

ABSTRACT

KEPEZ, ORCUN. Effect of Space on Health and Well-Being: An Environmental Assessment for Home-like Long Term Care Settings. (Under the direction of Dr. John O. Tector.)

Small scale and home-like long term care environments were generally associated with increased activity and positive outcomes. This study aims to test the hypothesis that plan types with different spatial configurations lead to differences in the use of spaces and the social interaction between residents that may affect well-being. The context of the study is 12-bed adult care homes with cognitively intact residents. Nine cases from four different sites, which contained 80 residents in total, were selected to be studied.

Caregivers were asked to complete a survey for each resident to report about each resident's background, competence in activities and instrumental activities of daily living, participation in social events, mood, and use of the outdoors. The corresponding distances between each resident's bedroom and the common spaces and syntax variables (depth, local, and global integration) were also considered. Behavior maps (n=308) were collected during observations in order to have three days of observation from each studied case. The use of spaces and conversations between residents were noted as an indicator of the residents' activeness and social interaction.

The hypothesis that there were at least two plan types with significantly different outcomes (survey outcomes, use, and social interaction) was accepted at $p < 0.05$ level. Shorter walking distances were found to be an indicator of an increase in the number of conversation groups formed only by residents. The numbers of spaces that residents needed to walk through to reach any of the common areas were also found to be a factor for social interaction. The distance was not found to be a factor for use in the studied context. The isolation of

bedrooms from the surrounding spaces was found to be necessary to provide privacy for residents. The results were independent from the bedroom sharing status of residents, which was shown to be a factor of use at larger scales. Depression levels of residents were found to be independent from the considered spatial variables.

© 2006 Orcun Kepez

**EFFECT OF SPACE ON HEALTH AND WELL-BEING:
AN ENVIRONMENTAL ASSESSMENT FOR HOME-LIKE
LONG TERM CARE SETTINGS**

by
ORCUN KEPEZ

A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

DESIGN

Raleigh, NC

2006

APPROVED BY:

Robin C. Moore

Dr. Christopher B. Mayhorn

Dr. Charles D. Korte

Henry Sanoff

Dr. John O. Tector (Chair of Advisory Committee)

*To my parents:
Gulnihal and Abdurrezak*

BIOGRAPHY

Orcun Kepez was born in Antalya, Turkey on September 10, 1977. Upon his graduation from Antalya Anatolian High School in 1995, he was accepted to the Department of Architecture, Istanbul Technical University (ITU) in Turkey. He received a Bachelor of Science in Architecture degree in 1999 and a Master of Science in Architecture degree in 2001 from Istanbul Technical University (ITU) in Turkey. Orcun's interest in healthcare started in undergraduate and he focused on hospital design for his master's dissertation, which was titled, "A Design Model for Hospitals Based on Preliminary Decision Making about Bed Units".

First, in 1998, as an intern, then in 2000 as an architect, Orcun was hired to take part in design teams of government projects that were designed by the Architecture Foundation of Istanbul Technical University. He worked on the design of two school projects for the Department of Education of Turkey and the design of the city center for the Yildirim District for the Bursa Municipality. Orcun's first building (an 86,000 sq foot multi-use complex) was constructed at the age of 25, while he was working for a construction company as a project architect.

Orcun was accepted to the PhD Design Program at North Carolina State University and moved to Raleigh, NC in 2002 and served as a research assistant for three years. He served as an advisor for graduate students of Landscape Architecture during the Manteo Planning Studio and did the relocation planning of the College of Albamerla, Manteo. He also received an Agents of Fellowship to participate in a national workshop in Oberlin, Ohio.

Orcun received "Special Recognition" for his contribution to the 1st International Symposium of Gerontology in Turkey in 2005. In 2004, he also shared the Best Paper Award with his coauthors in the Architectural Research Centers Consortium (ARCC) – European Association for Architectural Education (EAAE) Joint International Conference in Dublin. Nationwide, Orcun received the Irene Winifred Eno Grant of American Society of Interior

Designers Foundation, Inc. (ASID) and the Vercille Voss Scholarship of International Furnishings and Design Association (IFDA) for his dissertation proposal. College-wide, he received the Institute for Nonprofits Graduate Research Grant (Institute for Non-profits, NCSU) and first place in the 1st Annual North Carolina State University Graduate Research Symposium.

As an active scholar, Orcun presented his research findings at international conferences organized in the United States, Canada, and Europe. He also published in the Journal of Applied Psychology and proceedings of International Association of People-Environment Studies (IAPS), Environment and Design Research Association (EDRA) and Architectural Research Centers Consortium (ARCC), and International Symposium of Gerontology.

Upon graduation, Orcun would like to continue his academic and professional activities to help communities to have a healthier life through design. Orcun is an instrumental rock enthusiast, dedicated guitar player, and a growing composer since high school. For the past two years, Orcun has also been making home recordings of his music.

ACKNOWLEDGEMENTS

There are a number of people without whom this effort wouldn't be possible. First, I would like to thank Dr. John Tector for his extensive involvement and constructive criticism, which increased the quality of this work.

I cannot thank Professor Henry Sanoff enough. I don't think that I would have had the courage to continue my studies at NCSU without Henry's guidance through the rough times, and his continuous support as a scholar and a friend.

I would like to thank to my committee members Dr. Charles Korte, Dr. Christopher Mayhorn, and Professor Robin Moore for their constructive comments for this work. It was such a privilege to have them on my committee to accomplish my goals.

I also would like to thank:

The administrators, caregivers, and residents who volunteered to participate in this research;

The American Society of Interior Designers, International Furnishings and Design Association, and Institute for Non-profits of North Carolina State University for their recognition and providing grants for direct expenses associated with this research;

My editor, Margaret Blanchard, for keeping up with this lengthy document with a high level of skill and professionalism;

My statistical consultant, Eren Demirhan, for his help in the selection of data analyses methods and use of the statistical software;

My angels at Student Health Center, Dr. Laura Pratt and Dr. Lari Jackson, for taking good care of me all the time; and

To Ebru Efendioglu for her continuous support and patience with me.

Finally, I would like to thank my family, my parents Gulnihal and Abdurrezak, my brother Mehmet and my sister in law Esra Kepez, and my grandmother Emine Anac for their continuous support and prayers.

TABLE OF CONTENTS

LIST OF TABLES	xi
LIST OF FIGURES	xiv
CHAPTER 1: INTRODUCTION.....	1
CHAPTER 2: LITERATURE REVIEW.....	4
2.1. The Evolution of the Health Concept	4
2.1.1. Pathogenic Approach: What makes people sick?	5
2.1.2. Salutogenic Approach: What makes people healthy?.....	6
2.2. The Concept of Therapeutic Environments	8
2.3. Defining the Boundaries of Relevant Literature in Therapeutic Design of Long Term Care Settings	10
2.3.1. Lessons Learned from Nursing Homes.....	13
2.3.2. Innovations in Home-like Environments: Continuing Care in a Community	14
2.4. Conclusion	17
CHAPTER 3: A CONCEPTUAL FRAMEWORK TO STUDY THE EFFECT OF SPACE ON HEALTH AND WELL-BEING	18
3.1. Theoretical Perspective of this Research	18
3.2. The Purpose of the Study and the Conceptual Framework.....	23
3.3. Research Questions.....	27
CHAPTER 4: METHODOLOGY.....	29
4.1. A Closer Look at the Context of the Study.....	29
4.1.1. The Physical Environment of 12-Bed Adult Care Homes.....	32
4.2. Research Design Overview.....	34
4.3. Case Selection Criteria and Sampling Procedure	36
4.4. Resident Characteristics and Respondent Sampling.....	40
4.5. Methods of Data Collection	41
4.5.1. Primary Data Collection Instrument 1: Caregivers' Survey	42
4.5.2. Primary Data Collection Instrument 2: Observations.....	46
4.5.3. Secondary Data Collection Instruments.....	48
4.6. Data Collection Procedure	50
4.7. Data Analyses Strategies.....	54
CHAPTER 5: AN ANALYTICAL TOOL TO EXAMINE THE SPATIAL CONFIGURATION OF PLAN TYPES	58
5.1. Space Syntax: An Analytical Tool to Examine Plan Layouts	58
5.2. Space Syntax Literature on Care Environments	62
5.3. Applications of Space Syntax Methods in this Research.....	65
5.4. Spatial Configuration as the Plan Type Selection Criteria	67

5.5. The Need for Considering Metric Relationships as a Variable	67
5.6. Spatial Analysis of Individual Plan Types.....	70
5.6.1. Plan Type 1: The General Plan Layout.....	70
5.6.1.1. Plan Type 1: Drawing the Convex Map and the Graph.....	71
5.6.1.2. Plan Type 1: The Order of Integration Values of Convex Spaces.....	73
5.6.2.1. Plan Type 2: Drawing the Convex Map and the Graph.....	76
5.6.2.2. Plan Type 2: The Order of Integration Values of Convex Spaces.....	81
5.6.3.1. Plan Type 3: Drawing the Convex Map and the Graph.....	83
5.6.3.2. Plan Type 3: The Order of Integration Values of Convex Spaces.....	85
5.6.4.1. Plan Type 4: Drawing the Convex Map and the Graph.....	87
5.6.4.2. Plan Type 4: The Order of Integration Values of Convex Spaces.....	90
CHAPTER 6: FINDINGS OF THE CAREGIVERS' SURVEY.....	103
6.1. Descriptive Findings of the Caregivers' Survey.....	103
6.1.1. Background of the Residents	104
6.1.1.1. Plan Type 1: Background of the Residents.....	104
6.1.1.2. Plan Type 2: Background of the Residents.....	104
6.1.1.3. Plan Type 3: Background of the Residents.....	104
6.1.1.4. Plan Type 4: Background of the Residents.....	105
6.1.1.5. Overall Comparison of Background of the Residents	105
6.1.2. Competence of Residents in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs).....	106
6.1.2.1. Plan Type 1: Competence of Residents in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs).....	106
6.1.2.2. Plan Type 2: Competence of Residents in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL).....	107
6.1.2.3. Plan Type 3: Competence of Residents in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL).....	108
6.1.2.4. Plan Type 4: Competence of Residents in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs).....	109
6.1.2.5. Overall Comparison of Competence of Residents in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs).....	110
6.1.3. Caregiver's Evaluation of Residents' Participation in Social Events.....	112
6.1.3.1. Plan Type 1: Caregiver's Evaluation of Residents' Participation in Social Events.....	112
6.1.3.2. Plan Type 2: Caregiver's Evaluation of Residents' Participation in Social Events.....	112
6.1.3.3. Plan Type 3: Caregiver's Evaluation of Residents' Participation in Social Events.....	112
6.1.3.4. Plan Type 4: Caregiver's Evaluation of Residents' Participation in Social Events.....	113
6.1.3.5. Overall Comparison of Caregivers' Evaluations of Residents' Participation in Social Events.....	113
6.1.4. Caregiver's Evaluation of Residents' Moods	116

6.1.4.1. Plan Type 1: Caregiver’s Evaluation of Residents’ Moods.....	116
6.1.4.2. Plan Type 2: Caregiver’s Evaluation of Residents’ Moods.....	116
6.1.4.3. Plan Type 3: Caregiver’s Evaluation of Residents’ Moods.....	117
6.1.4.4. Plan Type 4: Caregiver’s Evaluation of Residents’ Moods.....	118
6.1.4.5. Overall Comparison of Caregivers’ Evaluations of Residents’ Moods.....	119
6.1.5. The Caregiver’s Evaluation of the Residents’ Use of the Outdoors.....	120
6.1.5.1. Plan Type 1: The Caregiver’s Evaluation of the Residents’ Use of the Outdoors.....	120
6.1.5.2. Plan Type 2: The Caregiver’s Evaluation of the Residents’ Use of the Outdoors.....	120
6.1.5.3. Plan Type 3: Caregiver’s Evaluation of the Residents’ Use of the Outdoors.....	120
6.1.5.4. Plan Type 4: Caregiver’s Evaluation of the Residents’ Use of the Outdoors.....	120
6.1.5.5. Overall Comparison of Caregivers’ Evaluations of the Residents’ Use of the Outdoors	120
6.1.6. Residents’ Bedroom Sharing Status	121
6.2. Converting Rating Scales of Caregiver Survey to Scores	122
6.3. Calculating the Distances between Bedrooms and Common Areas.....	124
6.4. The Syntactic Variables Included in Statistical Analyses.....	128
6.5. Comparison of the Survey Variables	129
6.5.1. Comparison of the Age of Residents from Different Plan Types.....	129
6.5.2. Comparison of the Length of Stay Associated with Residents from Different Plan Types.....	130
6.5.3. Comparison of ADL Scores Associated with Residents from Different Plan Types.....	131
6.5.4. Comparison of IADL Scores Associated with Residents from Different Plan Types.....	132
6.5.5. Comparison of the Number of Hours of Absence from Social Events Associated with Residents from Different Plan Types.....	133
6.5.6. Comparison of Willingness (to Attend Social Events) Scores Associated with Residents from Different Plan Types.....	135
6.5.7. Comparison of Friendliness (with other Residents) Scores Associated with Residents from Different Plan Types.....	136
6.5.8. Comparison of Depression Scores Associated with Residents from Different Plan Types.....	137
6.5.9. Comparison of the Least Square Mean of Hours that Residents Spent Outdoors.....	138
6.5.10. Comparison of Outdoor Use Scores Associated with Residents from Different Plan Types.....	139
6.5.11. Summary of One Way ANOVA of Survey Variables and Plan Type Comparisons	140
6.6. Comparison of Spatial Variables of Bedrooms in the Four Plan Types.....	142

6.6.1. Comparison of the Least Square Means of Walking Distances between Bedrooms and Common Areas of the Four Plan Types	143
6.6.1.1. Comparison of Actual Walking Distances between Bedrooms and Common Areas of the Four Plan Types.....	144
6.6.2. Comparison of the Least Square Means of Syntax Values Associated with Bedrooms in the Four Plan Types.....	147
6.6.2.1. Comparison of Global and Local Integration Values of Bedrooms in the Four Plan Types	147
6.6.2.2. Comparison of Depth Values of Bedrooms from Common Spaces in the Four Plan Types	150
6.6.3. Evaluation of Findings from the Differences of the Least Square Means of Outcomes and Spatial Variables.....	153
6.7. Linear Associations between the Variables	156
6.7.1. Correlations between Survey Variables.....	158
6.7.1.1. Spearman Correlation between the Survey Variables of Social Interaction	158
6.7.1.2. Spearman Correlation between the Survey Variables of Depression and Outdoor Use	161
6.7.1.3. Spearman Correlation between the Survey Variables of Different Outcomes	163
6.7.1.4. Spearman Correlation between the Survey and Spatial Variables.....	165
6.7.2. Studying Complex Relations Between the Survey and Spatial Variables.....	169
6.7.2.1. Multiple Regression Model I: Absence in Social Events as the Dependent Variable	169
6.7.2.2. Multiple Regression Model II: Depression Score as the Dependent Variable	172
6.7.2.3. Multiple Regression Model III: Number of Hours Spent Outdoors as the Dependent Variable	175
CHAPTER 7: FINDINGS OF OBSERVATIONS.....	178
7.1. The Use of Spaces of Plan Types	178
7.1.1. Plan Type 1: The Use of Space.....	181
7.1.2. Plan Type 2: The Use of Space.....	183
7.1.3. Plan Type 3: The Use of Space.....	187
7.1.4. Plan Type 4: The Use of Space.....	189
7.1.5. Overall Comparison of the Use of Spaces in Four Plan Types.....	191
7.2. Overall Comparison of the Social Interaction in the Four Plan Types.....	197
7.2.1. Observed Social Interaction of Residents in Plan Type 1.....	199
7.2.2. Observed Social Interaction of Residents in Plan Type 2.....	200
7.2.3. Observed Social Interaction of Residents in Plan Type 3.....	202
7.2.4. Observed Social Interaction of Residents in Plan Type 4.....	204
7.2.5. Comparison of Observed Social Interactions as a Use of Space in the Four Plan Types.....	206
7.3. Results of the Physical and Architectural Checklist (PAF).....	209

7.4. Comparison of the Observations in All Plan Types.....	212
7.4.1. Comparison of Percentage of Use of Dining Spaces in the Four Plan Types.....	217
7.4.2. Comparison of Percentage of Use of Kitchens in the Four Plan Types.....	217
7.4.3. Comparison of Percentage of Use of Dayroom in Four Plan Types.....	219
7.4.4. Comparison of Percentage of Use of Bedrooms in Four Plan Types	220
7.4.5. Comparison of Percentage of Use of Corridors in Four Plan Types	221
7.4.6. Comparison of Percentage of Use of Outdoors in Four Plan Types.....	222
7.4.7. Comparison of Percentage of Residents in Conversation Groups	223
7.4.8. Comparison of Percentage of Residents in Conversation Groups Formed by Residents	224
7.4.9. Summary of One Way ANOVA of Percentage of Residents Observed in the Same Type of Spaces of the Four Plan Types	225
CHAPTER 8: CONCLUSION.....	229
8.1. The Effect of Walking Distances on Well-being	230
8.2. Effect of Non-Metric Variables on Well-Being.....	233
8.2.1. Effect of Configurational Distinctiveness on Well-Being.....	234
8.2.2. Effect of Local Integration and Global Integration Values of Bedrooms.....	234
8.2.3. Effect of Depth of Bedroom from Common Areas	236
8.3. Effect of Alternative Spaces on Use and Social Interaction	236
8.4. Revisiting Outcome Variables: A Word of Caution	237
8.5. Including the Voices of Residents	238
8.6. Implications of this Study to Design of Home-like Long Term Care Settings.....	240
8.7. Future Prospects.....	242
REFERENCES.....	244
APPENDIX.....	255
APPENDIX 1: CAREGIVER SURVEY	256

