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Field Observations into the Environmental Soul: Spatial Configuration and Social Life for People Experiencing Dementia

Farhana Ferdous, PhD[1], and Keith Diaz Moore, PhD[1]

Abstract

This article focuses on the important, facilitating role architectural design plays in social interaction within long-term care facilities (LTCFs) serving people with dementia. Here, we apply space syntax, a set of theories and techniques for the analysis of spatial configurations, as an objective measure of environmental characteristics. Almost 150 rounds of behavioral observations were collected in the social spaces of 3 LTCFs. Using the visibility and proximity metrics of space syntax, the locations of occurrence of various social activities in relation to the furniture and spatial layout on architectural floor plans have been identified. The results did not confirm the space syntax hypothesis that spaces with greater visibility and proximity promote more social interaction. Further analysis revealed that when in settings with better visibility and accessibility, the residents were more likely to engage in low levels of interaction. High-level social interactions actually were more likely to occur in settings providing greater privacy (eg, less visibility and accessibility). The findings suggest an important nuance that architectural configuration factors impact not only the likelihood but also the type of conversations likely to occur in certain locations. This would have implications for both design and staff training on how best to utilize social spaces for therapeutic effect, particularly within the context of person-centered care.

Keywords

long-term care facility, social interaction, space syntax, elderly, architectural design

Introduction

Time and memory are 2 aspects of the human condition upon which architectural design is largely predicated. When designing for people experiencing dementia, these assumptions are challenged. For instance, today the emphasis on tradition and familiar styles in American long-term care facilities (LTCFs) may well have more to do with the desires of family members than the significant psychosocial needs of the resident, which appear to be as well met in contemporary architectural settings as found in Scandinavia, for example. We argue that such designs ought to be considered from a social justice perspective and with a desire to give voice to marginalized populations. As the rules are challenged, such design cannot be based upon expert intuition but rather requires intimate knowledge and experience of life within place. In this context, space is recognized as a place of social interaction and organizational resource. Therefore, senior care design needs to be designed in order to facilitate social interaction in the public and semi-public territories.

The relationship between the physical environment and the prevalence of social interaction has been a core topic of inquiry within environmental gerontology,[1-6] where social interaction is considered an essential therapeutic intervention for people experiencing dementia of the Alzheimer's type (DAT). Lawton 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"[(p.14). 7] 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.[8-10]

Over the last 2 decades, there has been a growing body of literature[11-14] providing evidence on the effect of unsupportive physical environments that contribute to common challenging behaviors in people with dementia, for example, spatial disorientation, anxiety or agitation, social isolation, and so forth. On the other hand, a well-designed supportive physical environment both in home and in LTCFs may reduce such challenging behaviors by fostering positive attitude, such as lower agitation, increase in social contact, more independence in conducting activities of daily living, and so forth.[15]

[1] School of Architecture, Design and Planning, The University of Kansas, Lawrence, KS, USA

Corresponding Author:
Farhana Ferdous, PhD, School of Architecture, Design and Planning, University of Kansas, Lawrence, KS 66045, USA.
Email: ferdousf@ku.edu

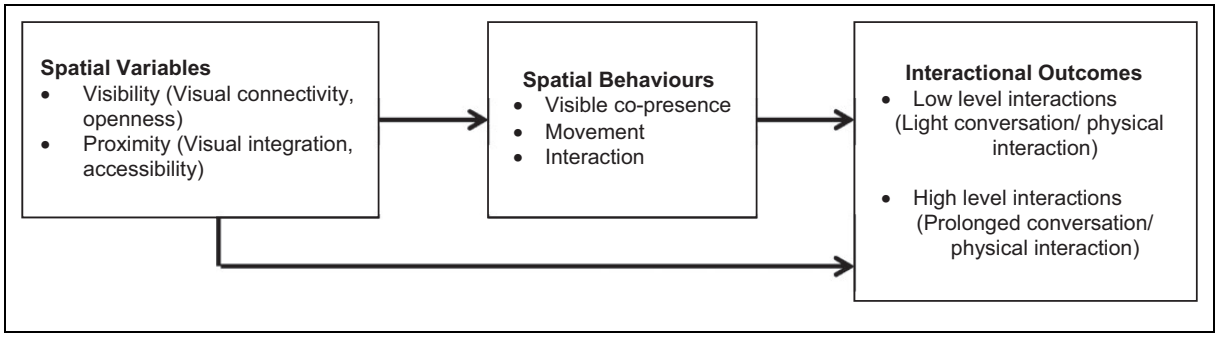

Figure 1. Spatial behavior interaction model.

