on how visually connected the location is both locally and globally (Holscher & Brosamle 2012; Turner et al. 2001). These spatial characteristics of a setting are important to understand spatial behaviors in general and social interaction in particular. Increased proximity and visibility are associated with higher levels of interaction within a space (Cai & Zimring 2012; Rashid et al. 2009). It has also been demonstrated that more frequent face-to-face interactions between individuals may occur when they are visually or physically proximate (Rashid et al. 2006). The utilization of space syntax within environment gerontology enabled us to draw upon well-validated and operationalized measures of proximity and visibility and apply them to concepts that have otherwise eluded measure and description.

In the last stage of the study, we analyzed the relationships between the spatial and observational/behavioral data using statistical techniques. We performed descriptive and correlational analysis in order to find out where these behaviors occurred in relation to visibility and proximity.

1.1 Data collection and analysis

The spatial data using space syntax was gathered by computer analysis of digitally formatted architectural plans of LTCF-DATs, and they included different global, relational and local measures of proximity and visibility. The observational data of activities occurring in dining and living rooms was recorded with a well-utilized behavior mapping instrument/technique by research team observers who participated in training to enhance inter-rater reliability (Van Haitsma et al. 2005).

Observations occurred over 2 days in each facility for a total of twelve hours of observations per facility (Chenoweth et al. 2009). The social interaction data resulting from the behavior mapping was then aggregated to the facility level of analysis in terms of both amount and level of social interaction. This data was associated with the spatial metrics of the respective dining and living rooms provided by space syntax. Plans were analyzed using space syntax techniques for their configurational properties of proximity and visibility.

For simplicity of data analysis with this relatively small sample, social interaction data was aggregated for each designated space. In order to examine the relationship between proximity and visibility of each space with the social interaction data, Pearson correlations was calculated for both types of spaces (dining room and living room). This resulted in 2 Pearson correlation coefficients for each type of space, a value representing the relationship between social interactions and proximity and a second value representing the relationship between social interactions and visibility.

1.2 Case Studies

This research included three long-term care facilities in Lawrence, Kansas as case study to establish the hypothesis, one of which (Neuvant House) was designed recently. Although previous literature identified the effects of proximity and environmental visibility in several workplace studies using space syntax theories and techniques (Rashid et al. 2006; Rashid et al. 2009), studies involving proximity and visibility in LTCF-DATs are almost absent. Therefore, a pilot study was conducted at three local long-term care facilities with different spatial configurations and floor layouts to develop and validate the techniques of behavioral observations discussed in the methodological section, and to see if the results of data analysis would support our hypothesis.

Our first case study, Neuvant House (Figure 2), has a small rectangular plan with an internal courtyard around which residential units and social spaces are organized. The social space of Neuvant House is formed with an open plan kitchen, dining area, family living and activity space. The second case study, Windsor of Lawrence (Figure 3), is a mid-sized facility with an internal courtyard, but here the residential units and activity spaces are organized around a circular circulation spine. Besides the main activity space, the dining room and courtyard also act as an activity space for the residents. Our third case study, Pioneer Ridge (Figure 4), is a large amalgamation of neighborhoods of up to 26 residents each, organized around a central core which has a large dining space through which access may be gained to a centralized courtyard.

Due to the limited accessibility this courtyard is not used by the residents and caregivers. Although there is designated activity space for the residents, most of the time the large dining area served as a primary social area and activity space for this facility.