LIST OF TABLES

CHAPTER 4

Table 1: The distribution of clusters	36
Table 2: Distribution of Age and Gender of Residents of ACH of Seven or More Beds.....	40
Table 3: The Summary of the data collected from four plan types	55

CHAPTER 5

Table 1: The Use of Space Syntax Values.....	65
Table 2: The global integration values of convex spaces considered for the cross plan type comparison and the mean global integration value of the plan types	96

CHAPTER 6

Table 1: Background of residents by plan type	106
Table 2: Competence of residents of plan type 1 in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL).....	107
Table 3: Competence of residents of plan type 2 in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL).....	108
Table 4: Competence of residents of plan type 3 in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL).....	109
Table 5: Competence of residents of plan type 4 in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs).....	110
Table 6: Overall comparison of plan types in residents' competences in performing Activities of Daily Living (ADL)	111
Table 7: Overall comparison of plan types in residents' competence in performing Instrumental Activities of Daily Living (IADL).....	111
Table 8: The summary of means of hours of participation in social events, the percentages of absence in social events, and the hours of participation in events outside the community (based on the caregivers' responses).....	114
Table 9: The summary of the caregivers' evaluation of the residents' willingness to attend social events	115
Table 10: The summary of the caregivers' evaluation of the residents' friendliness with other residents	115
Table 11: Caregiver's Evaluation of Plan Type 1 Residents' Moods.....	116
Table 12: Caregiver's Evaluation of Plan Type 2 Residents' Moods.....	117
Table 13: Caregiver's Evaluation of Plan Type 3 Residents' Moods.....	118
Table 14: Caregiver's Evaluation of Plan Type 4 Residents' Moods.....	119
Table 15: Overall Comparison of Caregivers' Evaluations of Residents' Moods.....	119
Table 16: The summary of the caregivers' evaluations of the residents' use of the outdoors	121
Table 17: The bedroom sharing status of residents of different plan types	122
Table 18: Comparison of area of each plan type	125
Table 19: Least Square Means Differences of the Age of Residents	130

Table 20: Least Square Means Differences of ADL Scores	132
Table 21: Least Square Means Differences of IADL Scores.....	133
Table 22: Least Square Means Differences of the Number of Absence Hours of Residents from Social Events	134
Table 23: Least Square Means Differences of Willingness Scores	136
Table 24: Least Square Means Differences of Depression Scores	138
Table 25: Least Square Means Differences of the Hours that Residents Spent Outdoors....	139
Table 26: Summary of ANOVA Results of Survey Variables by Plan Type and Summary of Plan Type Comparisons by using the Tukey-Kramer Method	141
Table 27: Least Square Means of Plan Types with the Longest and Shortest Walking Distances	145
Table 28: Summary of ANOVA Results of Actual Walking Distances and Summary Comparison of Plan Types by using the Tukey-Kramer Method	147
Table 29: Least Square Means of Plan Types with the Highest and Lowest Integration Values of Bedrooms	149
Table 30: Summary of ANOVA Results of Integration Values and Summary Comparison of Plan Types by Using the Tukey-Kramer Method	150
Table 31: Least Square Means of Plan Types with the Highest and Lowest Depth Values.....	152
Table 32: Summary of ANOVA Results of Depth Values and Summary Comparison of Plan Types by Using the Tukey-Kramer Method	153
Table 33: Summary of the Cross Analysis of Findings from Differences of Least Square Means of Outcomes and Spatial Variables	154
Table 34: Assessing the Strength of Correlation	158
Table 35: Spearman Correlations of survey variables of social interaction	160
Table 36: Spearman Correlations of survey variables of depression and outdoor use	162
Table 37: Spearman Correlations of survey variables of different outcomes.....	165
Table 38: Spearman Correlations between survey and spatial variables.....	167
Table 39: Solution for Fixed Effects of Regression Model-I (Dependent variable: Absence from Social Events).....	170
Table 40: Least Square Means of <i>predicted</i> Absence from Social Events	171
Table 41: Least Square Means Differences of <i>predicted</i> Absence from Social Events	172
Table 42: Solution for Fixed Effects of Regression Model II (Dependent variable: Depression Score).....	173
Table 43: Least Square Means of <i>predicted</i> Depression Scores.....	174
Table 44: Least Square Means Differences of <i>predicted</i> Depression Scores	175
Table 45: Solution for Fixed Effects of Regression Model III (Dependent variable: Number of Hours of Spent Outdoors).....	176

CHAPTER 7

Table 1: The Summary of the Observations Included in the Final Analysis	179
Table 2: Use of Spaces in Plan Type 1	181
Table 3: Use of Spaces in Plan Type 2	184
Table 4: Use of Spaces in Plan Type 3	187

Table 5: Use of Spaces in Plan Type 4	189
Table 6: Overall Comparison of the Use of Spaces in Four Plan Types	192
Table 7: Overall Comparison of Participants of Conversation Groups	197
Table 8: Overall Comparison of Conversation Groups formed only by Residents	198
Table 9: Distribution of Conversation Groups formed by Residents of Plan Type 1	199
Table 10: Distribution of Conversation Groups formed by Residents of Plan Type 2	201
Table 11: Distribution of Conversation Groups formed by Residents of Plan Type 3	203
Table 12: Distribution of Conversation Groups formed by Residents of Plan Type 4	205
Table 13: Comparison of Observed Social Interactions as a Use of Space in the Four Plan Types	207
Table 14: Comparison of Spaces of Social Interaction in Four Plan Types	207
Table 15: The Summary of Score Percentages of Plan Types in PAF Sections Selected	211
Table 16: The Frequency Procedure for the Number of Residents Observed In Dining Spaces	215
Table 17: Summary of Significance Test for the Use of Spaces	216
Table 18: Least Square Means Differences of Percentages of Residents Observed in Kitchens	218
Table 19: Least Square Means Differences of Percentages of Residents Observed in Dayroom Areas	220
Table 20: Least Square Means Differences of Percentages of Residents Observed in Bedrooms	221
Table 21: Least Square Means Differences of Percentages of Residents Observed in Corridors	222
Table 22: Least Square Means Differences of Percentages of Residents Observed in the Outdoor Areas	223
Table 23: Least Square Means Differences of Percentages of Residents in Conversation Groups	224
Table 24: Least Square Means Differences of Percentages of Residents in Conversation Groups Formed Only by Residents	225
Table 25: Summary of ANOVA Results of Observations of the Use of Space and Conversations of Residents by Plan Type	227

CHAPTER 8

Table 1: The relationships between the studied variables	231
--	-----

LIST OF FIGURES

CHAPTER 3

Figure 1: General Conceptual Framework of the Proposed Study	23
Figure 2: Detailed Conceptual Framework of the Proposed Study	27

CHAPTER 4

Figure 1: Site 1 with three identical 12 bed adult care homes	39
Figure 2: Site 2 with two identical 12 bed adult care homes	39
Figure 3: Site 3 with two identical 12 bed adult care homes	39
Figure 4: Site 4 with two identical 12 bed adult care homes	40
Figure 5: Data collection procedure of the study	54

CHAPTER 5

Figure 1: Step by step configuration analyses of three buildings	59
Figure 2: Spatial configuration of five buildings	69
Figure 3: Layout of Plan Type 1 (shaded spaces showing the circulation)	71
Figure 4: Convex Map (above) and Graph of Plan Type 1	72
Figure 5: The order of convex spaces in Plan Type 1, where the Porch is the most	73
Figure 6: Layout of Plan Type 2 (shaded spaces showing the circulation)	75
Figure 7: Convex Map of Plan Type 2	78
Figure 8: Justified Permeability Graph of Plan Type 2	80
Figure 9: The order of convex spaces in Plan Type 2, where Bathrooms 8, 9, and 10 are the most integrated and Corridors 4 and 5 are the most segregated spaces.	81
Figure 10: Layout of Plan Type 3 (shaded spaces showing the circulation)	83
Figure 11: Convex Map of Plan Type 3	84
Figure 12: Graph of Plan Type 3	85
Figure 13: The order of convex spaces in Plan Type 3 where the Entrance is the most integrated space and Corridor 2 is the most segregated space.	86
Figure 14: Layout of Plan Type 4 (shaded spaces showing the circulation)	86
Figure 15: Convex Map (top) and Graph of Plan Type 4	89
Figure 16: The order of convex spaces in Plan Type 4 where the Pantry is the most integrated space and Corridor 2 is the most segregated space	90
Figure 17: Color coded plan layouts and permeability graphs of all plan types	93
Figure 18: The cross plan type comparison of mean global integration values for each plan type	95
Figure 19: The cross plan type (P.T.) comparison of the order of spaces in terms of their global integration levels	97
Figure 20: The cross plan type (P.T.) comparison of the order of spaces in terms of their global integration levels	98
Figure 21: The cross plan type (P.T.) comparison of global integration values of considered convex spaces. Notice that the dayroom and the dining space have two comparisons, one of which included the effect of alternative spaces with the function.	100

CHAPTER 6

Figure 1: The distances between bedrooms and common areas, the entrance, and outdoor spaces.....	126
Figure 2: Least Square Means Plot of the Age of Residents	130
Figure 3: Least Square Means Plot of the Length of Stay of Residents	131
Figure 4: Least Square Means Plot of ADL Scores.....	131
Figure 5: Least Square Means Plot of IADL Scores.....	133
Figure 6: Least Square Means Plot of the Number of Absence Hours of Residents from Social Events.....	134
Figure 7: Least Square Means Plot of Willingness Scores.....	135
Figure 8: Least Square Means Plot of Friendliness Scores	136
Figure 9: Least Square Means Plot of Depression Scores	137
Figure 10: Least Square Means Plot of the Hours that Residents Spent Outdoors.....	138
Figure 11: Least Square Means Plot of Outdoor Use Scores.....	139
Figure 12: Least Square Means Plots of Walking Distances between Bedrooms and Common Areas.....	145
Figure 13: Least Square Means Plots of Percentages of Global and Local Integration Values of Bedrooms (With and Without Including the Outdoors).....	149
Figure 14: Least Square Means Plots of Depth Values of Bedrooms from Common Spaces.....	151
Figure 15: Regression Plot of survey variables of social interaction.....	159
Figure 16: Regression Plot of survey variables of depression and outdoor use	162
Figure 17: Regression Plot of Survey Variables of Different Outcomes.....	164
Figure 18: Plot of Least Square Mean of <i>predicted</i> Absence from Social Events	171
Figure 19: Plot of Least Square Mean of <i>predicted</i> Depression Scores	174

CHAPTER 7

Figure 1: The dayroom of plan type 1	181
Figure 2: The corridor of plan type 1 and the medication counter located at the corridor ...	182
Figure 3: The Kitchen of Plan Type 1	183
Figure 4: The Dining Room of Plan Type 1	183
Figure 5: Parlor as an alternative to the dayroom in Plan Type 2.....	184
Figure 6: The dayroom in Plan Type 2	185
Figure 7: Kitchen and Welcoming Alcove of Plan Type 2.....	185
Figure 8: Sitting room and immediate outdoor environment in Plan Type 2	186
Figure 9: Main Dining and the Garden Dining in Plan Type 2	186
Figure 10: Dayroom in Plan Type 3	188
Figure 11: Dining Room in Plan Type 3.....	188
Figure 12: Kitchen and Corridors in Plan Type 3.....	188
Figure 13: Entrance and Dayroom in Plan Type 4	190
Figure 14: Sunroom and Dining Room in Plan Type 4	190
Figure 15: Corridor and Kitchen Room in Plan Type 4.....	191
Figure 16: Weighted Behavior Maps of Four Plan Types for Use	194

Figure 17: Gazebo and Patio in Plan Type 3	196
Figure 18: Porch and Patio in Plan Type 4	196
Figure 19: Observed Social Interactions in Plan Type 1	200
Figure 20: Observed Social Interactions in Plan Type 2	202
Figure 21: Observed Social Interactions in Plan Type 3	204
Figure 22: Observed Social Interactions in Plan Type 4	206
Figure 23: Graph of the Percentage Scores for Each Plan Type for the Selected PAF Sections.....	210
Figure 24: Least Square Means Plot of Percentages of Residents Observed in Dining Spaces	217
Figure 25: Least Square Means Plot of Percentages of Residents Observed in Kitchens	218
Figure 26: Least Square Means Plot of Percentages of Residents Observed in Dayroom Areas	219
Figure 27: Least Square Means Plot of Percentages of Residents Observed in Bedrooms	220
Figure 28: Least Square Means Plot of Percentages of Residents Observed in Corridors	221
Figure 29: Least Square Means of Plot of Percentages of Residents Observed in Outdoors.....	222
Figure 30: Least Square Means Plot of Percentages of Residents in Conversation Groups.....	223
Figure 31: Least Square Means Plot of Percentages of Residents in Conversation Groups Formed by Residents.....	225

CHAPTER 1: INTRODUCTION

The U.S. older adult population is growing at a remarkable rate. There were 35 million individuals age 65 years or over in the U.S. in 2000 (Hetzl & Smith, 2001). This represents 12.4% of the U.S. population and a 12% increase from 1990. In 2000, there were 18.4 million individuals between ages 75 and 84 years. Those individuals age 85 (i.e., the oldest old) numbered 4.2 million and represented the most rapid growth of the older adult population (Hetzl & Smith, 2001). The number of oldest old increased 38% during the 1990s. In 2000, an estimated 2 percent of the population was age 85 and older. By 2050, the percentage in this age group is projected to increase to almost 5 percent of the U.S. population (Federal Interagency Forum on Aging-Related Statistics, 2000).

Projections by the U.S. Census Bureau suggest that the population age 85 and older could grow from about 4 million in 2000 to 19 million by 2050. Some researchers predict that death rates at older ages will decline more rapidly than reflected in the Census Bureau's projections, which could result in faster growth of this population (Guralnik, J.M et al., 1988; Manton, K.G et al., 1993).

It is evident that this change in population requires a new perception to the lives of aging people. In the society of aging people, there are many aspects that should be solved to provide a better quality of life of older population. Among many of those, long-term care of the elderly is inherently important. Nursing homes, which were once the only option for elderly, are now the last resort for those who don't require a skilled nursing assistance. The assisted living trend, which started in mid 90s, offers a large array of services for those who seek minor assistance. The design concept of assisted living facilities mainly relies on creating a home-like environment to increase the autonomy and satisfaction of the elderly during their assisted living experience. In fact, the *value* of assisted living (or community based long-term care with services) facilities, relies on the design of the environment that contributes to the health and well-being of the elderly. Yet, the problem is a lack of resources

to assess the therapeutic potential in the richness of different options with similar promises. In a larger perspective, this is a common problem in many sectors.

In their recent book, Porter and Teisberg (2006) argued that the way to make healthcare systems work in the U.S. is by creating a value-based competition based on reporting the results. The argument started that the absence of data on the results of the successes or failures of hospitals will allow people to choose their hospital. Since the issue was healthcare, the authors solely relied on the reason why people need healthcare: to receive a health service. Thus, their ignorance on the environmental factors is understandable. The bottom line is a patient will not want to go to a hospital if he/she knows that the hospital has a 95% failure rate in the surgery that he/she requires.

Yet, the issue is not the same with long term care facilities. People who looking for home-like long term facilities are not ill or having an emergency health situation. Second, elderly people expect to interact with other people and have social support when they move in to an assisted living building. According to a recent study (n=303), after “access to health care”, “dining with others” is a major factor that contributes to the happiness of the assisted living experiences of the residents (Cutchin et al. 2005). It was interesting that two factors have a similar occurrence in the answers (dining with others – 80% and access to healthcare - 81%). In the same survey, social activities inside the residence were also mentioned by 62% of the respondents. Thus, it can be said that moving to a facility where the social life is dull, can be viewed in parallel with selecting the wrong hospital for surgery. The results of a poor choice in a hospital may arise quicker and actions could be taken more quickly. Yet, starting a new life in the wrong place can dramatically reduce the quality of life in the golden years.

The design of the environment plays a major role in the value of home-like long term care settings since it is what makes the experience worthwhile. Thus, understanding the contribution of the home-like assisted living environment to the health and well-being of its residents is an important component of the value-based assessment in long-term care. This

study has been an effort to empirically understand the relationship between space and well-being of residents who choose to live in small scale home-like environments.

CHAPTER 2: LITERATURE REVIEW

2.1. The Evolution of the Health Concept

Today, in the world of technology and science, there's no single day that passes that we do not hear news about health. With the life expectancy way above what it was 20 years ago, public awareness of health related topics has increased. It is now common sense that being healthy means maintaining a healthy life style that incorporates healthy nutrition, physical exercise, and no more stress than is manageable. But this list can really grow if we consider the reasons behind health. The reasons for being healthy are also very individual; they are not only related to heritage but also decisions that we make that rely on our perception of different choices available to us in the society we live. Maintaining health in different dimensions of our life is multi-faceted and complex. In fact, being multi-causal and complex is what is obvious about the health concept and there's a lot more to explain. For a broader understanding, it's inherently important to have a closer look at the evolution of the health concept.

The word *health* is derived from the old English word *hal*, meaning whole, healed, and sound. Health is a difficult concept to define; therefore, it is not surprising that it has been interpreted in diverse ways (Lawrence, 2002). The evolution of the health concept followed these steps:

- (1) Pathogenic Approach: The definition of "What makes people sick?"
- (2) Salutogenic Approach: The call for defining "What makes people healthy?"