According to Chaudhury et al,[16] most frequent concerns of nursing home staffs are the inappropriate physical environment of the social spaces, especially dining room, as these are often loud and overstimulating places. The physical environment such as signage, furniture layout, lighting, color, and more specifically the architectural design, floor plan, and straight layout of the circulation system of nursing home has a significant influence on residents' spatial orientation as well as in supporting the way finding abilities of people with dementia.[12,18] Increased visibility, proximity, accessibility, openness, and connectivity can lead to meaningful interactions in workplace environments,[17,19,20] and similar hypotheses apply to LTCF design, such as found in Regnier's "100 percent corner."[21] Although for the past 50 years it has been accepted that the physical setting plays a salient role in the quality of life for persons with dementia, a shortcoming remains the objective and quantitative measure of such environmental settings. The aim of this article is to explore the objective and quantitative measure of environmental characteristics hypothesized to impact social interaction in 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.[22] Spatial interconnectedness is another factor affecting observed levels of interaction[23] that can be measured by visibility, accessibility, openness, and connectivity. Therefore, the aim of this article is to understand the impact of spatial configuration on social life for people experiencing dementia in LTCFs utilizing space syntax. In order to accomplish the research aim, we assert the hypothesis found in space syntax that spatial configurations characterized as having greater visibility and proximity should promote greater occurrence of social interaction. In a convenience sample, this article explores this hypothesis in relation to dining rooms and living rooms of 3 LTCFs in Middle America Town for people experiencing DAT (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.

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 2 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 copresence (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 and thereby copresence, a necessary precondition for social interaction. The model also shows that the relationship between space and social interaction is important because any increase in interactions may be influenced by the spatial configuration or behavior.

Methodology

This study used a 3-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 using behavior-mapping technique. The protocol of behavior-mapping technique was suggested by the Bradford Dementia Group,[24] 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.[25,26]

In the second stage, the visibility and accessibility of all 3 LTCF layouts were analyzed using the techniques of the visibility graph analysis (VGA) of space syntax. The "DepthMap" software developed by University College London (UCL) 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 employed to study and measure quantitatively the consistent effects of the configuration of space on behaviors at various scales of the physical environment.[27-29] The innovation and advantage of space syntax over other analytical methods is that it could objectively suggest design recommendations based on existing architectural design layouts 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.[28] 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.[30] 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 VGA.[14,31] Visual field analysis provides the relational patterns of the visual fields drawn from all the spatial units of a setting.[14,17,32] 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.[31,33] 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.[17,34] It has also been demonstrated that more frequent face-to-face interactions between individuals may occur when they are visually or physically proximate.[14] The utilization of space syntax enables the study 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 the 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.

Case Studies

This research included 3 LTCFs in Middle America Town as case study to establish the hypothesis, one of which (Facility A) was designed recently. Although previous literature identified the effects of proximity and environmental visibility in several workplace studies using space syntax theories and techniques,[14,17] studies involving proximity and visibility in LTCF-DATs are almost absent. Therefore, a pilot study was conducted at 3 local LTCFs with different spatial configurations and floor layouts to develop and validate the techniques of behavioral observations discussed in the methodological section and to see whether the results of data analysis would support our hypothesis.

Our first case study, Facility A (Figure 2), has a small rectangular plan with an internal courtyard around which residential units and social spaces are organized. The social space of Facility A is formed with an open plan kitchen, dining area, family living, and activity space. The second case study, Facility B (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, Facility C (Figure 4), is a large amalgamation of neighborhoods of up to 26 residents each, organized around a central core that has a large dining space through which access may be gained to a centralized courtyard. Due to the limited accessibility, the residents and caregivers do not use this courtyard. 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.

Data Collection and Analysis

The spatial data using space syntax were 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 data collection session was in January to February 2013. The observational data of activities occurring in dining and living rooms were recorded with a well-utilized behavior-mapping instrument/technique by research team observers who participated in training to enhance interrater reliability.[26]

Observations occurred over 2 days in each facility for a total of 12 hours of observations per facility.[35] The social interaction data resulting from the behavior mapping were then aggregated to the facility level of analysis in terms of both amount and level of social interaction. These data were 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 were aggregated for each designated space. In order to examine the relationship between proximity and visibility of each space with the social interaction data, Pearson's correlations was calculated for types of spaces (eg, dining room, activity room, family room, living room). This resulted in 2 Pearson's correlation coefficients for each