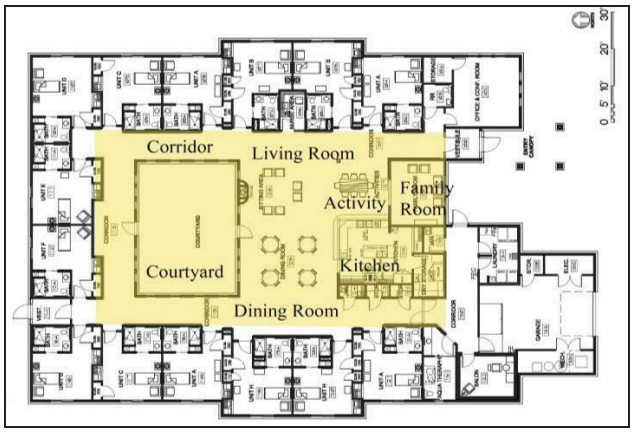

Figure 2: Floor plan and layout of social space in Neuvant House

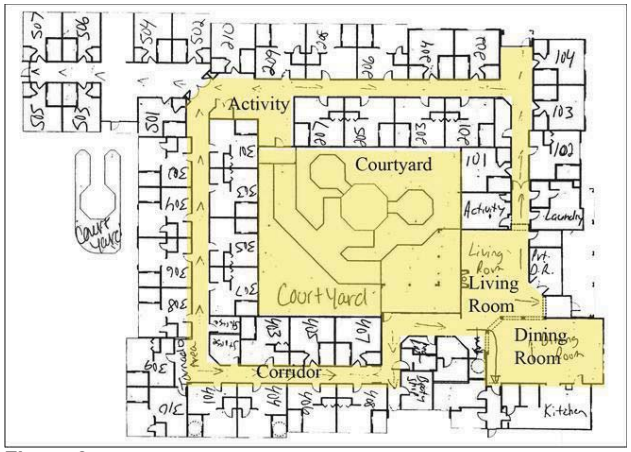

Figure 3: Floor plan and layout of social space in Windsor of Lawrence

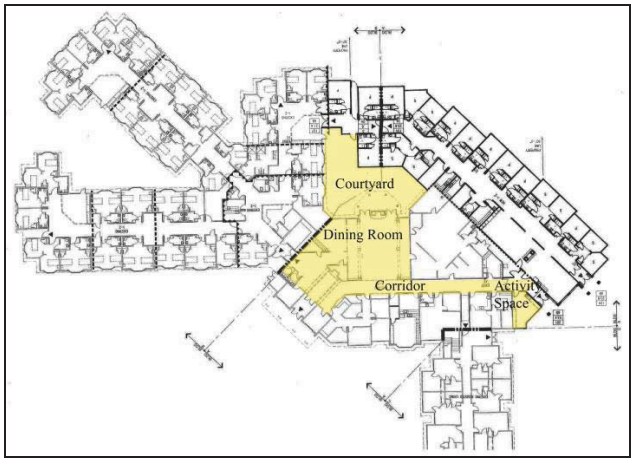

Figure 4: Floor plan and layout of social space in Pioneer Ridge

2.0 RESULTS

2.1 Descriptive Analyses of the Observation Data

The behavior-mapping instrument allows for recording observed social interactions at four levels of intensity: no contact, incidental social contact, low-level interaction and high-level interaction. Only light level conversations with minimal physical interactions were noted as low-level interaction. On the other hand, prolonged conversations or those involving physical touching, were identified as high-level social interaction. The majority of observed interactions in three LTCFs occur in dining room and family spaces.

For Neuvant House, the corridor also acts as an important interaction space. The open plan kitchen, dining room and family living area are mostly used as social space for this LTCF. On the other hand for Windsor of Lawrence, dining room, living room and courtyard are heavily used by the residents for social interactions. For Pioneer Ridge, the mostly used social space is the dining room, which is also used as an activity space. Table 1, represents the visibility and accessibility data of three LTCFs from space syntax analysis. According to the analyses, these three LTCFs were laid out to increase social interactions and from previous literature we know that more frequent interactions between individuals may occur when they are visually and physically proximate (Rashid et al. 2006). Therefore from the following tables, Neuvant House has the most connected (2428.66) and visually integrated (10.174) social space and Pioneer Ridge has the least connected (628) and visually integrated (6.983) social space for social interactions.

Table 1: Mean spatial data of three LTCFs from Space Syntax Analysis

	Neuvant House	Windsor of Lawrence	Pioneer Ridge
Mean Connectivity	2428.66 (89-5788)	2063 (101-5952)	628 (4-1653)
Mean Visual Integration	10.174 (3.479-19.564)	8.363 (3.038-15.209)	6.983 (2.597-12.389)
Visual Mean Depth	2.215 (1.548-4.085)	2.507 (1.749-4.752)	2.476 (1.772-4.682)
Visual Node Count	10216	16241	4537

2.2 Visibility Graph Analyses of three LTCF Layouts

Visibility Graph Analysis (VGA) measures visibility of any spatial system both locally and globally and involves the creation of a graph of mutually visible locations. After collecting the observation data of each resident in relation to the individual piece of furniture through behavior-mapping instrument, the visibility (isovist areas) and proximity (integration) metrics of space syntax were then applied to the location of each individual piece of furniture. Most of the time social activities were taking place near the furniture or while the residents were using the furniture. We then performed descriptive and correlational analysis in order to find out where these behaviors occurred in relation to visibility and proximity.

In general, a LTCF requiring more interactions would have its social spaces more easily accessible. We used the mean connectivity and visual integration value of three different LTCFs to determine the accessibility of these spaces. According to space syntax study, in general, public spaces are located along more integrated lines, whereas private spaces are located along less integrated lines. This makes sense because visibility graph of a layout with lower integration values are physically and visually less accessible. From Table 1, we could see that mean connectivity (2428.66) and visual integration (10.174) of Neuvant House is comparatively higher than Windsor of Lawrence and Pioneer Ridge. Therefore, according to our hypothesis, the large integrated social space of Neuvant house with better visibility and proximity is considered to promote low-level of social interactions. On the other hand, the lower mean connectivity and visual integration of Pioneer Ridge with less visibility and proximity is considered to promote high-level of social interactions.