Early efforts were concentrated on explaining the cause of sickness, which was used to prevent transmission of diseases and develop cures. This medical approach basically defines two categories of people: healthy and unhealthy. But is it really that simple to distinguish health status of people according to the presence or absence of illness? In order to answer this question, first I will explain the early conceptualization of health.

2.1.1. Pathogenic Approach: What makes people sick?

Until the 1870s, the miasma theory, that noxious vapor transmits pathogens, was used to explain the transmission of diseases, including cholera. This approach argued that miasma “bad air” had to be eradicated by improved exposure to sunlight and effective ventilation between and inside building (Lawrence, 1983). Although the miasma theory was wrong, it was successful in guiding an indirect way by connecting people’s health conditions to environmental factors. In fact, during the Public Health Movement in England in the 1840s, it was agreed that it was a responsibility of society to protect the citizens from unsanitary working and housing conditions (Rosen, 1993). Then the miasma theory was falsified and replaced by the germ theory by Snow who showed that cholera is communicated by means of a contaminated water-supply (Snow, 1854). By using the street map of London and tracking the addresses of people who died from cholera, Dr. Snow found the link that most of the deaths were associated with addresses that were closer to the water pumps. He drew a map, which today is known as the most famous and classical example in the field of medical cartography.

These early efforts are regarded as the pathogenic perspective or model that emphasized the development of illness (Stokols, 1992). The pathogenic approach was used by medical sciences to study sick body parts in isolation of the whole. Research that was developed over the pathogenic paradigm is directed to identifying the pathogens and the search for their elimination. Thus, people who attacked by a pathogen are called sick, and as long as the effect of this pathogen is defeated, people will return to their health.

Obviously, this concentrated effort to identify the reasons for sickness promoted the intellectual development of very valuable improvements in the medical sciences. Before the proposal of an alternative approach, two major lines of criticism emerged against the pathogenic paradigm. The first one was the school of prevention that focused on keeping the people under high or medium risk of disease healthy. The second line of criticism was focused on the lack of multiple causality of disease (Antonovsky 1979, 1990). Yet, these two

schools of thoughts did not reach beyond the non-biological factors that may reveal the “mysteries of health” (Antonovsky 1987, 1996).

2.1.2. Salutogenic Approach: What makes people healthy?

According to definition of WHO (1946), health is “not merely the absence of disease and infirmity but a state of optimal physical, mental and social well-being”. Lawrence (2002) stated that:

This definition has the merit of not focusing on illness and disease, which have often been considered as either temporary or permanent impairment to health or as the malfunctioning of a single or several constituents of the human body –defined as pathogenic approach. (pp. 395-396)

Since the pathogenic model limited “being healthy” to the health status of body parts, which is consistent with Western medical thinking, healing, and environment relation is oversimplified by exposure to sickening factors such as infection (Antonovsky 1996). According to Antonovsky (1979, 1987, 1996) the pathogenic model lacks the multiple causation theory and the biopsychosocial model. The early attempts for an alternative paradigm to study health still remained in the pathogenic perspective by focusing on those under some certain risk for disease or other factors that may cause disease and remain in the borders of the pathogenic approach (Antonovksy, 1987, 1990).

Pathogenic orientation, which infuses all western medical thinking, is described by Antonovsky as follows:

...a paradigm which emphasizes the individual person, the material body, the mechanistic interrelationships among the parts of the body, and the cheerful assumption that most of the time, for most of us, the machine does no break down (Antonovsky, 1990, p:1)

The way that the pathogenic model approaches the human organism that is threatened by pathogens is described by Antonovsky as follows:

The human organism is a splendid system, a marvel of mechanical organization, which is now and then attacked by a pathogen and damaged, acutely, chronically or fatally. (Antonovsky, 1996, p: 13)

Antonovsky (1979, 1987, 1996) questioned the assumption that the human system is *inherently* flawed, subject to unavoidable entropic processes, and subject to unavoidable final death. Thus, there is more to explore and understand about the origins of health (salutogenesis). In other words, all unhealthy situations, in this case a body part, *can not* be explained only by attack of a pathogen. Moreover, the loss and gain of health is not an instantaneous event but an even that occurs over a continuum during the lifetime of people. A loss of health status happens under various conditions that have biological, psychological, and social reasons. The pathogenic approach and germ theory is an incomplete explanation of human illness and disease since it ignores the contribution of numerous physical and social dimensions of the environment that can affect health (Antonovsky, 1979; Stokols, 1992; Lawrence; 2002).

Antonovsky (1979) proposed a *salutogenic* model that starts questioning health from the opposite side: “Why do people maintain good health?” This question is more complicated than the pathogenic model that poses the question as “Why do people become ill?”. Since the answer cannot go beyond the exposure of sick people to risk factors, it’s an incomplete explanation of health. This new approach, which accumulates knowledge about the conditions for health, investigates the reason why some people remain in good health in spite of being exposed to risk factors.

Antonovsky (1987) developed the concept of Sense of Coherence (SOC) and proposed that one’s SOC was a significant factor in facilitating the movement toward health. SOC is made up of three main domains that were meaningfulness, comprehensibility, and manageability. Confronted with a stressor, a person with a strong SOC will:

- wish to, to be motivated to, cope (sense of meaningfulness);
- believe that the challenge is understood (sense of comprehensibility); and
- believe that resources to cope are available (sense of manageability).

(adapted from Antonovsky 1996, p: 15)

A 29-item SOC scale of “Orientation to Life” scale (and, to a slightly lesser degree, its 13-item version) has been found to be consistently feasible, reliable, and valid (Antonovsky, 1996).

The salutogenic paradigm didn’t reject the benefits of the pathogenic paradigm but surely broadened the understanding of health. The salutogenic approach not only served as the foundation of health promotion but also opened a whole new perspective in research agendas of various disciplines. There were explicit and implicit reflections of the salutogenic approach in the design discipline. In fact, design researchers who aimed to enrich the practice of discipline by focusing on the social and psychological aspects of design were already on a similar pattern of research.

2.2. The Concept of Therapeutic Environments

Earlier I mentioned that misinterpretation about the transmission of disease by miasma (bad air) that raised awareness of issues such as ventilation and natural lighting in buildings. Even after the germ theory, the pathogenic environment perceived the physical environment as a medium (agent) of disease if the environment did not have adequate conditions. It is obvious that an environment with adequate hygiene is the first requirement for health. Yet, in light of the salutogenic approach, environment has a lot of potential to contribute to well-being of its occupants.

In the same year as when Antonovsky proposed the salutogenic model, Canter and Canter (1979) published the “Designing for *Therapeutic* Environments: A review of Research” by including various contributions from researchers who shed light on the therapeutic values of settings like the hospital and housing on different users (such as the children and the elderly). In early research samples presented in this book, the benefits of a therapeutic environment were justified by maintained or enhanced satisfaction and social interaction (Canter and Canter, 1979).

Another group of studies focused on the therapeutic benefits of natural environments. The main argument is that exposure to certain environmental conditions, such as natural and aesthetic amenities, can alleviate stress and promote physical and emotional well-being (Kaplan and Kaplan 1989; Hartig, Mang, and Evans 1991).

The most explicit and earliest link between the salutogenic approach and the environment first appeared in the healthcare environments. The design of hospitals is based on a medical model where each sick body part is associated with a set of spaces in which the illness will be treated. Antonovsky (1990) noted that:

...every society has developed a social institution, based on its understanding of illness, to deal with the problem. In modern western industrialized societies, what is called the biomedical model provides this paradigm. It is embodied in the complex of medical care institutions we have created. (p: 1)

Two important innovative design concepts that found to have positive influence on psychological well-being of users of healthcare buildings are health village and planetree model.

Health Village: Nesmith (1995) mentioned that between 1980 and early 1990s the search for a better care environment was emerged through different design innovations. The main concept initiated during this period was the decentralization of the services. This concept not only made the addition of new services easier but also provided a chance to create a less institutional appearance of the health care facility (Verderber and Fine 2000) Verderber and Fine (2000) explained that the decentralization of services caused functional deconstruction which allowed separation of residency (patient unit) and medical functions. Obviously this resulted by various types of buildings and the concept of health village. The separation of the care unit also provided patients more privacy, accessibility to outdoors and isolation from negative factors of hospital such as noise. Today health village concept can be viewed in many long term care facilities where elderly people accommodated in community based home-like dwellings.

Planetree Model: Patient-centered care, which primarily aimed to provide choices to patients, lead to different care programs. The Planetree model (Martin et al. 1990), which emphasizes creating a home-like environment for patients, is a well-known patient-centered care program. Two of its goals are training patients to be partners in their healthcare and increasing the satisfaction of nurses. Planetree model is a pioneer concept in care market that aims to foster control and provide choice to patients. This notion is also inherited by long-term care market after its success in healthcare.

Effect of single parameters, most of which were tested in health care facilities, provided insights for long-term care facilities. The effect of positive distractions such as window view (Ulrich 1984); the effect of noise (Hilton 1985; Bayo Garcia & Garcia 1995); the quality of lighting and color (Kolanowski 1992; Benya 1989; Carpman & Grant 1993) and the concept of healing gardens (Marcus & Barnes, 1999) can be counted as main groups that main studies fall (Ulrich & Zimring 2004; Devlin and Arneil 2003 for further review).

2.3. Defining the Boundaries of Relevant Literature in Therapeutic Design of Long Term Care Settings

Although there has been a great variety in studies that examined overall effects of design variables on the elderly, studies that compare different building types in terms of their psychological outcomes are very rare. The paucity of research in the emerging field of community-based housing is often underlined by researchers (e.g., Schwarz and Brent 1999, 2001; Namazi and Chafetz 2001). This lack of research was not a new topic since Lawton, Lebowitz, and Charon (1970) commented that: “The merits of physical design of a treatment setting are much discussed, but infrequently tested empirically”. In a similar sense, Kolanowski (1992) mentioned that the paucity of research in care environments is especially in the area of studying environmental patterns that promote harmony.

Quality of life studies that measure the well-being of residents by including many aspects of their life queried very general differences between concepts (home, home-like, and institution) and differences within a concept. For example Christ (1999) showed that the

quality of life among persons over age 65 differed due to the housing in which they resided. The elderly that stayed at homes, which are physically not adaptive, reported low quality of life but not lower than the elderly who were institutionalized. The elderly that lived in low-rise, village type assisted living communities with a group living arrangement assigned to each unit reported the highest quality of life. Another study by Mitchell and Kemp (2000) studied the quality of life among functionally impaired adults ($n=201$) that were randomly selected from 55 assisted living facilities. Similar to Christ's findings, the take home message from this study is developing small facilities or creating smaller groupings of units within larger facilities to decrease conflict among residents and thereby increase resident satisfaction and quality of life.

The main limitation of those quality of life studies is their method of distinguishing buildings such as big versus small, high-rise versus village type, urban versus suburban, etc. The housing research already answered those variations of design that people prefer. That is, it was found that people smaller human scale buildings in a general village type setting that is associated with a feeling of access to nature. On a neighborhood scale, people prefer locations that are convenient to resources, such as the grocery store; locations that are safe; and locations where there is some kind of outdoor interaction that help them to build sense of community (for further review see Altman, Lawton, Wohwill 1986; Altman and Werner 1986). Those people who live in desirable conditions summarized above are more likely to report a higher quality of life, a higher status of health, and a lower stress level (Cohen et al. 1986).

The Journal of Architecture and Planning Research dedicated its 2001 autumn issue on long-term care facilities of elderly and presented discussions of housing alternatives (e.g., assisted living, naturally occurring retirement communities, metamorphosis of long-term care, international perspectives). Empirical research in assisted living facilities was focused on perception of *homeyness* (*home-likeness*) (e.g., Marsden 1999). Yet, a large number of

recommendations to maintain home-likeness in long term care environments have rarely been tested by measuring the impact of adoption of them.

Universal Design, which is another growing field, targets usable and accessible environments and products for all people with much of it focused on disability and impairments of the general population and in consequence, of the elderly (definition based on Mace, Hardie and Place 1991). This focused interest, combined with the strong objective measurements of bio-mechanical research and ergonomics, explained the design outcomes of simple elements. In summary, this research is very strong in explaining the needs of the disabled by providing objective criteria such as size and shape for the wheel chair accessibility. However, this research does not develop a shared consciousness in the big picture of psychological outcomes of the application of Universal Design Principles. Yet, some researchers (e.g., Lingaert et al. 2002, Preiser 2001) emphasized the need for a holistic approach to design research and showed that implications of UD principles may affect the psychological well-being of the elderly via *enabling* environments.

In contrast to the lack of hard data for new building types of long-term care facilities, there are two promising sources of literature showing evidence of a significant difference in psychological well-being of occupants due to differences in physical design of the environment. The first source is research on Alzheimer Care facilities. Today there is enough evidence that some design guidelines, which were tested for many years, helped to create therapeutic environments for people with dementia (Liebovitz et al. 1979; Cohen and Weissman 1991; Zeisel, et al. 2003). The second source is the growing literature on health care facilities, where the results are based on experimental studies. Since the positive features of space were found to be correlated with higher satisfaction, decreased use of medication, a positive mood, and shorter hospital stays, this body of literature is defined as “a once-in-a-lifetime opportunity” for researchers who are willing to study the role of the physical environment on outcomes (Ulrich and Zimring 2004).

The general boundary that I have briefly outlined shows that the literature on the psychological outcomes of design variations in long-term care facilities is multifaceted. An important body of literature that helped to conceptualize the effect of space on psychological well-being of its occupants came from controlled environments, such as hospitals and nursing homes. Those discrete findings helped researchers to conceptualize new environments where increased personal control, availability of choices, and a home-like environment are expected to enhance the well-being outcomes. However, new building types designed by the market were more likely to be the center of theoretical speculations, rather than application of rigorous empirical studies. The new innovations in long-term care basically inherited the idea of reversing the negative effects of nursing home. Thus, prior to the introduction of the examples of new approaches in long-term care environment, the lessons learned from studies in nursing homes will be discussed.

2.3.1. Lessons Learned from Nursing Homes

For the elderly, institutionalization is a specific kind of relocation that refers to relocation from a non-institution to a long-term care setting (Markides and Cooper 1989). Institutionalized older persons typically found themselves in unfamiliar environmental settings that they did not select (Kahana et al. 2003). Nursing homes are counted as this type of long-term care facility.

Nursing homes, as the oldest and most common long-term care facilities, have been criticized for their hospital-like, unfriendly atmosphere where residents have limited privacy and individuation (Schwarz and Brent 2001). Koncelik (1972) stated that “the ostensible, dehumanizing qualities” of the nursing facilities resulted because of the design process of those buildings that were based on efficiency and medical models. Due to an increase in the proportion of elderly in the growing population, the need for improving chronic and debilitating conditions that accompany aging were discussed (Sherwood 1975).

Early studies on long-term care institutions and studies in hospital patient wards focused on the effect of spatial arrangement on social interaction. The main assumption was that the elderly people who are more socially active are less likely to have stress and develop depression (based on Markides and Cooper 1989). In an earlier study that took place in a psychiatric ward, Osmond (1959) pointed out that a physical setting might tend to keep people apart (*socio-fugal spaces*) or bring them together (*socio-petal spaces*). Similarly, Sommer and Ross (1958) described the relationship between furniture arrangement and behavior in a geriatric hospital. Holahan (1972) found the same kind of effect in a psychiatric hospital by observing patients seated around the table talking to one another more than the patients seated in rows against the walls. More generally, spatial arrangements, including both the location of the public spaces and the congregating of persons of a similar functional status within wards, were cited as strong influences on friendship formation (Retsinas and Garrity 1985; Witzius, Gamber and Dustine 1981; Friedman 1966; Jones 1975; Miller and Beer 1977).

Another environmental dimension that can be regarded as one of the major differences between institutional and community residence is *privacy*. The distress caused by the lack of privacy in nursing homes has been documented in several studies (Gubrium 1975; Firestone, Lichtman, and Evans 1980). Moos and Lemke (1980) demonstrated that the amount of privacy is highly influenced by specific and reversible features of the nursing home's physical environment.

2.3.2. Innovations in Home-like Environments: Continuing Care in a Community

The decentralization of hospital care has been accompanied by an increase in units for special populations. The elderly population was one important group of consumers of those new building types. Moving beyond nursing homes, four architectural types of continuing-care retirement forms emerged by the mid-1990s (Verderber and Fine 2000). Verderber and Fine described these as the pastoral campus type, the denser suburban type, the new-urbanist village type, and the urban high rise type. The examples included for this review contain

studies of assisted living facilities that contains a diverse types of buildings. Two other innovative facilities that can provide evidence of improved or enhanced psychological outcomes are Alzheimer care facilities and the Eden alternative facilities.

Assisted Living Facilities: The term assisted living (AL) appears to have first been used by the facility sponsors (Regnier 1994). Literature shows that trade publications like Provider, Contemporary Long Term Care, and Retirement Housing Report were the first to use it or to recognize its use in the retirement housing industry (Long-Term Care National Resource Center at UCLA/USC, 1989). Wilson (1990) offered one of the earliest definitions of the paradigm in four components:

- (1) AL is a setting where a person can create his/her own place;
- (2) AL is responsive to the needs of individuals at different levels of physical and mental abilities;
- (3) AL encourages sharing the responsibility with residents and their family members; and
- (4) AL encourages autonomy and independence of residents.

All these components were much like the revised version of patient-centered design guidelines, especially for the elderly. However, the effect of restrictive policies on quality and the extent to which those objectives are achieved by design is often questioned (Golant 1998; Schwarz and Brent 2001). Empirical research in assisted living facilities was focused on the perception of home-like qualities. The basic hypothesis is that the home-like appearance will construct place attachment easier than other facilities that have an institution appearance.