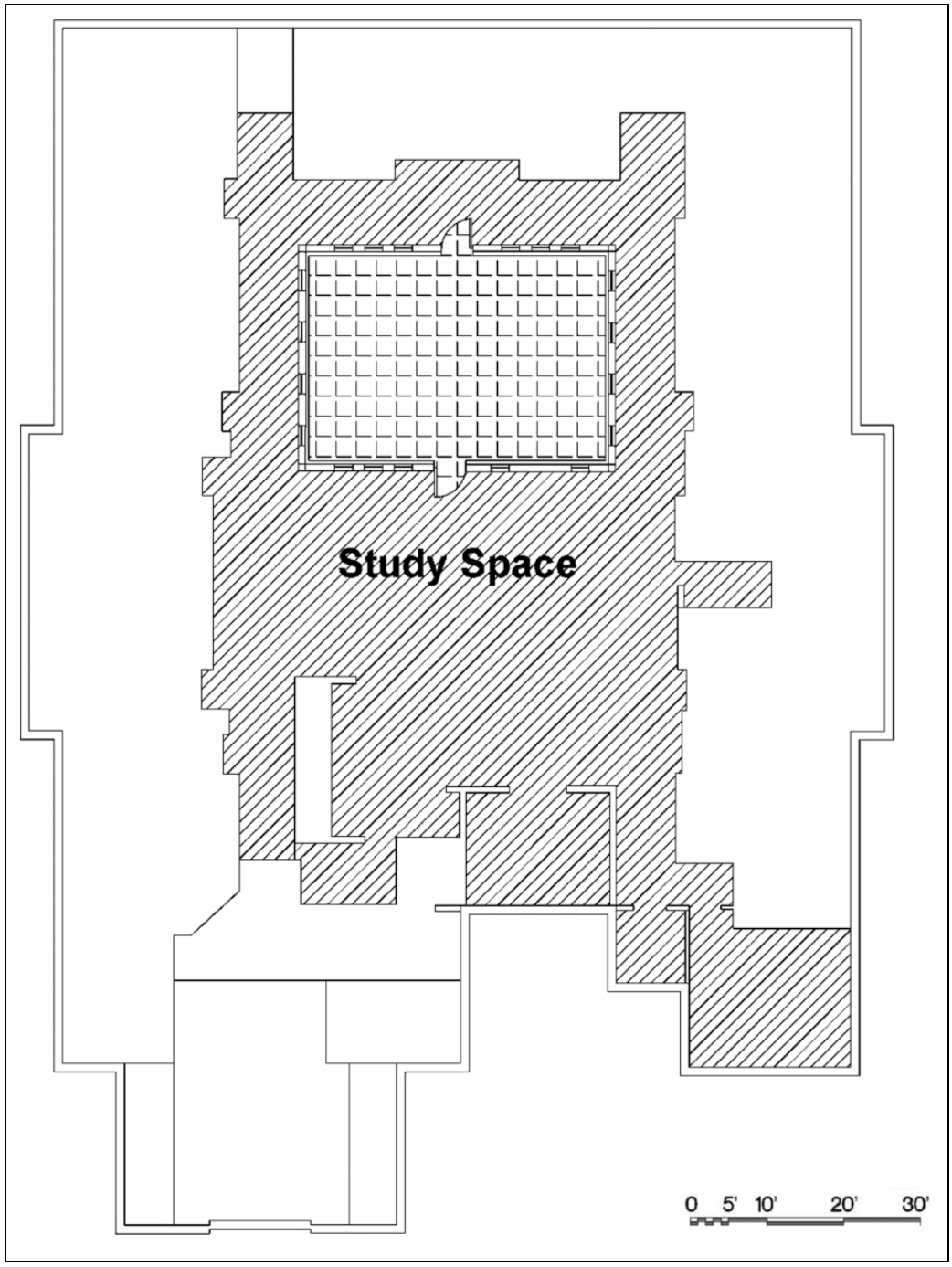

Figure 2. Floor plan and layout of social space at Facility A.

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.

Results

Visibility Graph Analyses of 3 LTCF Layouts

Visibility graph analysis 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 (Figures 5-7). 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.