3.0 FINDINGS

The findings of the descriptive and visibility graph analysis show that the residents were engaged in low-level social interactions in locations with better proximity and visibility (Figures 5&6). However, for very high-level social interactions, they preferred locations with less visibility and proximity (Figures 7&8). The

correlational analysis, which show significant negative correlations between high-level interactions and proximity (integration) and visibility (isovist area), further supports this observation (e.g., Pearson correlation of -.565 ($p<.01$) and -.538 ($p<.01$) respectively). These findings also support the previous literature (Rashid et al. 2006; Rashid et al. 2009) indicating that for high-level interactions in workplaces people tend to avoid more visible and accessible locations. From the findings of this study, it is evident that to promote high-level social interaction between residents and care givers, less visibility and proximity is considered as preferred spatial configurations for LTCFs.

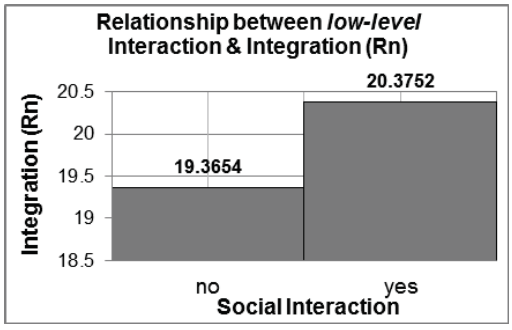

Figure 5: Mean integration values of locations where very low-level social interactions occurred vs. where they did not occur.

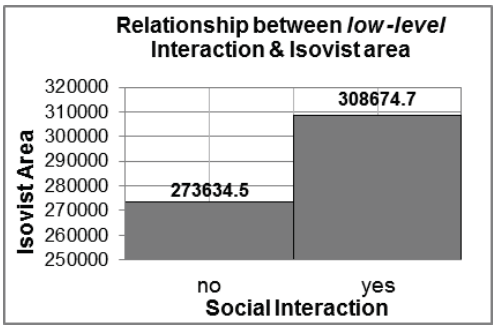

Figure 6: Mean isovist areas of locations where very low-level social interactions occurred vs. where they did not occur.

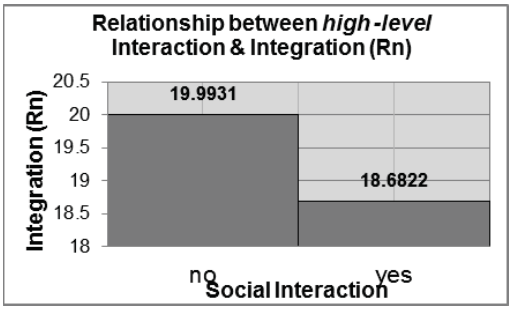

Figure 7: The mean integration value of locations where high-level social interactions occurred vs. the mean integration value of locations where they did not occur.

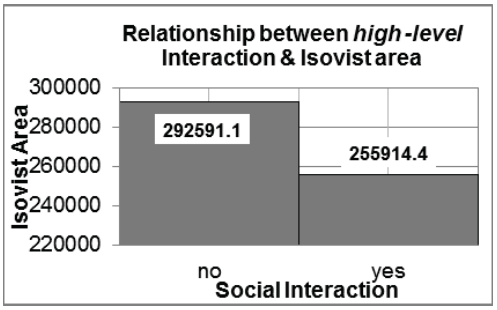

Figure 8: The mean isovist area of locations where high-level social interactions occurred vs. the mean isovist area of locations where they did not occur.

DISCUSSION

In this paper we have reported a study in which we used space-syntax theories and methods to address questions of how patterns of spatial layout affect movement, visible copresence, and interactions. Space syntax is interesting because it allows us to describe the generic properties of three different spatial layouts in a rigorous way. Although it was difficult to perform a comparative study of widely different LTCFs, space syntax eliminates the problem, because its methods of description using visibility graph can be used to study any physical setting without ambiguity.

It is also necessary to note here that there is a significant lack of studies involving movement, visible copresence, social interaction, and layout attributes. Until now, there has been no consistent technique for observing these behaviors. As a result, researchers have been unable to investigate the relationships among these behaviors and layout attributes in different settings, especially in LTCFs. In this regard, we have presented a methodological innovation. We showed how these behaviors can be consistently and simultaneously observed by using behavioral observations.

Social interaction is repeatedly considered as an essential therapeutic intervention for people experiencing dementia of the Alzheimer's type (DAT) to improve their quality of life. We believe that these findings will have a measurable impact on the future design of long-term care settings. According to the findings, people were engaged in fewer interactions in spaces, and were less visible from spaces with higher visibility, integration and connectivity values. Residents avoided interacting with others and being seen with others from such spaces, which are more visible and accessible. From the previous literature, proximity and

visibility are considered as a significant design criteria that could objectively define the shape and design of care communities in the future. Therefore, a finer grained and systematic analysis of visibility and proximity metrics of space syntax is intrinsically important for future robust analysis in LTCFs, to encourage and expedite social interaction in individuals with dementia.

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