Alzheimer's Care Facilities: Started in late 1970s, the efforts to create a therapeutic environment for Alzheimer's patients resulted in one of the "hot" products in the market (Zeisel 2003a). Cohen and Weisman (1991) mentioned that many of the problems experienced by people with dementia and their caregivers are linked directly to the planning

and design of the environment. The set of behaviors that Alzheimer's patients exhibit, such as wandering around, loss of long-term cognitive capabilities, and sudden mood changes due to increased complexity of situations (such as getting lost, feeling stuck) were approached by practical design solutions. Research results from an early setting, the Weiss Institute of Philadelphia Geriatric Centre, showed that open treatment areas helped patients to orient themselves (Lawton 1979). The environmental effects that help the well-being of patients with dementia were described as prosthetic effects (Cohen and Weisman 1991). The most extensive study that investigated the effect of environmental factors on the well-being of elderly with Alzheimer's disease was performed by Zeisel et al. (2003b) by including 427 residents in 15 special units. The study found that there are associations between each behavioral health measure and particular environmental design features.

The Eden Alternative: The Eden alternative is an innovative model of geriatric residential care that helps to promote well-being among residents by promoting individual autonomy and addressing the problems of loneliness, helplessness, and boredom (Tavormina 1999). It was first proposed by Dr. William Thomas (Thomas 1996), a physician director of a nursing home in the early 1990s who reacted to a number of institutionalization problems inherent in the medical model underlying nursing home care (Hill and Greg 2002). The home-like qualities of the Eden nursing home setting, such as the inclusion of pets, plants, and children in the care environment, as well as the training provided to the staff provide benefits such as reduced medication use, reduced staff turnover, and improvements in resident satisfaction and self sufficiency (Bruck 1997; Sterner 1998).

The latest innovation that was brought to light was The Green House Project which was described as an offshoot of the Eden Alternative (Thomas and Johansson, 2003). The main improvement to the existing model was to reduce the scale of the setting in order to house 8 to 10 elderly; this is described as "a radically new approach to residential long-term care of the elderly" (Thomas and Johansson, 2003). Another challenge of The Green House Project was rejecting the presence of a daily schedule, which regulates the hours of meals, sleep, and

planned activities and provide a full flexibility to the residents. There are number of studies planned to measure the resident and staff outcomes of the Green House Project (Kane 2003).

2.4. Conclusion

In institutional care environments, such as traditional hospitals and nursing homes, there are a number of stressors, such as a lack of privacy, control, and choice that originate from the environmental qualities and the type of care given. Yet, reducing these stressors by changes in the environment are found to be an effective way to increase positive outcomes.

Increased personal control by providing privacy, choice, and familiar environments (home-likeness) were emphasized to provide better psychological outcomes. Providing autonomy, providing functional independence by improved design features, and maintaining social support were counted as factors that make a difference in well-being. All these ideas were inherited by the caregivers and used to market new types of services and buildings that were rarely empirically tested by researchers for their impact on residents.

The review clearly showed the paucity of empirical studies in the new generation of home-like environments. Yet, the findings that serve as a ground for designing therapeutic environments were systematically underlined in the scope of this literature review.

CHAPTER 3: A CONCEPTUAL FRAMEWORK TO STUDY THE EFFECT OF SPACE ON HEALTH AND WELL-BEING

The scope of this chapter is to construct a conceptual framework to describe the main factors to study the effect of space on health and well-being. Prior to the conceptual framework discussion, the theoretical background that gives perspective to this study will be introduced. The factors that are proposed as influential on health and well-being will be investigated by a set of research questions.

3.1. Theoretical Perspective of this Research

This study is primarily based on the core theoretical assumptions of socioecological theory. Ecology, by term, refers to the interrelations between organisms and their environments (Hawley 1950). Although human ecology originates from biology, it has been adopted by various disciplines, such as sociology and psychology, to construct a general framework to understand the behaviors of people in physical, social, and cultural contexts (e.g. Barker 1968; Park and Burgess 1925). According to Stokols (1992), the main difference between human ecology and socioecology is the school of socio ecologists' increased attention to the social, institutional, and cultural contexts of people environment relations. Stokols (1992) outlined four important core assumptions of socioecological theory; I have used these assumptions to develop the design of this research on measuring the effect of space on the health and well-being of the elderly:

- (1) The health and well-being of the elderly that reside in home-like environments are assumed to be influenced by “multiple facets of both the physical environment and the social environment”;
- (2) Studying the health and well-being of the elderly “should address the multidimensional and complex nature of selected long-term care environments”;
- (3) Understanding the effect of space on the health and well-being of the elderly requires “the need for diverse methodologies that incorporate multiple level of analyses”; and

- (4) The selected long-term care environment is “nested” in a larger “system” of care environments, thus the orientation of the selected long-term care environment in this larger “system” should be explained.

Under these basic assumptions of the socioecological perspective, this research has utilized two theories for a better understanding of long-term care environments under the basic assumptions of a salutogenic approach. The salutogenic approach that questions the reasons for being healthy falls in the socioecological perspective (Antonovsky 1979; Stokols 1992). Antonovsky (1996) proposed the use of the salutogenic paradigm and the sense of coherence framework as a useful theory for health promotion research. In fact, there have been explicit and implicit reflections of the salutogenic paradigm to theories that were used to study care environments. The explicit use of the salutogenic paradigm can be followed in the theory of *supportive design* that was developed in the light of research findings from healthcare environments (Ulrich 2001; Dilani 2001).

The implicit use of the salutogenic approach can be followed in the recent model of the ecology of aging. To explain the implicit use of the salutogenic paradigm, the evolution of theories that were used to study environments for the aged will be discussed. These theories were referred to as person-environment (P-E) fit theories, which have their foundation from the work of Lewin (1951). Lewin (1951) proposed that an individual interacts with a “life space”, which includes not only the person and the physical space of the interacting environment, but also the “psychological space” in which the P-E interaction takes space. There are two mainstream theories in the ecological model of aging that conceptualized the “fit” between the environment and the person.

Lawton and Namehow (1973) proposed a *press-competence model* to study the relation between the environment and the aging individual. The model posits that individual behavior and well-being is a function of a dynamic balance between the demands forced by the environment (press) and the individual’s ability to cope with those demand (competence).

According to the competence model, the health functioning of an individual in a certain environment relies on the fit between the demands of the environment and competence of the individual. Based on this model, Lawton and Namehow (1973) postulated a *docility hypothesis* that states that individuals with high competence can withstand greater levels of environmental press, whereas those who exhibit lower personal competence are more vulnerable.

The competence approach, which is also known as Lawton's original ecological model of aging, received three main lines of criticism due to its focus on:

- (1) negative aspects of the environment (press);
- (2) physical capabilities of the aging individual (competence); and
- (3) the limited context of housing and institutional design features but not features of other settings (Carp and Carp 1984; Golant 1998; Kahana 1982).

Carp and Carp (1984) proposed a *congruence model* of aging in which the needs are balanced through the use of resources and supports within the environment. The congruence between the environment and the aging individual is based on the condition where both life-maintenance and high-order needs are met. Life-maintenance needs are used to measure the congruence by looking for a correspondence between environmental resources or barriers and person's competence relevant to activities of daily living (e.g. bathing, dressing, etc.). Congruence of the environment with high order needs measures the availability of environmental resources to meet the individual's needs.

In response to the criticism, Lawton (1987) introduced the concept of an *environmental proactivity hypothesis*, which states that environmental resources are likely to be better used by people of higher competence. Proactivity is displayed when individuals attempt to change themselves or when they create environments to facilitate a desired behavior. In revision of his ecological model, Lawton also added a broad quality of life measure to capture the well-being of the elderly (Lawton 1998).

It is evident that Lawton's revisions make the competence-press and congruence models quite similar. In fact, the original competence model can be described as pathogenic in terms of focusing on the absence of physical competence and the absence of supportive environmental features. However, compared to the competence model, the congruence approach has a salutogenic attitude by underlining the importance of resources in the environment that have the potential to enhance health and well-being. Both models have been utilized to design assessment instruments and to measure satisfaction. Yet, both gerontological frameworks predict that life satisfaction will decrease with age or with poor health (Cvitkovich and Wister 2001). In this sense, both models were weak in explaining the contradiction that despite declining physical and cognitive competence, seniors have a positive outlook on their life situation (Lawton 1990). Still, the concept of environment and the aging individual of the congruence model serves better for the theoretical framework of this study.

The theory of supportive design, which is the second theory utilized in this research, proposes that the capability of healthcare environments to foster improved outcomes is linked to their effectiveness in promoting stress reduction and coping (Ulrich 1991, 1999, 2000). Although this theory is based on the evidence derived from research at healthcare environments, it has strong implications to the home-like long-term care setting where the setting should be designed to enhance the health and well-being of the elderly. Ulrich (2001) generalized physical implications of the supportive design theory in three main domains, which he simply stated as guidelines for designers:

- (1) **Foster control, including privacy** refers to having some control over situations, and having the opportunity to balance between desired and achieved levels of privacy;
- (2) **Foster social support** refers to emotional support and tangible assistance that individuals receive from others; and

(3) **Provide access to nature and other positive distractions** refers to a subset of environmental and social conditions marked by a capacity to improve mood and effectively promote restoration from stress.

Those three domains of supportive design are more practical when compared to the congruence model. Nevertheless, the supportive design theory is based on empirical research that provided hard evidence that are known as *outcomes*. Outcome research moves from the medical evidence (use of medications; monitoring of blood pressure; medical healing indicators for specific illnesses, etc.) by also including the psychological mood of a respondent by reported pain, stress, anxiety, and depression levels (e.g. Ulrich 2000; Zeisel 2003). Yet, the congruence approach provides a broader understanding of the subjective relations between the aging person and the environment by focusing on individual behavioral patterns, perception, and satisfaction.

Utilizing these two theories under the general perspective of the salutogenic approach provides a broader understanding of the complexity of the studied phenomena. The supportive environment theory calls for objective measurement instruments and quantitative analyses. Yet, it decreases the effect of space to only one or a handful of variables selected for this study. The congruence approach displays a bigger picture by including various attributes of the environment that may affect the behaviors of the elderly. Thus, utilizing both of the theories in this study will provide the overall effect of space on behaviors of the elderly, and will explain whether there are associations between environmental variables and behaviors that enhance well-being.

The explicit use of the salutogenic paradigm as a theoretical framework to study long-term care environments is fairly new. Kepez (2005) reviewed existing environmental theories for the elderly and outlined the benefits of employing a salutogenic perspective to upgrade the quality of the built environment. Wister (2005) described salutogenic and pathogenic pathways through which the built environment may influence health, functioning, and

longevity. The adoption of the theory of supportive design from healthcare environments to the home-like long-term care environment is also a new attempt of this research.

3.2. The Purpose of the Study and the Conceptual Framework

The main purpose of this study is to understand the effect of space on the health and well-being of the elderly who reside in home-like long-term care settings. The context of the study is 12-bed group homes for the elderly. The proposed study conceptualizes health and well-being as outcomes of an interaction between a set of complex relations among resources in the environment and human needs (Figure 1). To understand this process it is inherently important to investigate the availability of resources in the environment and the human needs that should be met. It is evident that to the extent that human needs are covered by the environment, the environment can contribute to health and well-being.

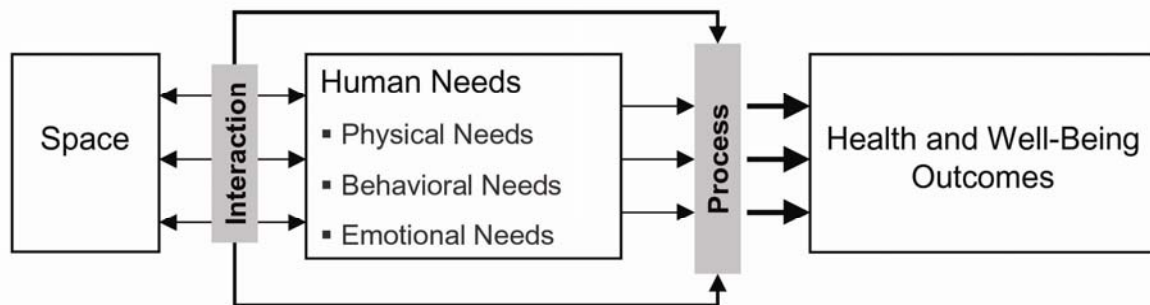


Figure 1: General Conceptual Framework of the Proposed Study

Maslow (1954) summarized the needs of cognitively intact people in three main categories: needs related to survival, maintenance, and personal actualization. Zeisel (2001) adapted Maslow's framework to propose the healing design performance criteria for the elderly with Alzheimer's disease. In the proposed hierarchy of needs for the elderly with Alzheimer's, three types of needs were corresponded to Maslow's original framework. These needs are: physiological or physical needs (survival), behavioral needs (maintenance), and emotional needs (self-actualization). The general conceptual framework of this study inherited the

previous hierarchies of human needs that were extensively described in the works of Maslow (1954) and Zeisel (2001).

The needs of the elderly who reside in selected group living arrangements will be discussed in a detailed conceptual framework. Before that, it is important to point out that this study focuses on the behavioral and emotional (psychological) outcomes of the physical space. Thus, the technical performance of space such as lighting, heating, and ventilation as well as sanitation, are omitted from the assessment of the environment. These conditions in fact were all controlled by standards to provide optimum comfort level. Housing with an optimum comfort level and adequate hygiene is necessary to explore the effect of space on health and well-being. As Maslow (1954) identified and Lawton (2001) contributed:

“If an environment cannot satisfy basic physical needs, there is no opportunity to pursue other needs higher in the hierarchy” (p.7.3)

The studied group living arrangements respect the building codes that describe the list of required spaces with the minimum floor areas, as well as the furniture that should be installed. Although the presence of required spaces with appropriate features can be counted as resources in the environment, this doesn't necessarily imply that behavioral and psychological needs are covered. Thus, the absence or presence of resources in the environment would be an incomplete explanation of the therapeutic potential of space. Human behaviors in the environment also make an important dimension of the health and well-being phenomena. Thus, understanding the link between space and behaviors that may contribute to well-being is an important part of an environmental assessment. There is a complex process that develops as a result of interaction between a people and the environment during the process of meeting needs. Some of these processes may also affect the health and well-being of individuals.

The main behavioral needs that should be covered in an environment are privacy, social interaction, functional independence, and to the ability to read the environment. The physical environment plays an important role in helping individuals achieve a desired level of privacy

(Altman 1975) and define their personal space (Sommer, 1969). It is also known that the physical design of the environment can encourage or discourage social interaction (Osmond 1959; Hall 1966, 1969; Lang 1987) and appropriate design of the environment can increase the physical capability of its occupants (Lawton 1980; Steinfield and Danford 1999). The environment should also be at a certain level of complexity to provide a visual stimulus for cognition and maintain brain activity in a healthy state (Davidson et al. 1997).

In an environment, psychological needs are the needs that we cover by being part of the environment (belongingness), by defining our territory with non-verbal cues (individuation), or simply by having a stable positive experience of being in the space (mood). Zeisel (2001) preferred to use the adjective “emotional” to describe the needs at the highest level in the hierarchy of needs of the elderly with Alzheimer’s disease. I would prefer to use the adjective “psychological” to emphasize the results that can come out of unmet emotional needs.

The variables that can fall in a different hierarchy of needs are simply more than the basic needs counted above. Although it is unmanageable to accurately describe every need and to develop strategies to measure the coverage of needs by the environment, the outcomes of unmet needs are easier to conceptualize and investigate.

The literature in healthcare settings presented valuable findings of research samples that identified a link between outcomes and the environment (Ulrich and Zimring 2004). However, studies that rely on medical outcomes generally have a population that is identified by some particular health condition, such as patients recovering from surgery (Ulrich 1984) and premature infants (Miller et al. 1995). The elderly population that is selected to be studied is diverse and is expected to use multiple medications, some of which are necessary to maintain their health condition. Thus, reduced medication use may not necessarily be an outcome of environmental attributes. Due to the use of medication and the probability of diverse physical competencies, the blood pressure and pulse rate, which were counted as another indicator of positive mood (Ulrich et al. 2003; Leather et al. 2003) would also be a

biased medical outcome for the elderly. Moreover, grounded on the salutogenic model, this study conceptualized health and well-being regardless of the physical competence of the respondents. This theoretical assumption also prevents any possible conflict that may arise due to studying a group of people with diverse physical competence. The theoretical framework of the study also presented the concept that as long as the environment enhances the well-being, this has positive implications to any of the medical outcomes. Yet, keeping individual track of each respondent's medical outcomes would be a "pathogenic" turn by focusing on illness related factors. Thus, the conceptual framework of this study omits any of the "pathogenic" outcomes of health and focuses on well-being.

Depression and stress also have been studied as an important outcome of environmental attributes. Among the two, *depression* is a better indicator of continuing "pressures" (Lawton and Namehow 1973) in the environment or a lack of "congruence" (Carp and Carp 1984) between the environment and the elderly. This study conceptualized that *the daily use* of group home space provides cues about the healing potential of the environment. The level of social interaction and the use of indoor and outdoor space were defined as the major outcomes of the design of group home space. Spatial configuration, the fixed (e.g. wall) and semi-fixed (e.g. movable furniture) features of spaces; size (scale) of spaces; and the walking distances between spaces were counted as main factors that effect the interaction between the elderly and the environment, as well as the social interactions between residents. The proposed concept relies on testing the assumption that changes in the factors of space (configuration, scale/distance, and features) may affect the well-being of the elderly by intervening in their daily use of the environment. The detailed conceptual model (Figure 2) shows the relationships between the explained concepts and the variables selected to be studied.