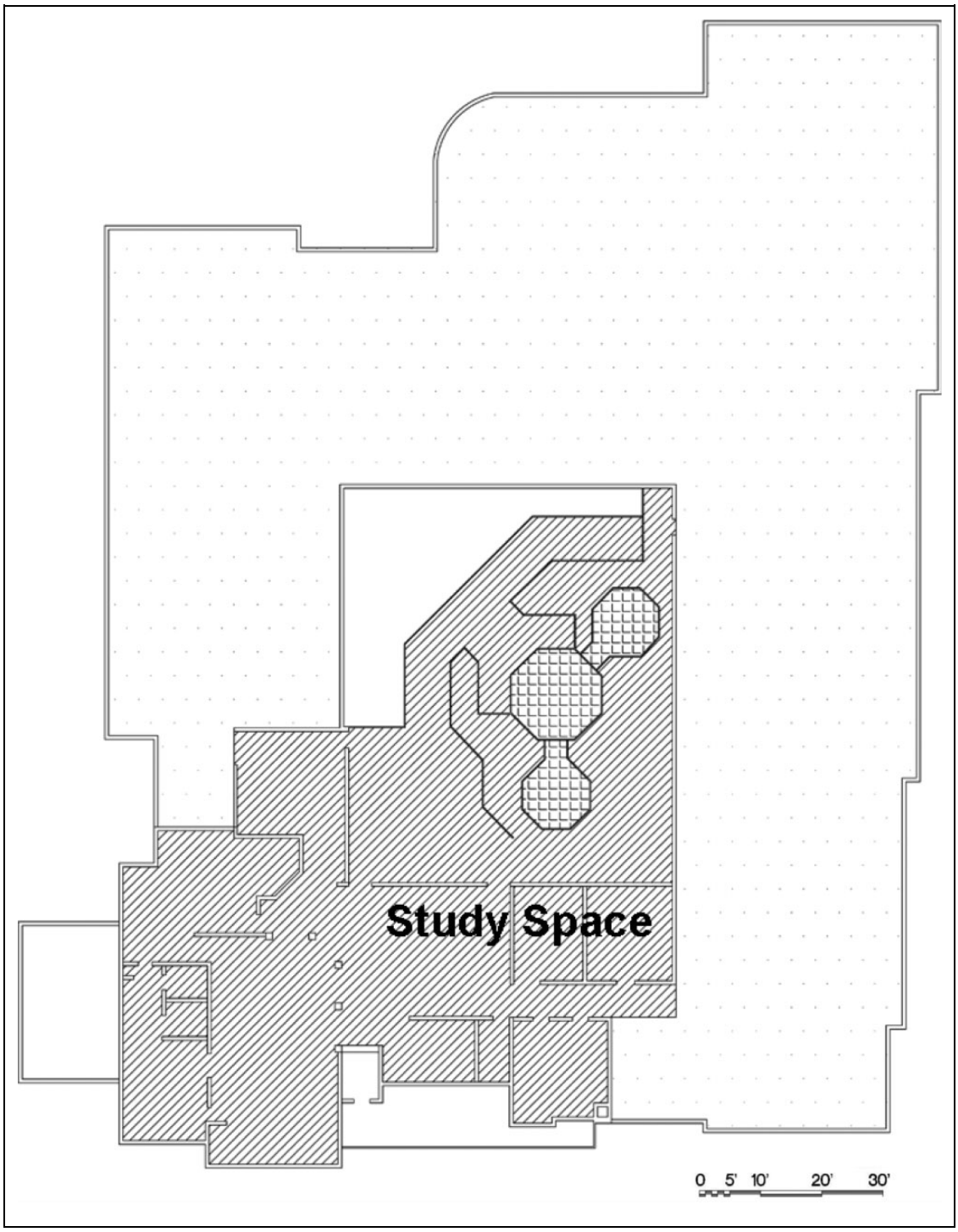

Figure 3. Floor plan and layout of social space at Facility B.

The literature suggests that LTCF seeking greater social interactions would have its social spaces more easily accessible.[14,17] We used the mean connectivity and integration value of 3 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 see that connectivity (2428.66) and integration (10.174) of Facility A are comparatively higher than Facility B and particularly in comparison to Facility C (628 and 6.983, respectively). Therefore, according to our hypothesis, the large integrated social space of Facility A, with better visibility and proximity, should promote low level of social interactions.