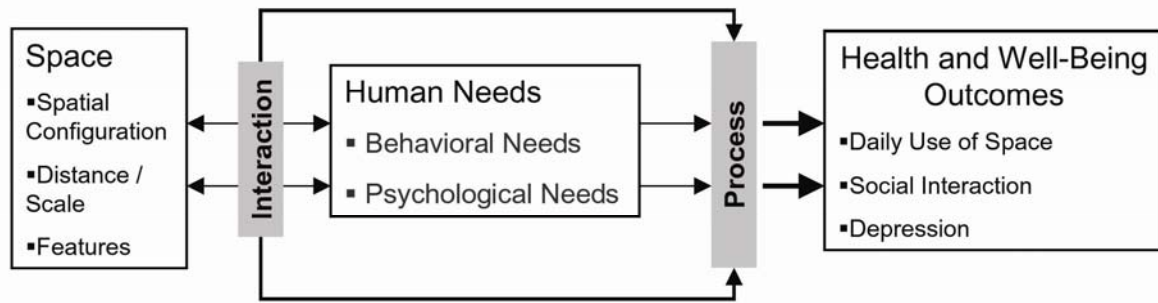


Figure 2: Detailed Conceptual Framework of the Proposed Study

3.3. Research Questions

The main research question of this study is: “What is the effect of space on health and well-being?” In the general context of the conceptual framework specifically applied to group homes, daily use of space and social interaction were regarded as well-being outcomes. The way that spaces come together defines a configuration that was described as a factor that plays a major role in behavioral and psychological outcomes. Walking distance, which correlates with the scale of the group home and the features of spaces were also described as other spatial factors that may affect the health and well-being of the elderly. Thus, questioning the effect of these spatial factors on space use and on the social interaction of residents also provides answers explaining the effect of space on health and well-being.

The main research questions for the three sub-groups of space-related factors are as follows:

A.1. Effect of spatial configuration on the use of space:

(1) What are the properties of spatial configuration that lead to more active use of the environment?

A.2. Effect of spatial configuration on social interaction:

(1) What are the properties of spatial configuration that lead to an increase in social interaction?

B.1. Effect of walking distances on use of space:

- (1) What is the effect of distance between a resident's bedroom and one of the common areas on the use of the designated space?
- (2) Which variables, other than distance, could be a factor for the use of space?

B.2. Effect of walking distances on social interaction:

- (1) What is the effect of distance between a resident's bedroom and one of the common areas on social interaction at the designated space?
- (2) Which variables, other than distance, could be a factor for the use of space?

C.1. Effect of Environmental Features:

- (1) Which environmental features are associated with increased activity?
- (2) Which environmental features are associated with increased social interaction?

Another inquiry can be made by investigating the reliability of the factors that were described as well-being outcomes for the respondents of this research. Since the basis of these well-being outcomes are from the literature, answers to these questions will only provide the consistency of the data collection.

D.1. Is there any association between use of the outdoors and social interaction?

D.2. Is there any association between use of the outdoors and depression levels?

D.3. Is there any association between use of one of the common areas and social interaction?

In order to answer the research questions above and discuss the findings, this study tested the basic hypothesis that plan types with different spatial configurations lead to differences in the use of spaces and the social interaction between residents that may affect well-being. The methodology followed and data collection instruments used in order to compare the plan types will be presented in the next chapter.

CHAPTER 4: METHODOLOGY

4.1. A Closer Look at the Context of the Study

The context of this study was previously described as “home-like group homes for the elderly”. Yet, this description includes a large array of buildings with different features according to the number and needs of the people accommodated. The respondent group was defined as a “diverse population” due to their different physical competencies. There has been also limited reference to cognitive capabilities of the population and the level of care they received. Thus, prior to explaining the methodology of this research, the setting of this study and the physical and cognitive competency of the residents selected to be studied will be introduced.

According to the Centers for Medicare & Medicaid Services’ classification (2002), there are three types of long-term care facilities that can serve the elderly with different functional independence:

- (1) **Traditional community** is generally for residents with high independence and contains building types such as single family housing and apartments.
- (2) **Community housing with services** is generally for residents with medium independence and contains building types such as group homes, care homes, and assisted living facilities
- (3) **Long-term care facility** is generally for residents with low independence and contains building types such as long-term care centers and nursing homes.

To make these classifications more precise, it’s necessary to describe the levels (low, medium, high) of independence of the residents of each category. The physical independence of the elderly is generally measured by their competence in activities of daily living (ADL) and instrumental activities of daily living (IADL) (Lawton and Brody 1969; Lawton 1990). Activities of daily living are bathing, dressing, eating, getting in/out of a chair/bed, walking, and using the toilet. Instrumental activities of daily living are using the telephone, performing light/heavy housework, preparing meals, shopping, and managing money. There has been a

discussion that these two measures do not cover all the variability in measuring independence of older adults, especially the willingness to adapt to a changing environment (Roger et al. 1998). Yet, by far, these instruments are preferred with priority since they provide accurate results for the decision-makers (Lawton 1990). There are various methods to measure the cognitive status. However, since the selected context does not include cognitively impaired elderly, these methods will not be discussed here.

The context of this study falls in the facility type of community housing with services. According to data regarding Medicare enrollees (Centers for Medicare & Medicaid Services, 2002) age 65 and older with functional limitations, 37% of community housing with residents have no ADL limitations and 18% of them had only limitations in performing IADL. Thirty three percent (33%) of residents of this category had one or two ADL limitations, whereas 12% of them had three or more ADL limitations.

Community housing with services is an umbrella term that still contains a large number of different buildings. Thus, there is also a need to describe specific subgroups of buildings in this category. The term “home-like care setting” is often perceived as assisted living facilities, which are a subgroup of this category. However, as discussed in the literature review, assisted living facilities contain various types of living arrangements. This variation can also be observed in capacity and thus in the scale of the building; these factors cause differences in physical features of the building. Selecting cases from facilities with the same capacity is essential to control these factors.

Another variation comes from the differences in the quality standards of the state in which the facility is licensed. In contrast to nursing homes, no federal quality standards exist for assisted living facilities. Additionally, states vary significantly in their licensing requirements, quality standards, and monitoring and enforcement activities (AARP Public Policy Institute 2004). Since this lack of standardization may cause physical differences in

care-giving settings and may cause a bias if cases are selected from different states, North Carolina was defined as a geographic cluster for this research.

North Carolina's long term care system calls assisted living facilities "Adult Care Homes". Senate Bill 502, ratified by the 1995 General assembly, established new terminology and definitions for what were formerly called domiciliary homes in North Carolina. Adult care homes are now defined in G.S. 131D-2 as follows:

"Adult Care Home" is an assisted living residence in which the housing management provides 24-hour scheduled and unscheduled personal care services to two or more residents, either directly or, for scheduled needs, through formal written agreement with licensed home care or hospice agencies. Some licensed adult care homes provide supervision to persons with cognitive impairments whose decisions, if made independently, may jeopardize the safety or well-being of themselves or others and therefore require supervision. Medication in an adult care home may be administered by designated, trained staff. Adult care homes that provide care to two to six unrelated residents are commonly called family care homes. Adult care homes and family care homes are subject to licensure by the Division of Facility Services.

As mentioned in the definition, there are some differences between Adult Care Homes (ACH) according to the number of beds that they are licensed to operate. A closer look at the policies revealed three main scales of adult care homes, according to the maximum amount of residents (beds) they can accommodate:

- (1) Adult care homes with two to six residents (also known as family care homes)
- (2) Adult care homes with seven to twelve residents.
- (3) Adult care homes with more than 12 residents.

There are different building codes and policies applied to each scale. The family care homes have completely different building codes than the others. The rules that apply for adult care homes of seven or more beds were published in the same book of rules. Yet, the design and construction section of the book of "Rules for Adult Care Homes of Seven or more Beds" clearly stated that:

All new construction, additions and renovations to existing buildings shall meet the requirements of the North Carolina State Building Code for I-2 Institutional Occupancy if the facility houses 13 or more residents or the North Carolina State Building Code requirements for Large Residential Facilities if the facility houses seven to twelve residents. 10A NCAC 13F.0302 (a) p: 7

Two interviews conducted with state officials from the Rules, Administrator Certification, and Education Programs and Construction Section of the NC Department of Health and Human Services, Division of Facility Services (on 06/23/2005) provided a snapshot of the situation of adult care homes at the time.

According to the information gathered from interviews:

(1) Family care homes are facing diverse problems. The original ideal behind the family homes was to provide support to families to take care of older adults in their homes. However, when approached only as a profitable business by inexperienced families in care giving, owners of these facilities are overwhelmed with long lists of responsibilities they have to shoulder. When a family care home is operating with minimum number of occupants or under capacity, the caregiver may also face financial problems.

(2) There has been a recent trend to build 12-bed adult care homes since these homes cost less during construction. For example, there is no requirement to install a sprinkler system and build an industrial kitchen if the facility is licensed to run with maximum of 12 people. It is common to build a 12-bed unit and then add other separate units on the same site after the existing unit receives recognition in the care market.

In light of the interviews, careful analysis of the rules and field trips to facilities with different capacities were made; 12-bed adult care homes were selected as the context of this study.

4.1.1. The Physical Environment of 12-Bed Adult Care Homes

Section 13F.0305 of the rules book (10A NCAC, pp: 9-11) for adult care homes of seven or more beds talks about the properties of the physical environment of 12-bed adult care homes. The physical environment of a 12-bed adult care home primarily consists of three common areas: the kitchen, the dining room, and the living room (dayroom). The bedrooms can be private or shared by two residents. The minimum requirements for these spaces, as well as

minimum requirements for corridors, outdoor areas, bathrooms, and toilets, are clearly defined under the same chapter.

The rules generally state the obvious that should be in the design of the physical environment. For example rule a-(4) of the chapter identified above states that “each living room and recreational area shall have windows.” There are also some rules that require “obvious” relationships between spaces such as rule h-(1) that states, “Service entrances shall not be through resident use areas” or rule e-(2) that specifies that “Entrance to the bathroom and toilet facilities shall not be through a kitchen, another person’s bedroom or another bathroom.”

These rules define obvious relationships between spaces to maintain privacy. Yet, some rules define spatial relations without a clear basis. For example rule b-(1) indicates, “Each living room and recreational area shall be located off a lobby or a corridor. At least 50 percent of required living and recreational areas shall be enclosed with walls and doors.” Similarly rule d-(4) states, “Bedrooms shall be located on an outside wall and off a corridor.”

The presence of the corridor may be unavoidable in larger facilities but there’s no exception for facilities with 12 beds or smaller. These two rules implicitly described a corridor to link the bedrooms to the recreational area. The outside of the facility is described as “outdoor grounds” under the m subsection of the rules of the physical environment. The lighting of the outdoor walkways, cleanliness, safety, and specifications of an outside fence (if installed) were the only factors mentioned about outdoors.

The minimum furniture that should be installed is also defined under the chapter of housekeeping and furnishings (10A NCAC 13F.0306, pp: 11-12). The absence of any rule for outdoor furniture clarifies that the use of the word “furnishings” is limited to only indoor furniture. Some rules provide details about the furniture in addition to the required number and/or size. For example the dining tables should be “small tables serving from two to eight

persons (d-1)” and there should be “a minimum one comfortable chair (rocker or straight, arm or without arm, as preferred by resident), high enough from floor for easy rising (b-5)” in each resident’s bedroom.

Sometimes these rules can be unbalanced in terms of providing details such as rule c of the same chapter that states, “The living room shall have functional living room furnishings for the comfort of aged and disabled person with coverings that are easily cleanable.” In this rule the quality and arrangement of the furniture to comfort the aged and disabled person is overlooked. However, the maintenance for any possible incontinence is provided as a criterion for the living room furniture.

The rules for the physical environment and furnishings of adult care homes guarantee that each resident gets a bed, a side table, a storage space, a chair in a bedroom, a sitting area in a living room, a chair in a dining room, and access to a semi-private bathroom and toilet. The rules also guarantee that these spaces and furniture should be adequately hygienic and in good physical condition. However, the rules barely discuss anything other than the basic physical needs. The behavioral and psychological outcomes of the physical environment were often ignored.

4.2. Research Design Overview

As explained in the previous chapter, this study fits in the socio ecological theoretical perspective, which underlines the complex nature of the relation between well-being and the environment. In the case of studying the effect of space on the well-being of the residents of 12 bed adult care homes, this complex nature of the problem was perceived as a call to employ a multiple case study methodology.

According to Yin (1994):

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context; especially when the boundaries between phenomenon and context are not clearly evident. (p: 13)

In this study, the selected adult care homes have a selection criterion that all cases have distinctive designs. Although the selected cases may not accurately represent all distinctive designs of adult care homes, they represented a meaningful sample to study the phenomena by utilizing analytical selection criteria.

This research aimed to test whether differences in plan layouts lead to differences in residents' use of the environment that may influence well-being. The differences in behaviors were explained by the differences in relationships between spaces in a plan layout. The proposition is that existing or future designs that have similarities to the selected cases will function in a similar way. Thus, in the end, these propositions will be used to make an environmental assessment for home-like long-term care settings.

In multiple case studies, each case is argued as a single experiment and the combined analysis of all cases is expected to explain a causal link. In this study, the analysis of each case (experiment) was reported in descriptive statistics. However, cross case comparisons were made by using inferential statistical methods which will be discussed in Chapters 6 and 7.

Yin (1994) argues that case studies can be explanatory, descriptive, or exploratory in purpose. According to the purpose or purposes, case studies can have different structures. Having explanatory, descriptive, and exploratory purposes, this study has a *linear analytic structure* format with an established problem statement, followed by a literature review, methods, and results.

Nine adult care homes with twelve bed capacity were purposefully selected to be studied. These nine cases represented four distinct plan types. One plan type has three cases and the other three plan types have two representative cases. This research was conducted on four different sites and each site contained cases with the same plan type.

This research employed multiple instruments for data collection that provided qualitative and quantitative data. Later sections will provide details regarding the design and application procedures for these instruments, as well as the selection of cases and respondents of this research.

4.3. Case Selection Criteria and Sampling Procedure

A list of 12-bed facilities was derived from a list of licensed adult care homes retrieved from the Adult Care Licensure Section of Division of Facility Services of State of North Carolina website (<http://facility-services.state.nc.us/licenseinfo.htm>) in June 2005. The list provided the name of the owner, contact information (address, phone, and fax), license number, and the licensed capacity. This list contained 631 facilities ranging in capacity from 8 to 201; 84 (13.3%) of the facilities were 12-bed adult care homes.

The owners who run more than one facility generally give the same name to facilities at the same site but add a number according to the building number or the order of license application. Except for 28 (33%) individual homes, 56 (67%) of the twelve bed adult care homes were located as clusters of 2 to 6 homes. The priority of the case selection was given to the facilities that own more than one home, preferably on the same site.

The distribution of facilities that were located in the same ZIP Code and licensed to the same owner can be seen in Table 1. Half of these clusters contain two buildings which make 32% of the total number (56) of buildings that were in clusters.

Table 1: The distribution of clusters

Number of Buildings in Cluster	Number of Clusters (Same Owner and ZIP Code)	Σ Buildings in Clusters
2	9	18
3	4	12
4	1	4
5	2	10
6	2	12
	18	56

There were three criteria established based on the list of adult care homes and the recent list of adult care homes that received penalties during the previous year. In order to be eligible to be participants in this research, the adult care home:

- (1) Should not be on the list of facilities that received a penalty or violation;
- (2) Should be within 1.5 hours of one way driving distance from the researcher's origin;
- (3) Should contain at least two buildings with 12-bed capacity on the same site or two close locations (24 of the licensed homes were only one building at one site); and

There are two types of violations that a facility can be given. Type A violations are those that create substantial risk that death or serious physical harm will occur or where such harm has occurred. Type B violations are those that present a direct relationship to the health, safety, or welfare of residents, but not substantial risk of death or serious physical harm. In either case, the facility is not appropriate to present conditions that this research aims to explain.

Since the design and data collection of this research required the researcher to spend an extensive amount of time at selected sites establishing a proximity criterion for the selection of cases was necessary. By using the ZIP Codes of the addresses and online maps, the driving time between the researcher's origin and the adult care homes were calculated. Then, a separate list was generated by including adult care homes that were within a 1.5 hour one way driving distance.

Earlier it was mentioned that the nearly 70% of cases were on the list were clusters. Selecting research sites that contain clusters provided the benefit of reaching the necessary number of respondents. This criterion also decreased the number of owners to contact to ask for participation and thus decreased the number of eligible homes. However, once an owner volunteered, access was obtained to at least two cases under the same administration.

The active use of space and social interaction between residents were conceptualized as well-being outcomes, which required the presence of at least a small group of residents. Thus, the

participation of a group home that did not house at least half of the capacity would provide biased data. Therefore, for the reasons explained, a fourth criterion was established for the facilities that agreed to participate that there should be at least 6 residents (per building) who won't be away during the application of research.

By using the first 3 criteria, 42 adult care homes were selected from the list of 56 adult care homes. These 42 candidate cases were deliberately chosen to include the adult care homes that were in the closest driving distance to the researcher's origin.

A letter from the North Carolina State University College of Design was sent to the administrators of these selected adult care homes prior to the phone call they received from the researcher. A brief introduction of the research project, information about the researcher, and an invitation for participation in this research project was provided in the letter. A separate support letter, addressed to the small amount of facilities that were owned by non-profit organizations, was sent from the Institute for Non-Profits of North Carolina State University. In that letter, it was confirmed that the researcher received a small grant to study the physical environment of non-profit institutions. In both letters the contact information of the researcher was included on a separate card in the event that the administrators wanted to contact the research upon reading the support letter(s).

The letters were mailed in two groups such that the second group was mailed after receiving responses from the first group of facilities. The first group contained 19 adult care homes that were owned by 6 different organizations. The second group contained 23 adult care homes that were owned by 8 different organizations. Two different organizations agreed to participate from the first mail group. One organization had three buildings and other had two buildings at their location. One organization that owned four adult care homes in pairs at two different locations called willingly from the second mail group. Other organizations either rejected the request or never returned the call.

Administrators who accepted the opportunity to participate in the study provided the current number of residents during phone conversations. All facilities met the minimum resident number criteria established. In summary, there were 9 adult care homes from 4 different sites, three of which contained 2 cases and one of which contained 3 cases (Figure 1-4).



Figure 1: Site 1 with three identical 12 bed adult care homes



Figure 2: Site 2 with two identical 12 bed adult care homes



Figure 3: Site 3 with two identical 12 bed adult care homes



Figure 4: Site 4 with two identical 12 bed adult care homes

4.4. Resident Characteristics and Respondent Sampling

Respondents of this study were residents of selected cases who were eligible to participate.

Section 13F.0701 of the rules book (10A NCAC, p: 28) defined the admission of residents to adult care homes as:

- (1) Any adult (18 years of age or over) who, because of a temporary or chronic physical condition or mental disability, needs a substitute home may be admitted to an adult care home when, in the opinion of the resident, physician, family or social worker, and the administrator the services and accommodations of the home will meet his particular needs.

According to the licensure renewal applications of 2003, there were 24,893 residents of adult care homes of 7 or more beds. Thirty three percent (33%) of this population was male and 67% was female. Although there was no separate data available for the homes with 12 beds, looking to the distribution of the ages provides a general picture (Table 2). Sixty one percent (61%) of the whole population was above 75 years old. Sixteen percent (16%) of the whole population was also between 65 and 74, which showed that 77% of the whole population was older than 65 years old. In sum, it is more likely to come across female residents older than 65 years old.

Table 2: Distribution of Age and Gender of Residents of ACH of Seven or More Beds

	Age Categories (1=100%)						All
	25-34	35-49	50-64	65-74	75-84	85+	
Total	0.01	0.07	0.14	0.16	0.30	0.31	1.00
Male	0.01	0.05	0.07	0.06	0.08	0.05	0.33
Female	0.01	0.03	0.06	0.09	0.23	0.26	0.67

Source: The Department of Health and Human Services of State of North Carolina, Division of Facility Services, Adult Care Home Licensure Section

There is no study that reports the physical and cognitive competence of the elderly who reside in 12 bed adult care homes. The adult care homes with special care units for Alzheimer's and Mental Health Disability were not considered in the case selection procedure. However, facts showed that approximately 52% of assisted living residents had some form of cognitive impairment (National Center for Assisted Living 2001). The population studied consisted of residents who were cognitively intact enough to socially interact with others and make decisions. If a resident did not have legal competency to sign a consent form he/she was not counted as a respondent.

4.5. Methods of Data Collection

Considering the diverse physical and cognitive competencies of the adult care home residents, the data collection methods were selected to minimize the involvement of residents. This research primarily relied upon surveys for each respondent that were designed to be completed by caregivers and systematic observations as data collection methods. These two instruments were used to collect the primary data that were used to make cross-case comparisons.

The plan layouts of the studied cases were used to run a spatial analysis to show that each plan type had a different configuration. The plan layouts were also used to calculate distances from residents' bedroom to each of the common areas (kitchen, dining room, and dayroom). By employing analytic measurement tools, plan layouts were validated as a resource for data. However, software that were used to derive the data for comparison of plan types and used to measure the distances were perceived as a tool for analyses, rather than data collection instruments. More detailed information about these analyses will be provided in the following chapters.

There were also series of secondary data collection methods and instrumentation such as interviews, record consulting, and checklists. The administrators of the selected cases and the willing residents were interviewed. The Part D of a recent license renewal form, which

contained the census information of the licensed building, for each case was also collected. The qualities of the physical environment were measured by using a Physical and Architectural Features Checklist (PAF), which is part of the Multiphastic Environmental Assessment Procedure (MEAP) that was developed by Moos and Lemke (1996). Interviews, records of license renewal form, and a PAF checklist were regarded as the secondary data, which were used to gather detailed case-specific information.

4.5.1. Primary Data Collection Instrument 1: Caregivers' Survey

It is common in studies of long-term care environments to ask caregivers' evaluation of residents. Especially in cases where the studied population lacks the cognitive capabilities to respond to the data collection instruments that require active participation. For instance, while studying the associations between environmental design features of nursing home special care units and the incidence of aggression, agitation, social withdrawal, depression, and psychotic problems among the residents with Alzheimer's disease, Zeisel et al. (2003) employed instruments that heavily relied on nurses' day to day experience with the subjects and information in medical records.

Caregivers' involvement is also valued when there is a need for data that requires record consulting. For example, the Resident and Staff Information Form (RESIF) part of the Multiphastic Environmental Assessment Procedure (MEAP; Moos and Lemke, 1996) contains questions about a resident's background (age, education, occupational background, etc.), payment plans, length of stay, and physical competence.

This survey was designed to be completed by caregivers of selected cases in this study and was made up of six parts:

(1) Background of the resident: This part asked for information regarding gender, age, country of birth, native language, ethnic background, marital status, and length of stay of the resident. The Background Information Form (BIF), which was a part of the RESIF (Moos and Lemke 1996) was used as the basis for the questions in this part. The BIF was

originally designed to be conducted with the resident in facilities where the records were incomplete or nonexistent. The questions that were in the original instrument were modified to be completed by a caregiver instead of the resident himself/herself. The questions that were about the educational background, religious preference, occupation, and source of security income were omitted.

(2) Competence in Activities of Daily Living (ADL) and Instrumental Activities of Daily

Living (IADL): Competence in the six items of the activities of daily living (bathing, dressing, eating, getting in/out of a chair/bed, walking, and using the toilet) and the five items of the instrumental activities of daily living (using telephone, performing light/heavy housework, preparing meals, shopping, and managing money) were queried by using a 3 point scale (no help needed/some help needed/cannot do it all) to represent the status of being independent (no help needed), somewhat independent (some help needed), and completely dependent (cannot do at all). The scale and the frame of the question were adopted from the 11th question of the BIF (Moos and Lemke 1996). The question was again reworded to be completed by a caregiver instead of the resident.

(3) Caregiver’s Evaluation of Resident’s Participation of Social Events: This part of the survey was designed to measure the participation of each resident in social events.

According to the rule 10A NC AC 13F.0905 titled as “activities program”:

Each adult care home shall develop a program of activities designed to promote the residents’ active involvement with each other, their families and the community” (part a, p: 37) and “There shall be a minimum of 14 hours of a variety of planned group activities per week that include activities that promote socialization, physical interaction, group accomplishment, creative expression, increased knowledge and learning of new skills. (part d, p: 37).

The activity director, as required in Rule .0404 of the same subchapter, shall “...evaluate and document the overall effectiveness of the activities program at least six months [sic] with input from the residents...” Based on the requirement stated by the rules, the hours of attendance to weekly planned social events were queried. Caregivers were also asked

to compare the willingness of the resident to attend social activities with other residents by using a 4 point scale (very willingly, willingly, somewhat willingly, not willingly).

Since the selected cases were in clusters, each cluster and the surrounding area was defined as a community and the number of hours of weekly participation of each resident to the events inside and outside this community were queried. When there was no activity that was arranged for participation of residents from different buildings, caregivers were told to bypass the question. The last question asked the friendliness level of the resident with other residents by using a 4 point scale (very friendly, friendly, somewhat friendly, not friendly).

(4) Caregiver's Evaluation of Resident's Mood: In the context of the proposed study, stress can be explained as the *short-term* outcome of the environmental conditions. However, depression is conceptualized as a *long-term* outcome that may have occurred as a result of constant exposure to stressors related to the environment. In other words, the long-term failure in the coverage of human needs may cause depression. The instruments used to measure the depression were generally based on self-report of 10 to 30 items of depression symptoms on rating scales or simply positive and negative responses. (30 items, Geriatric Depression Scale, Yesavage and Brink 1983; 15 items, Geriatric Depression Scale-15, Sheikh and Yesavage 1986; 21 or 13 items, The Beck Depression Inventory (BDI), Beck and Steer, 1987; 10 items, Center for Epidemiological Studies Depression Scale (CES-D), Robinson, et al. 2002). Yet, the use of any of these instruments in the selected research settings was not possible due to several reasons. First, these instruments require direct involvement of the participants, which made it impossible to directly use them. Even if this weren't an issue, these instruments contain questions such as "Do you feel worthless the way you are now?" (In the original and shorter versions of GDS, Geriatric Depression Scale, Yesavage and Brink 1983; Sheikh and Yesavage 1986) that can easily offend participants and/or the owner of the facility, both of whom reserve the right to decline participation in the study at any time.

The instruments, such as the 13 item Multidimensional Observation Scale for the Elderly (MOSES; Helmes et al. 1987) that has been used to measure depression (7 items) and social withdrawal (6 items) relied on the caregivers' daily experiences. Yet, with its formal design and nature of questions, there was a chance it would be easily rejected considering this study's circumstances where participation was voluntary. Moreover, the scope of this study needed only the basic idea of a residents' mood instead of a detailed depression diagnosis. Thus, a new and less formal scale was developed for caregivers to assess the mood of the residents based on their observations for the past two months.

Caregivers were asked to assess residents' mood by providing opinions to seven propositions on a 3 point scale rating (always, sometimes, never) that describes the frequency of the behavior observed in last two months. These seven criteria (depressive mood most of the day, diminished interest in everything, diminished pleasure in everything, weigh loss or gain, insomnia or hypersomnia, decline in ability to think or concentrate, fatigue or loss of energy nearly everyday) that were used to evaluate the residents' moods were derived from the American Psychiatric Association's Diagnostic and Statistical Manual of Mood Disorders' (DSM-IV; American Psychological Association 1994) criteria for a major depressive episode. The original list consisted of 9 items that also included two criteria for individual factors that might not be observable ("feelings of worthlessness" and "recurrent thoughts of death") and a criterion of psychomotor agitation or retardation nearly everyday, which by its presence, would disqualify the resident from this study. A criterion that "included diminished interest" and "pleasure in all" was divided into two items, which in total made seven items.

- (5) Caregiver's Evaluation of Resident's Use of Outdoors:** In this section, caregivers were asked the number of hours of outdoor use for each resident in a usual week. The subjective rating of the caregiver for the resident's use of the outdoor on a day with

appropriate weather conditions were also queried on a 3 point scale (very, somewhat, never).

(6) Resident's Privacy Status: The resident's room sharing status (private bedroom vs. shared bedroom) and the resident's relationship with his/her roommate (with relative/spouse vs. with non-relative) was queried in two questions provided to the caregivers.

The self-administered survey was completed with two final questions: One question asked the caregiver about the resident's general competency in hearing, understanding, and speaking to assess the resident's competency for an interview. The final question included the plan layout of the building and asked the caregiver to mark the resident's bedroom or the side of the resident's bed if the room was for double occupancy.

4.5.2. Primary Data Collection Instrument 2: Observations

When declining competencies of adult care home residents are considered, the use of data collection techniques that require direct involvement of the participant becomes questionable. In addition to the variety of residents with different cognitive competencies, the status of receiving care often puts adult care home residents in a biased position to report their negative thoughts about the environment. This study conceptualized the daily use of the adult care environment and social interaction between residents as an important outcome of design. In the context of adult care homes, the differences between the daily uses of space, as well as the differences between social interactions of the residents, could be best understood by employing systematic observation and behavioral mapping as the data collection instrument.

Observation and behavioral mapping is a method for describing what people do in the designed environment. It is an indirect approach compared to the methods that have relied on direct user involvement in seeking design-related information (Sanoff 1991). Studies that incorporate observation as a data collection instrument in care environments generally use 30 minute intervals (e.g. Peatross 1997; Schwarz et al. 2004). However, the population for these

studies were mentally handicapped (Peatross 1997) or elderly with Alzheimer's disease (Schwarz et al. 2004). In Parker et al.'s (2004) study of 38 long term care buildings, observations were made every 15 minutes during two-hour periods in the morning and in the afternoon; only 8 observations in total were made to represent the actual use of the environment. Some studies preferred causal observations instead of systematic observations (Peatross 1997 and De Syllass 1999). However, Sanoff (1991) stated that:

Causal observation may result in incomplete findings that reveal only what seems to be obvious (p: 79).

The 40-45 minute observation cycles were tested by pilot studies carried out at two independent research sites prior starting to collect the data and determined to be an appropriate time to capture the daily life in an adult care home. The number of behavior maps to be collected for analyses was determined in consideration with the statistical methods used.

Observing conversation between two residents was defined as an indicator of social interaction. By this definition, all the conversation groups in which caregivers or visitors were involved were not considered a social interaction that was initiated by the residents.

These limitations defined a special conversation group that was named the "resident only" conversation group that was counted as an outcome of social interaction. Among these types, only some interactions that involve "lively conversations" between residents were defined as conversations that infer social interaction with residents.

In order to be counted as a conversation in this category, conversation should be continued during the observation, which generally took approximately 5 minutes. The residents who were actually observed while they were talking were noted as conversation group members. Listeners who were in the same group (side of the room, table, etc.) but demonstrated behaviors that indicated that they were not part of the group (no eye contact, not facing the conversation, intensely occupied with something else) were not counted as a member of the

conversation group. Ignoring all the conversations between caregivers and residents, the inequity due to caregivers' level of social involvement with residents was controlled to an extent.

In summary, the behavior maps provided the following information:

- (1) The use of a 12 bed adult care home space; and
- (2) The number of people in conversation groups and the location of conversation groups in the facility.

4.5.3. Secondary Data Collection Instruments

Secondary data refers to the data that was collected to describe the background of a facility, to analyze individual plan types and to include thoughts of participants about the environment. Interviews, administration of an environmental checklist, taking photographs and record consulting were the techniques used for collecting secondary data.

Interviews: Administrators and willing residents were interviewed. A structured face to face interview was conducted with administrators with open ended questions in the very first meeting (upon their agreement to participate to this study). Information about the building, staff and residents, their priorities as a caregiver, and their views of the environment were queried. Residents who desired to speak about the environment were also interviewed. They were asked to describe a regular day in the facility. Based on their answers, more specific questions were asked about the environment, such as their way of individualizing their environment, their favorite spaces, and their thoughts regarding social life in the facility. The pilot study, which included 10 residents, showed that questions with open ended answers worked better than the questions with scales for the respondents since these questions require less memory and can be answered more flexibly.

The Physical and Architectural Features Checklist (PAF): Lawton et al. (1997) consider the Multiphastic Environmental Assessment Procedure (MEAP) the most extensive and best-developed environmental assessment instrument. Yet, due to its applicability to a large array

of building types ranging from nursing homes to congregate apartments, many of the questions became irrelevant in the scale of a 12 bed adult care home. The PAF is one of the five instruments that make up MEAP that measures the physical resources of group residential settings for older people (Moos and Lemke 1996) and was selected to be used.

The PAF comprises 153 scored items that cover facility location and space allowances; however, the PAF focuses only on the availability of these resources and not on their use. A set of 31 additional items provide a description about the neighborhood and building. All information is obtained by direct observation. Moos and Lemke (1996) described four dimensions of the physical environment to be measured by eight different subsections of the PAF. These are:

- (1) **The degree of physical integration** are measured by the “community accessibility section”;
- (2) **Physical features for comfort and involvement** are measured by the “physical amenities” and “social-recreational aids” sections;
- (3) **Supportive physical features** are measured by “prosthetic aids”, “orientational aids”, and “safety features” sections; and
- (4) **Spaces for resident and staff functions** are measured by the “staff facilities” and “space availability” sections.

Except for the “space availability” scale, most PAF items allow for a dichotomous (yes/no) response, reflecting the presence or absence of a particular feature. Since the sizes of the rooms were covered by separate analyses, this feature of the PAF was not used.

Records: The Part D of the recent license renewal for each building was collected from the administrator of each facility. It contains the census data (total number, age, payment plan type of the residents, total number of admissions, death, etc.) and information related to staff (number of people employed, staff turnover rate, etc.) The plan layouts of the buildings were copied from fire evacuation plans displayed in the facility and each facility was photographed to provide information about common indoor and outdoor spaces.

4.6. Data Collection Procedure

Upon acceptance of the invitation to participate in the research by the administrator in the initial phone conversation, an onsite meeting time was requested. In this meeting, the aim of the research and level of involvement of the administrators, staff, and residents were explained. Each data collection instrument was introduced in the same format that would be used during the data collection. The consent forms for each participant type (administrators, caregivers, and residents) and the approval of the Institutional Review Board of North Carolina State University for the instrument and procedures of this research were shown and explained.

After clarification of any concerns that the administrator might have, he/she was asked to sign the consent form that enabled the researcher to officially start conducting this research. According to the administrator's time constraints at the time, this initial meeting was followed by the interview or a separate day was scheduled. At the end of the first meeting:

- (1) A facility tour, which was guided by administrator, was completed;
- (2) The researcher was introduced to caregivers and residents that were in common areas;
- (3) The plan layout of the buildings were collected from the fire evacuation plan;
- (4) The administrator was given the surveys to be completed by caregivers;
- (5) Dates were set up for a community meeting and for observations; and
- (6) The recent license renewal for the buildings of the facility was requested.