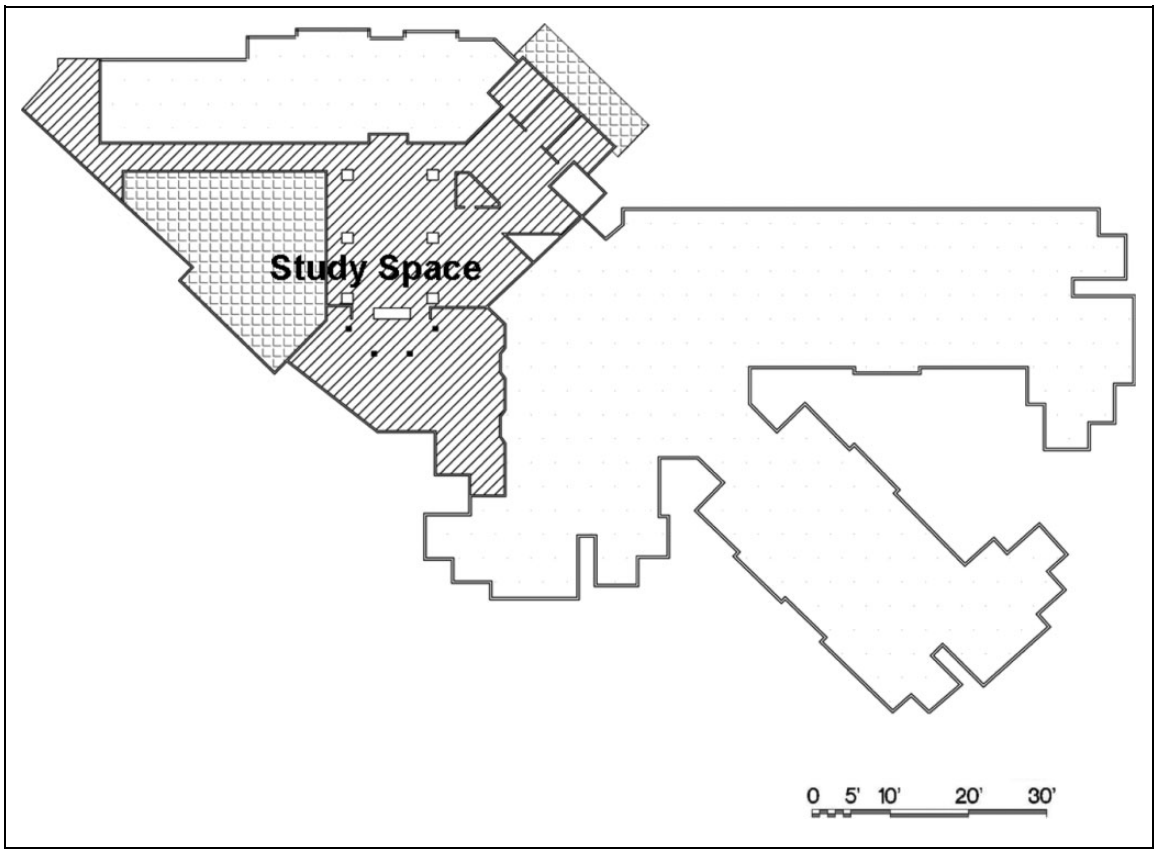

Figure 4. Floor plan and layout of social space at Facility C.