The interview with the administrators took from 15 minutes to an hour. The interviews were digitally recorded and a photo of the administrator was taken at his/her favorite location at the facility. At one research site, the administrator volunteered to complete caregiver surveys. At other sites, caregivers who had day to day experience with the residents completed the surveys. Upon providing the survey, a short informal meeting was held with caregivers who were going to complete the survey and the instrument was introduced. Caregivers were also asked to sign consent forms in this meeting. Surveys for each case were collected in a closed envelope. Additionally, caregivers' photographs were taken in their favorite location at the facility.

This initial phase of the research project took a quite different turn at one of the research sites located in a large retirement community where two eligible buildings were just a small part of the community. Upon agreeing to the project, the general administration of the facility required the research project to be reviewed by their research review board that was established by the residents of that community. Then, after passing that board, the researcher was asked to meet with residents of the two eligible buildings to convince them to participate. At the other three sites, community meetings were set up after consent was given by the administrator.

The plan layouts of the buildings were analyzed before proceeding to further stages of the research. This was done to confirm that the spatial configuration of the building clusters were different from each other. Since each site contains buildings with identical plan layouts, there's one plan layout for spatial analysis. The spatial analysis of each plan type belonging to four different facilities showed four unique configurations of the common spaces (kitchen, dining, and dayroom).

The aim of the second visit was to meet with the residents in a community meeting and have them sign the consent forms after the information session. In the case where the participation of the facility was tied to the residents' votes, a specially designed communication technique was used. Used heavily in internet based customer services for providing answers to possible questions that may arise, the Frequently Asked Questions (FAQ) idea was utilized in a presentation. Ten questions were designed to cover the content of the consent forms and provide answers for inquiries about this research. Each question was printed out in a large panel with large font size that was readable from a distance. The researcher stood in front of the community and one of the caregivers was requested to hold the panels. During the 15 minute session, each question was read loudly and then answered by the researcher. After completion of the session, most of the residents signed the consent forms. A few residents who had additional questions stayed to talk in detail about their concerns. This technique was

observed to be very successful in eliminating the individuals who may influence others by their questions and comments in a community meeting.

In each case, the spoken format of the consent form was played through a stereo at an adequate level when the residents were provided the consent forms form for signing. The resident consent form was also printed in large and bold fonts.

Observations were performed in order to cover two weekdays and one day during the weekend. When a full day of observations was not appropriate due to the scheduled events of the facility, two half day observations were performed. In summary, each facility was observed for six periods of breakfast time to lunch time and six periods of lunch time to dinner time. The behaviors of residents and their spatial location were noted on the plan layout of building. The caregiver was asked to provide the total number of residents who were present at the observation cycle at the times when all residents were not visible from common areas.

The residents were observed during a walking tour that was taken once for every 40-45 minute interval between each observation cycle. The days of the observations were purposefully selected from the usual days of facility. No data was collected at special times of the year such as holidays, on any special day for the facility (e.g. birthday of a resident, cleaning day) or when there was a prearranged social event.

During the observations, in order to minimize the intrusion of the researcher to the environment and avoid any bias the following actions were taken:

- (1) Prior to collecting the data used in analysis, the researcher spent at least a half day at each facility to make some initial observations that were not used and answer the residents' questions;
- (2) Residents were not given the exact day of the observations but were provided with the weeks when the researcher might show up;

- (3) The researcher was outside of the facility at all times between the observation cycles at a place which is not directly visible from the facility;
- (4) No other data was collected during the observations; and
- (5) Socialization with staff and residents was minimized.

In order to observe residents during the times when they have free choice to do any activity they want, no observation data was collected during the daily regular events such as meals or prearranged social hours. In general, observations started 45 minutes after the breakfast was served and ended at 8:00 pm, leaving time for two observations after the dinner was completed around 6:30 pm. In order to meet the requirement for the statistical analyses, at least 30 observations were recorded from each building during this procedure.

Upon completion of the observation and the collection of surveys from caregivers, interviews with willing residents were collected, residents were interviewed privately and their voices were digitally recorded. At the end of the interview, their pictures were taken at their favorite location in the facility.

After the completion of each step, an informal session was set up with the administrator, if requested, to discuss the preliminary findings from the site. The time required to complete each research site ranges from 9 to 15 days, upon gaining full access to the research site. The whole data collection took 3 months, excluding the time spent gaining access to the research sites.

The data collection procedure for this study is summarized in Figure 5. The flowchart displays the hierarchy of the procedure by displaying the application of the primary data collection instruments. For example, observations could not be done before informing residents in a meeting. Prior to starting the interviews with residents, the caregivers' survey should be in hand to provide a profile of the respondent who was going to be interviewed.

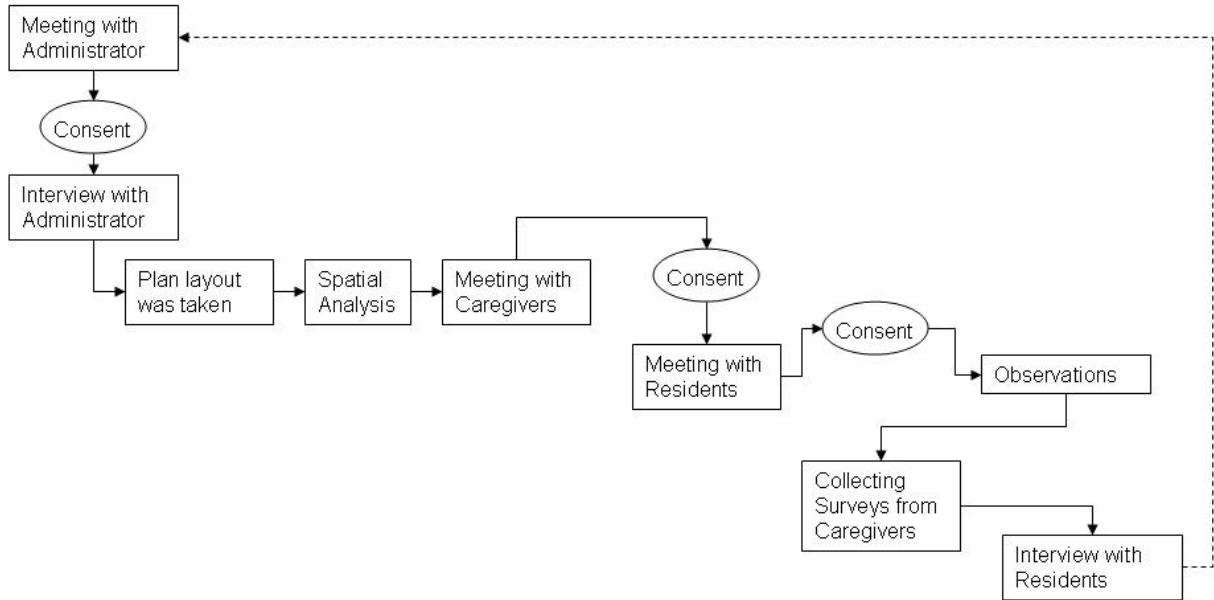


Figure 5: Data collection procedure of the study

The secondary data (checklist, data from records) -except the plan layout- that could be collected anytime after gaining access to the research sites, were omitted from the flow chart.

The photographs of participants were framed and sent with certificates of participation to respondents as incentives. A separate invitation to the public presentation of this research will be also sent to each facility. Also, onsite presentations will be held for the residents after the completion of the final document.

4.7. Data Analyses Strategies

Table 3 shows the summary of the data gathered from four different sites. One site contained three (3) buildings and other three sites contained two (2) buildings with the same plan layout. In total, there were 80 respondent residents in total ranging from 13 residents to 23 at different locations. Eighty (80) surveys in total were collected from four sites since there was one corresponding caregivers' survey that was filled for each resident. The mean observations per case were 36 from the first two sites and 32 from the other two sites that resulted as 308 observations from 9 cases. In total, there were 21 interviews which ranged from 2 to 9 interviews per site.

Table 3: The Summary of the data collected from four plan types

	Number of				
	Cases	Residents	Caregiver's Survey	Observations	Interviews
Plan Type 1	3	21	21	36 x 3 = 108	6
Plan Type 2	2	13	13	36 x 2 = 72	9
Plan Type 3	2	23	23	32 x 2 = 64	4
Plan Type 4	2	23	23	32 x 2 = 64	2
Σ 4 plan Types	9	80	80	308	21

The main aims of the data analyses strategies and the corresponding analysis for each strategy were as follows:

- 1) To test and show that the selected plan types for this study had a different configuration (spatial analysis of each plan type);
- 2) To report information about the residents in each case (descriptive analysis of each plan type);
- 3) To report whether residents of different plan types have differences in outcomes (cross-plan type comparison);
- 4) To test the consistency of caregiver responses to survey questions by treating the whole data set as one (regression model);
- 5) To report the associations between the variables reported for the entire population of residents (regression model based on combined data of all plan types);
- 6) To test whether the observed space use in different plan types was different (cross-plan type comparison);
- 7) To test whether the observed social interaction in different plan types was different (cross-plan type comparison); and
- 8) To report the residents' views about their living arrangements (quoting from interviews).

The detailed description of each analysis will be performed in the next three chapters. The first findings chapter is focused on the spatial analysis which was done by incorporating Space Syntax techniques. The theory and application of Space Syntax is based on replacing

the plan layout with a non-metric interface where each space has values to represent its relations to other spaces in the system. The introduction of this theory, the definition of the values, and creation of the non-metric interface will be in the next chapter that is also the first chapter of findings.

The second chapter was focused on reporting the findings from the caregivers' surveys. First, the results for each site with a distinct plan type were reported to provide a detailed description about background, competence, mood, and level of social interaction of residents. Second, a cross plan type comparison was able to be made by assigning scores to the ordinal scales and calculating means of the variables for each plan type.

Third, by using the quantitative data of all respondents a regression model was built to query associations between the variables. The distances between common spaces and residents' bedrooms, the rank of each bedroom in the building in terms of its proximity to common areas, the values derived from the syntax analyses, and the size of residents' bedroom were also included as quantitative variables in the data set. There were two benefits of employing regression. The first benefit of using a regression model was to be able to define whether there were associations between the spatial variables and any of the outcomes. For example, with this model one can query whether there is any relation between a resident's distance to the dayroom and his/her participation in social events. The second benefit was to test whether there is any consistency between caregivers' responses to survey questions and testing findings of the literature by using this model. For example, based on the literature, use of the outdoors and the level of social interaction were expected to be negatively correlated with depression. Thus, observing the opposite might have required further investigation by considering reliability of the caregivers and the presence of other variable(s) that was (were) ignored.

The third and final chapter of findings reports the findings of observations. First the observations from each site with a distinct plan type will be reported individually. Then, two

types of cross plan type comparisons were made by incorporating the actual number and percentages of residents in each observation. The numbers of residents were different in each building and each plan type; this may cause a bias if only the actual numbers were used for comparison. For example, observing the same number of people in the dayroom of buildings with a different total number of residents may result as no difference in use in the dayroom of these two buildings. Thus numbers of residents observed in each space were divided by the total number of residents in the building to calculate the percentages. The same analyses were done to make a cross-plan type comparison of observed social interaction. All maps that were used to mark the locations of residents were overlapped and resulted in a map of use and a map of social interaction for each plan type.

Interviews that were conducted in this research were unstructured and mostly provided diverse data. The results of interviews were not reported in a separate findings chapter but quoted in the conclusion chapter. Residents' daily use of their environment, which was queried in the interview, was also covered by the findings of observations. Thus, only residents' recommendations to future buildings and their comments on their facility were collected from the interviews. The inclusion of interviews with residents was perceived as giving a voice to the residents of 12-bed buildings, rather than data analyses.

CHAPTER 5: AN ANALYTICAL TOOL TO EXAMINE THE SPATIAL CONFIGURATION OF PLAN TYPES

5.1. Space Syntax: An Analytical Tool to Examine Plan Layouts

Space syntax is best described as a research program that investigates the relationship between human societies and space. This relationship is investigated from the perspective of a general theory of the structure of inhabited space in all its diverse forms: buildings, settlements, or even landscapes (Sonit 2003). The theory of space syntax is built on the assumption that an inhabited environment has a structure that can be used to explain the social logic of observed behavior patterns.

This structure of a social system can be configured into a connected set of *discrete units* and the knowledge of space can be compressed to a set of relationships among these discrete parts (Hillier and Hanson 1984). This theory will be explained further when discussing the building scale that was applied in this research. Since the plan layout and immediate outside of the building has been studied for this research, the use of “space” applies to the interior and exterior of the building but not larger scales.

The way that space syntax methods describe any space is by first defining the *units* that make the plan and then defining the relationships between these units. These units in a plan layout are termed **convex spaces**. The objective is to divide the plan layout into the fewest number of convex spaces. Hillier and Hanson (1984) briefly explained this procedure as follows:

Two dimensional organization (plan layout) could be identified by taking the convex spaces that have the best area-perimeter ratio, that is the fattest, then the next fattest, then the next, and continue until the surface is completely covered. (p: 17)

After dividing a whole plan into convex spaces, each convex space is identified by a circle or a dot (node). In this step, it is also necessary to select an origin, which for this research is the immediate exterior area outside of the main exit. The selection of the origin is essential to proceed to the next step of drawing lines between the nodes to represent the connections

between convex spaces. The final product of these procedures is called a **permeability graph**, which represents the relationships of permeability between each of the convex spaces in a layout. In a graph, the least number of lines (steps) that one can follow to go from one node (convex space) to another is defined as the **depth** between these two spaces.

In space syntax terminology, the origin is termed as the **carrier**, and is represented with a cross superimposed on a circle. The carrier can be any of the spaces in a graph. In fact if a graph is restructured so that a carrier is placed at the bottom, then it is termed a **justified permeability graph**. When a graph is justified, a notion of hierarchies between spaces becomes obvious. In a justified permeability graph, it is easy to track the depths of other spaces from the carrier since they are noted as depth levels.

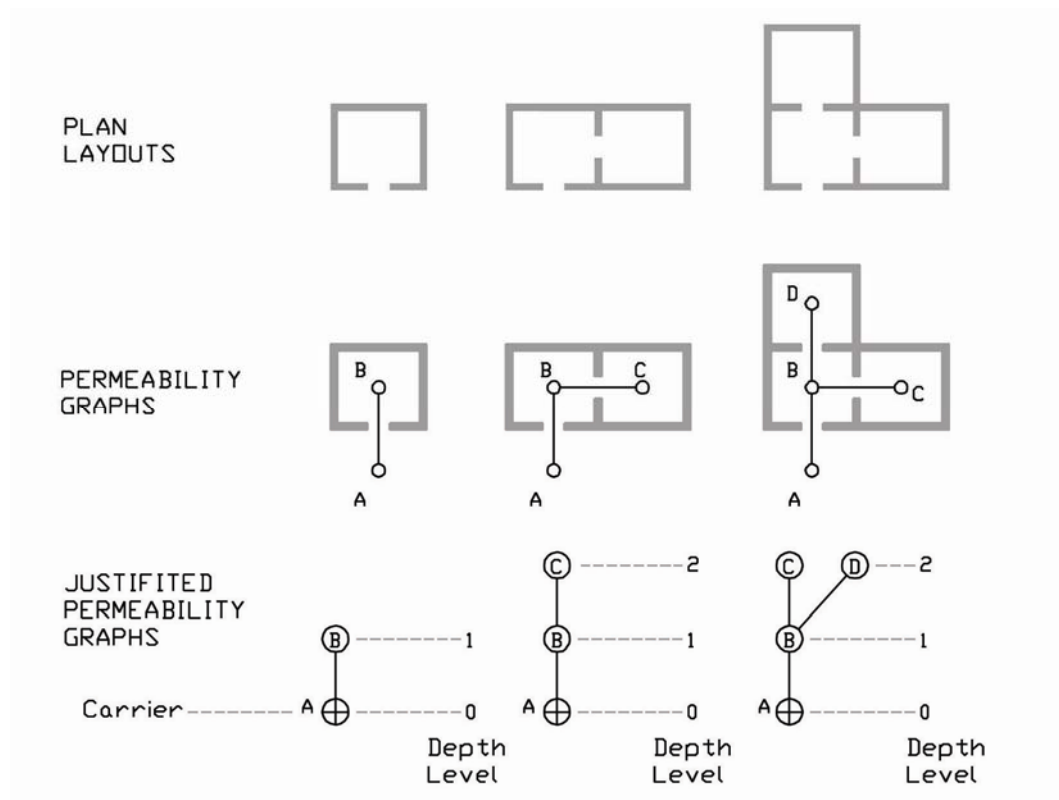


Figure 1: Step by step configuration analyses of three buildings

A set of three “abstract” buildings will be used to demonstrate the configurational analysis and concepts previously described (Figure 1). As seen on the plan layouts, all three buildings

have a different number of rooms and therefore they have a different number of convex spaces. Taking the entrances as the carrier, in the first building, the convex space B is one depth level from the entrance. Whereas in the second building, there are two depth levels with the inclusion of convex space C. In the third example, the convex space B gives access to two other convex spaces (D and C). The location of D and C is different but their relationship to the carrier and B is the same, which shows that they belong to the same depth level.

The notion of depth introduces other concepts and measurements that are useful for making comparisons between convex spaces that are in the same building or for making cross comparisons of convex spaces in different buildings. These concepts will be briefly introduced here however; formulas for calculations have been omitted.