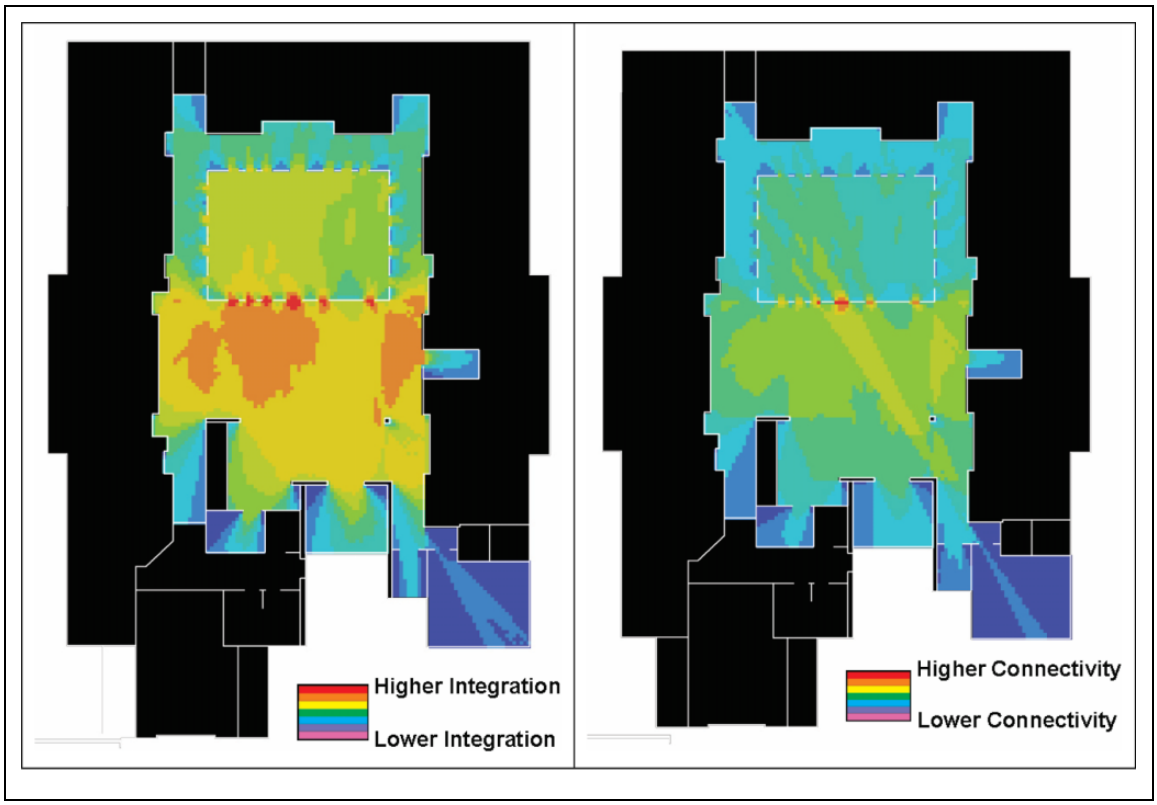

Figure 5. Visual integration and visual connectivity map of Facility A.

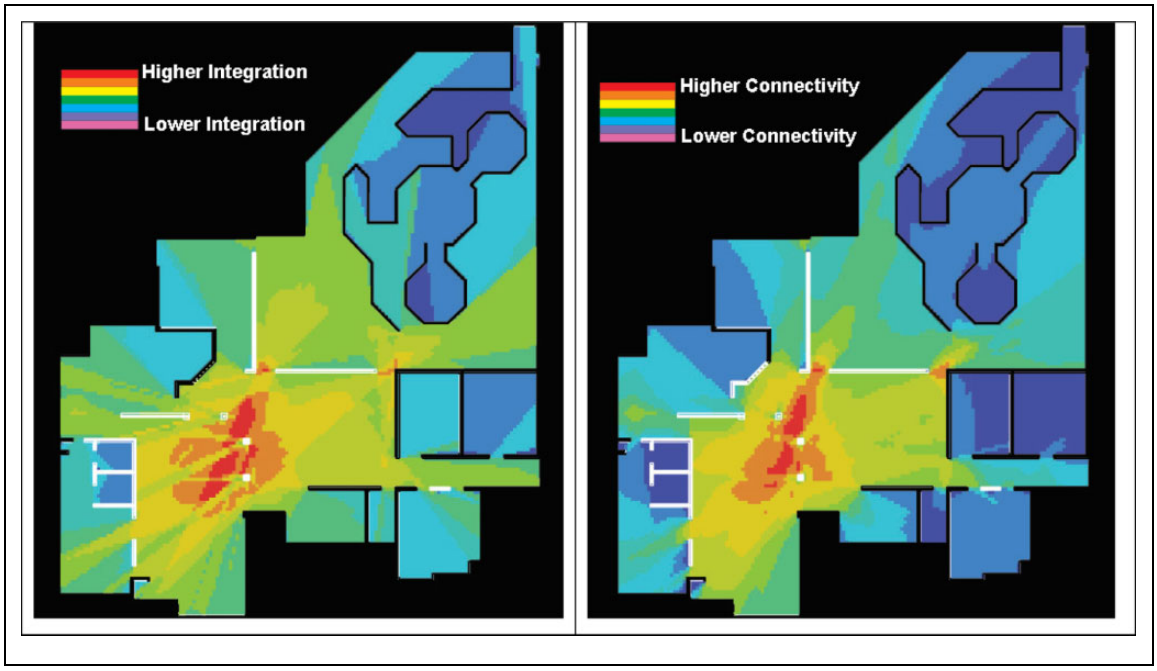

Figure 6. Visual integration and visual connectivity map of Facility B.

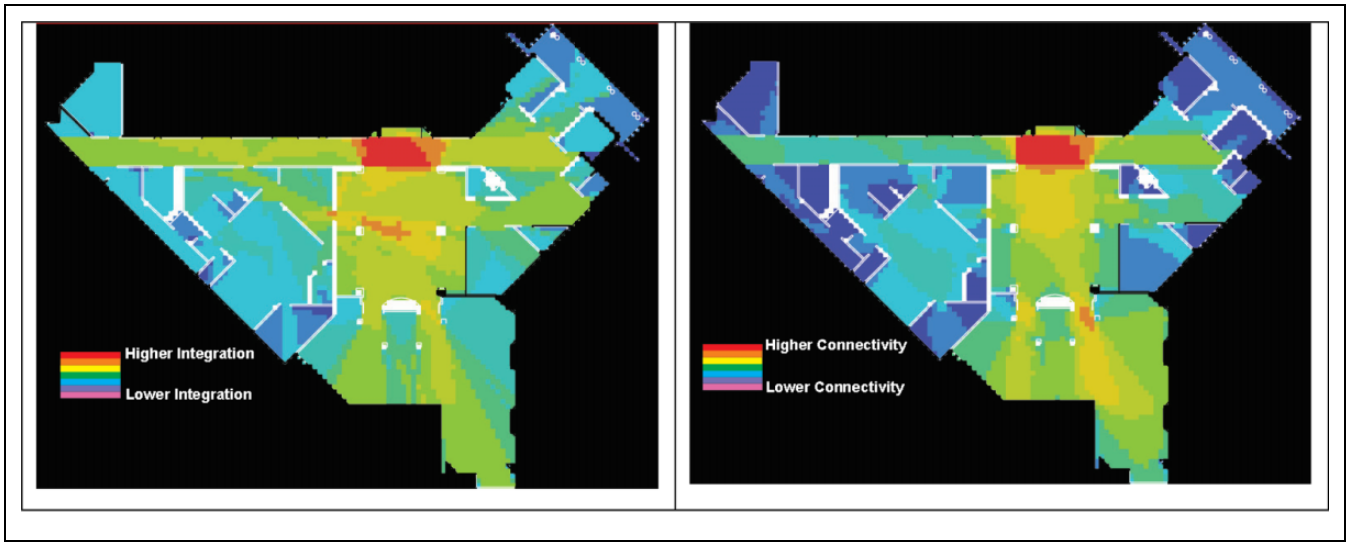

Figure 7. Visual integration and visual connectivity map of Facility C.

Analyses of the Observation Data

Human presence is also impacted by function such as the programming of the space. Therefore, Table 2 presents observed social interaction data linking with different types of social spaces that cut across the 3 facilities. The physical environment is described in terms of the integration value and isovist area, or proximity and visibility, respectively. Space syntax theory would suggest that those spaces with higher integration and isovist values would have greater occurrence of social interaction. These data suggest that in this sample, the dining areas, which had the highest syntactical values, actually had the lowest percentage of observed social interaction compared to the other types of social spaces.

Although the data reject the space syntax hypothesis of visibility and proximity being associated with greater likelihood of social interaction, the behavior-mapping instrument allowed for recording observed social interactions at 4 levels of intensity: no contact, incidental social contact, low-level interaction, and high-level interaction. Only light-level conversations (2 or less exchanges) were noted as low-level interaction. On the other hand, prolonged conversations or those

Table 1. Mean Spatial Data of 3 LTCFs From Space Syntax Analysis.

	Facility A	Facility B	Facility C
Mean connectivity (min-max)	2428.66 (89-5788)	2063 (101-5952)	628 (4-1653)
Mean integration (min-max)	10.174 (3.479-19.564)	8.363 (3.038-15.209)	6.983 (2.597-12.389)
Visual mean depth (min-max)	2.215 (1.548-4.085)	2.507 (1.749-4.752)	2.476 (1.772-4.682)
Visual node count	10216	16241	4537

Abbreviations: LTCF, long-term care facilities; max, maximum; min, minimum.

Table 2. Relationship Between Spatial Configuration of Different Social Spaces and Social Interaction.

Social Spaces	Integration, Rn	Isovist Area	Percentage of Total Observations Documenting Social Interaction	Low-Level Social Interaction (% of Observations)	High-Level Social Interaction (% of Observations)
Dining room	4530.68	67 521 734	41.94	27.19	14.75
Activity room	991.48	13 830 534	80.00	10.00	70.00
Family room	773.9	10 049 625	73.79	8.62	65.17
Living room	346.6	4 081 349	73.5	6.25	67.25

Table 3. Relationship Between Social Interaction, Integration and Isovist Area.

	Low-Level Social Interaction		High-Level Social Interaction	
	Yes	No	Yes	No
Integration, Rn	20.3752	19.3654	18.6822	19.9931
Isovist area	30 8674.7	27 3634.5	25 5914.4	29 2591.1

involving physical touching were identified as high-level social interaction. This allowed us to engage in a secondary analysis wherein we asked ''Is spatial visibility and accessibility associated with differences in level of interaction that takes place?''

The findings of the descriptive and visibility graph analysis in relation to level of social interaction as depicted in Tables 2 and 3 show that the residents were engaged in low-level social interactions in locations with better proximity and visibility (higher integration and isovist area). However, for very high-level social interactions (those that have a greater number of dyadic segments or exchanges), they preferred locations with less visibility and proximity (lower integration and isovist area). The correlational analysis, which show significant negative correlations between high-level interactions and proximity (integration) and visibility (isovist area), further supports this observation (eg, Pearson's correlation of $-.565$ ($P < .01$) and $-.538$ ($P < .01$), respectively). This is an interesting nuance to space syntax theory which suggests that greater visibility and accessibility lead to greater social interaction, but here we find these conditions may also constrain the potential for more engaged, higher level social interaction as is advocated within the person-centered care approach. From the findings of this study, there is preliminary evidence to suggest that to promote high-level social interaction between residents and caregivers, less visibility and proximity are considered as preferred spatial configurations for LTCFs. It may well be that copresence is more impacted by the activity programming than the spatial characteristics in LTCFs but that then within those spaces, the provision of some modicum of visual and access control may provide the opportunity for more prolonger, higher level resident–staff social interactions thought to be therapeutically beneficial.

Discussion

In this article, 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 3 different spatial layouts in a rigorous way. Although it is 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 in LTCFs. As a result, researchers have been encumbered in finding generalizable relationships among social behaviors and layout attributes in different settings, especially in LTCFs. In this regard, the current study presents what may be considered a methodological innovation in environmental gerontological research.

Social interaction is repeatedly considered an essential therapeutic intervention for people experiencing DAT to improve

their quality of life. We believe that this research will have a measurable impact on the future design of long-term care settings. According to the findings, people were engaged in more frequent but low-level social interactions in spaces with higher visibility and proximity values. High-level social interactions were more likely to occur in spaces that provided visual and access control. From the previous literature, proximity and visibility (or what may be simply viewed as openness) are considered as significant design criteria by which to design LTCF clusters or neighborhoods, one that this pilot data questions. But these findings suggest that within such open social areas, smaller defined social groups, such as the clustering of 2 to 3 chairs in an arrangement that provides some visual access control, seem to be more likely to generate higher level social interaction. 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.

Implications for Practice

Such nuance suggests the need for further care training to encourage the more effective use of the physical environment for what Scheidt and Norris-Baker felicitously refer to as "place therapy."[36] As the industry moves toward person-centered care, this research suggests that care providers need to be trained in best practices as to how to utilize the affordances provided by the physical setting. It matters not only how we interact with residents (eg, without elderspeak) but also where. It is wholly inappropriate to expect residents to engage in personal or intimate discussions in large social spaces and yet this is not that uncommon.[37] The social distances between people send nonverbal but culturally significant cues about the type of communication expected in the social interaction. Additionally, there are power relationships intrinsic to the physical situation, which may be nuanced, in an institutional setting such as LTCFs. Although the private room may be conceptually viewed as under the control of the resident, do staff indeed act in that manner or does the privacy actually enable greater imposition of an external locus of control? Similarly, within social spaces, would sub-areas allowing a modicum of privacy allow staff greater comfort to improvise more freely and to provide more personalized care? The physical environment is a significant sunk cost by care organizations, and the understanding of staff to optimally utilize what is provided is an all-too-often missing component of care training.

In terms of interior design, the implications of this study suggest the need to provide a balance between that which promotes copresence (greater visibility and accessibility) and that which promotes longer, deeper social interactions (greater privacy regulation). With the movement toward person-centered care, the desire to simply increase social interaction must now be addressed in a much more nuanced fashion, emphasizing differentiation and choice. Furniture arrangement is certainly critical as is the flexibility of that furniture. Are there screening elements that are movable (eg, shoji screens and rolling storage shelves) as well as fixed (eg, half walls, dropped ceilings, and counters)?

Conclusion

In terms of research, this early study scratches at the implications the physical environment has on promoting therapeutic social interaction. The nuanced finding that environmental characteristics may well impact the kind of social interactions that occur opens up a whole new area of inquiry. It may well be that elderspeak, for instance, is much more likely to occur within certain sociophysical milieu than in others. If the design of the physical setting may reduce the likelihood of such negative communications, then it becomes incumbent upon designers and care organizations to understand and rectify those preconditions. This study explored public spaces, but does the same nuance apply to private rooms? For instance, it may well be that residents, feeling a sense of external locus of control, may actually prefer to have private conversations in areas that provide some visual or at least auditory access to shared spaces. Thus, where a resident, or staff member, selects to have a conversation may tell us a great deal about each party's expectation toward that conversation.

This study highlights the power of place in the quality-of-life experience in LTCFs, particularly in terms of social interaction. It is clear that the physical setting plays a powerful role in shaping what is likely to occur where, and this has significant implications for care training in a highly differentiated approach such as person-centered care. Person-centered care only highlights the significance of Lawton's observation that "a small improvement in environmental quality could make all the difference in the world to a person with major limitations on his competence." Both architects and care professionals need to become much more intentional and fine grained in how the physical setting can become a therapeutic and professional resource for residents and staff, respectively, in this new world of person-centered care.

Declaration of Conflicting Interests

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