Integration, which is also known as **relative asymmetry (RA)**, describes the average depth of a space to all other spaces in the system. Hillier and Hanson (1984) noted that:

The measure of relative asymmetry generalizes this (depth) by comparing how deep the system is from a particular point with how deep or shallow it theoretically could be – the least depth existing when all spaces are directly connected to the original space, and the most when all spaces are arranged in a unilinear sequence away from the original space, i.e., every additional space in the system adds one more level of depth. (p: 108)

Integration can be calculated for each convex space; the sum of all integration values provides the integration value for the building. The integration value of any convex space varies between 0 and 1, with low values indicating a space from which the system is shallow. A shallow system, or a system with a low value, indicates that the space tends to integrate the system. High values indicate a space that tends to be segregated from the system (Hillier and Hanson 1984). The integration value is used to compare the convex spaces within the *same building*.

It is possible to calculate *integration values with and without the exterior*, which refers to considering or ignoring the relationship between indoors and outdoors when drawing the convex maps. In this study, the exterior of a building is described as the immediate outdoor environment (e.g. porch, patio) designed for recreational activities. Previous research commented that looking at houses with and without the exterior is an important dimension of configurational analysis. This is especially true when including the exterior creates a ring pattern in the graph (Hanson 1998); this pattern indicates that including exteriors depicts new accesses to some of the convex spaces.

Global Integration, which is also known as **global real relative asymmetry (RRAn)**, is the transformation of integration values of different systems to make comparisons across systems with a significantly different number of convex spaces. When integration values are transformed to global integration values; the results will not be simply between 0 and 1, but above and below 1. Values well below 1 will be strongly integrated while values tending to 1 and above will be more segregated (Hillier and Hanson 1984).

Local Integration, which is also known as **local real relative asymmetry (RRAⁿ)**, is a local measure of integration according to the number (n) of convex spaces around the convex space for which the local integration value is calculated. Local integration is usually calculated according to three convex spaces around the considered space.

Connectivity of a convex space in a system is the number of all other spaces directly linked to it (Hillier and Hanson 1984). In this definition the word “directly” emphasizes that there is no change of direction in the access of one space to another. Simply, it is the number of immediate neighbors of any convex space that are within one depth level.

Control value is the sum of the access that a space receives from its immediate neighbors. Hillier and Hanson (1984) described control value as follows:

Each space has certain number n of immediate neighbors. Each space therefore gives to each of its immediate neighbors $1/n$, and these are then summed for each receiving space to give the control value of that space. Spaces which have a control value greater than 1 will be strong control, those below 1 will be weak control spaces. (p: 109)

The calculation of these values was made by using NetboxTM and NetwaveTM software that were obtained from the Space Syntax Laboratories of the University College London. NetboxTM was used to draw the graphs and justify them by taking the entrance as the carrier. NetwaveTM was used to calculate the tables that have control, connectivity, local integration, and global integration values.

5.2. Space Syntax Literature on Care Environments

Although the theoretical foundation of Space Syntax goes back to 1970s, the application of Space Syntax in care environments is fairly new. A small number of studies focused on group living arrangements for children (De Syllass 1989; Peatross, 1994, 1997), mentally handicapped people (De Syllass 1999), individuals with Alzheimer's (Peatross 1994, 1997), and the elderly who reside in different scales of long-term care settings (Hanson and Zako 2005).

Peatross (1997) has used space syntax to compare the spatial dimensions of three Alzheimer's units and three juvenile detention centers in the United States of America. Peatross found that the core most integrated spaces usually supported the group activities of residents. The ways in which the major routes cut thorough the common areas (dayroom, multi-purpose room, etc) and the rings (loops) created by these routes were found to be factors that played a role in the use of the space.

De Syllass (1999) studied 11 local authority hostels for mentally handicapped people in Britain. The policies at the time were founded on the theory that housing mentally handicapped individuals in their home communities, rather than isolating them in closed institutions, will increase their social integration to a normal life and their independence. The 11 studied hostels housed 20 to 30 people and contained different types of buildings. Interactions between residents, staff, and people in local community were observed and the

spatial configuration of the plan layouts was analyzed by employing Space Syntax tools. The study provided evidence suggestive of a strong relationship between spatial provision and spatial organization of the hostel buildings and the potential for residents to achieve a degree of independence and choice in their domestic lives. Additionally, the study argued that both large and small facilities can function well, if appropriately designed. There was no correlation between space syntax variables and the social interaction that conflicted with the original theory. The study proposed a model of social relations to explain this finding and concluded that spatial configuration is an important factor for social interaction, yet social interaction has other non-spatial factors. De Sylass noted that:

...although spatial integration may be a pre condition of social integration, it is not a sufficient condition. (p 45.2)

The most extensive study of long-term care environments by employing space syntax theory and applications was conducted by Hanson and Zako (2005) in collaboration with another research team from University of Sheffield.

In the review of empirical studies in care environments (Barnes et al. 2002), the Sheffield team underlined the necessity of assessment instruments that are more reliable for British care settings. Later, the Design in Caring Environments Study (DICE) was conducted by this team by collecting cross sectional data on building design and quality of life in 38 care homes in and near Sheffield, Yorkshire. The sample of buildings were stratified into approximately three equal groups based on the number of beds: small (less than 31), medium (31-40), and large (41 or more). The residents' quality of life and staff morale were assessed. The physical environment was measured by a new tool that was developed in the scope of this study called the Sheffield Care Environment Assessment Matrix (SCEAM). The SCEAM is comprised of a matrix of 318 user requirements that are grouped into eleven user-centered domains and seven architectural elements. The study found significant positive associations between several aspects of the built environment and the residents' quality of life (Parker et al. 2004).

The plan layouts of 38 buildings that provided the data to the DICE study were analyzed by utilizing Space Syntax tools (Hanson and Zako 2005). Syntactic variables were then included in the existing data set that contained quantitative measures of the quality of life of residents and staff. Multi-level regression analyses showed that axial global and local integration were significantly associated with quality of life outcomes.

The ten syntactic variables included in analyses showed no correlation with any of the Sheffield's architectural variables, therefore showing that including syntactic measures to statistical models enrich the spectrum of the variables.

The results of this study revealed clear and positive correlations between spatial design variables and three critical variables: the proportion of the residents' active time, the frequency of the residents' enjoyable activity, and the extent of the residents' choice and control over their environment. In summary, this study showed that the more integrated the building, the more active the residents. The overall findings of this study suggested that the whole building layout has a clear role to play in supporting important aspects of the quality of life of residents living in care homes. Based on the findings, the authors criticized the current design guidance (see Hanson and Zako 2005 and Hollingberry 1993) that emphasizes the importance of localized and segregated building layouts, particularly for dementia sufferers. They suggested that the hotel type of home where all the residents have access to a shared and well-integrated public realm may result in a better quality of life for older residents.

Hanson and Zako (2005) concluded in their paper that the configuration of space plays a part in long term care residents' quality of life. They also underlined the need for future research that included the space syntax variables that were not taken into consideration in this research.

The way that this study utilized Space Syntax is somewhat different from the studies discussed here. The main use of the syntactic analyses is to confirm that the selected plan

types were different from each other in terms of their spatial configuration. There were nine cases with four plan types that were below the statistical requirement to form a multiple regression model by including syntactic values, data from observations, and caregiver reports. Thus, the syntactic results of four plan types, as well as the mean of other investigated variables, were compared to each other by ordinal rankings of the plan layouts.

However, the caregivers' reports regarding 80 residents, metric (distance to common areas and area) values, and syntactic values of each residents' bedroom were analyzed by employing multiple level regression model. The use of space syntax in this research will be explained in detail later.

5.3. Applications of Space Syntax Methods in this Research

The main use of space syntax in this research is two-fold. First, the space syntax method was used to describe whether the selected plan types are different from each other. Second, the syntactic values that belong to each respondent's bedroom were included in the data set derived from the caregivers' report about each resident. Table 1 shows the relation between space syntax data and use.

Table 1: The Use of Space Syntax Values

Space Syntax Values	Plan Type Selection Criteria	Regression Model
Integration	Yes	No
Global Integration	Yes	Yes
Local Integration	No	Yes
Connectivity	No	Yes
Control	No	Yes
Depth from Common Spaces	No	Yes

Comparison of global integration values of spaces has previously been established as a method to make cross plan type comparisons in interior spaces (Hillier and Hanson 1984; Hanson 1998). This is mainly because the calculation of integration relies on the total number of spaces in the system and mean depth value. The transformation of the integration

values to global integration values provides a useful piece of information that allows researchers to make comparisons across buildings that have a different number of spaces.

The plan types selected for this study have a different number of convex spaces and therefore, require the use of a transformation of *integration* values to *global integration* values when making cross comparisons. Two main types of cross comparisons were made with the global integration values at hand:

- (1) A cross comparison of **the order of global integration values** of convex spaces for each plan type; and
- (2) A cross comparison of **the global integration values of common spaces** (kitchen, dining, dayroom, and exterior) for each plan type.

In this research, all of the comparisons between plan types were done by involving the exterior space. A cross comparison on the impact of including exterior environments was performed separately to describe whether the immediate environment of the selected plan types produced significant changes in the integration variables.

The other variables were local, meaning that they were focused on a convex space and its immediate neighbors. When evaluating the data that was provided by caregivers for each resident; each resident's bedroom is marked on the plan layout. This spatial information was used to calculate space syntax variables of each bedroom and to add these as individual variables to the regression model. For each resident, the global and local integration; control, and connectivity variables of his/her bedroom were treated as individual spatial information.

Global integration, local integration, connectivity, control, and depth of the bedroom from dayroom, dining, kitchen, exterior, and entrance areas were calculated by using the obtained research software. When there was more than one convex space for the same activity, the means of all values with the same activity were calculated. Calculation of means became necessary since:

- (1) Plan Type 2 has two different dining spaces (garden dining and general dining) and three different dayrooms (living room, sitting room and parlor);
- (2) Plan Type 4 has two different areas for sitting activities (dayroom and sunroom); and
- (3) Plan Type 1 and Plan Type 2 have two outdoor convex spaces, whereas others only have one outdoor space.

5.4. Spatial Configuration as the Plan Type Selection Criteria

The pivotal argument of this study is that differences in the design of the environment provide different health and well-being outcomes. Thus, it is crucial to define plan type selection criteria that objectively describe the difference between plan types. In the conceptual framework of this study, this criteria was described as the *spatial configuration*.

The **configuration of a space (spatial configuration)** simply describes the interrelations of all spaces within a plan layout. It is important to distinguish *spatial relations* and *spatial configuration*. Spatial configuration is a complete set of all spatial relations that are observable in a given plan layout. Hanson (1998) noted that:

Spatial relations exist where there is any type of link between two spaces. Configuration exists when the relations which exist between two spaces are changed according to how we relate each to a third, or indeed to any number of spaces. Configurational descriptions therefore deal with the way in which a system of spaces is related together to form a pattern, rather than with the more localized properties of any particular space. (pp: 22-23)

5.5. The Need for Considering Metric Relationships as a Variable

Transforming the plan layout to a permeability graph provides the non-geometric and non-metric relationships of all convex spaces to each other. It is a compressed piece of information that one can easily decode to understand the interrelationships between the spaces in a given plan layout. However, the geometric (shape) and metric (length, area) properties of space are not represented. According to space syntax theoreticians, the representation of all spatial relationships between convex spaces is more useful to understand the social logic of space.

Some of the space syntax concepts that were introduced earlier are expected to correlate with the metric information that is lost during the generation of the graphs. For example the walking distances in buildings is expected to increase as the total area of the building increases. It is also natural to expect an increase in the number of rooms with the increase of area, which in turn, increases the depth levels. Yet, there is no absolute rule that proves that an increase in area is directly proportional with the number of rooms.

Figure 2 displays five example buildings to clarify the relation between plan layouts and graphs. All plan types have four convex spaces. Buildings 1, 2, 3, and 4 have the same total area with the same area of each convex space, whereas building 5 is larger than the others. If we make a categorization based on *shape* of the plan layout, there are three categories. Buildings 1, 2, and 3 have square plans; Building 4 has a broken line shaped plan; and Building 5 has a rectangular plan type.

If we make a categorization based on *spatial configuration*, then there are three different categories. The first category includes Building 1 compared to the second category that includes Building 2. The third category contains Buildings 3, 4, and 5. In this example set it can be observed that buildings with the same plan configuration (same number of depth levels) may have different areas and (or) shapes. These differences between sample buildings may result in a corresponding difference in the walking distances. Thus, it is hard to depend on the spatial configuration when the actual distances between spaces are expected to play a role in the behavioral outcomes.

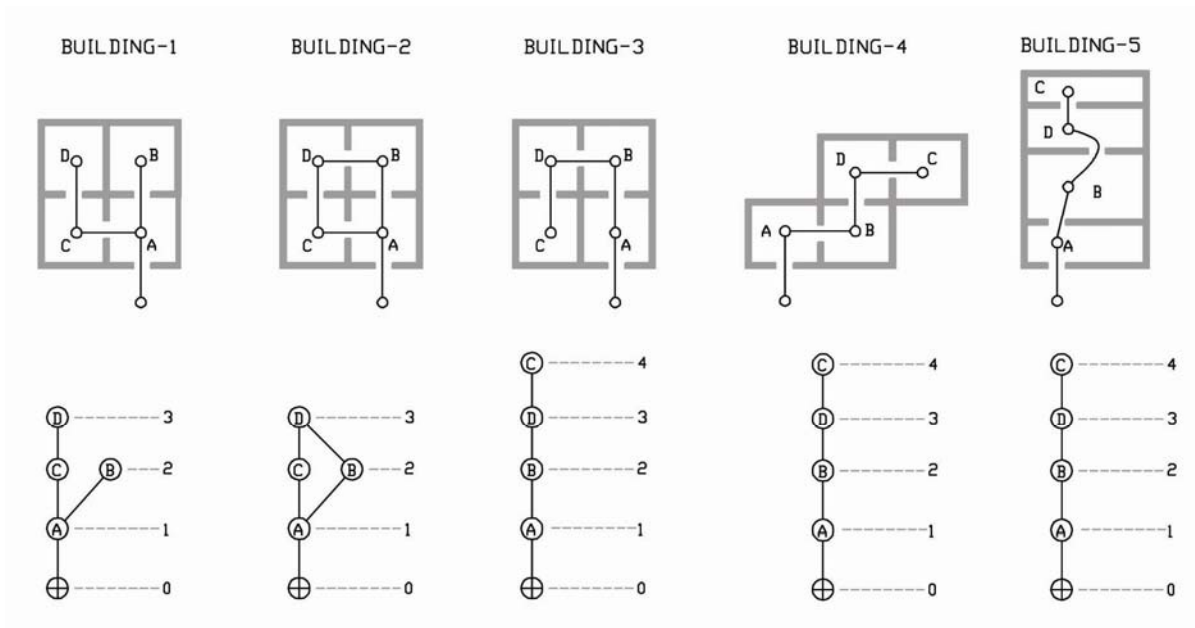


Figure 2: Spatial configuration of five buildings

The conceptual model of this research outlined the walking distances between bedroom and common spaces as a factor of the actual use of the space. However, the use of syntax analysis may be inadequate considering the fact that the depth level between bedrooms and other spaces may not be taken as a factor of distance. Two or more bedrooms may have the same integration value to any of the common spaces, but still might be perceived as close or far from the destination by the user. Due to the declining competencies of the residents of adult care homes, even small walking distances can be challenging.

Hence it is important to include the walking distances from bedrooms to common spaces and the area of bedrooms as variables. Walking distances are calculated as the *shortest path* between centers of origin and destination. This prevented alternate routes for the destination by providing a natural selection of the most feasible route.

In a given plan type, the metric properties have an *actual* and a *relative* value. The actual value is what the length of the route or the area of the convex space is. Considering each plan type as an independent environment, the rank of the metric properties may impact the actual

perception. For example a resident whose bedroom ranked as 56th in the list of actual walking distances between all residents' bedrooms to the dayroom may have the bedroom with the closest walking distance to the dayroom in his/her facility. The same is true for the area of the bedroom.

In order to include this as a variable to be tested, relative values of distances and areas for each bedroom convex space were calculated by first adding all same category of metric values in a plan type and then obtaining the percentages by dividing each actual distance (or area) to the total distance (or area).

5.6. Spatial Analysis of Individual Plan Types

The space syntax methods and their use in this research were previously explained. This section demonstrates the spatial analyses by using space syntax tools. First, general information will be provided by presenting the layout of each plan type. The spatial relations that emerge as important in the plan level will be discussed. Then, the convex maps will be derived from the plan layouts by defining each unit that contributes to the plan layout. The convex map will be used to draw a graph by utilizing the research software. Based on the relations defined in the graph, syntax values will be calculated. The graphs and the values will be evaluated and spatial configuration of each plan type will be defined.

5.6.1. Plan Type 1: The General Plan Layout

The plan layout of Plan Type 1 can be simply described as a *linear double loaded corridor*, which means that the layout consists of a large corridor with rooms lined up on both sides of the corridor (Figure 3). The rooms on either side of the corridor can be perceived as groups. However, a closer look at the functions of these spaces indicates that the spaces on one side basically contained all the common spaces (kitchen, dining, and dayroom) and the spaces on the other side contained all the shared bedrooms. This facility contained only one bedroom on the opposite side of the corridor of other six bedrooms. This type of group of spaces with similar functions will be referred to as *clusters*. In Plan Type 1, the spaces not only formed groups according to their location on one side of the corridor, but they also defined two main clusters.

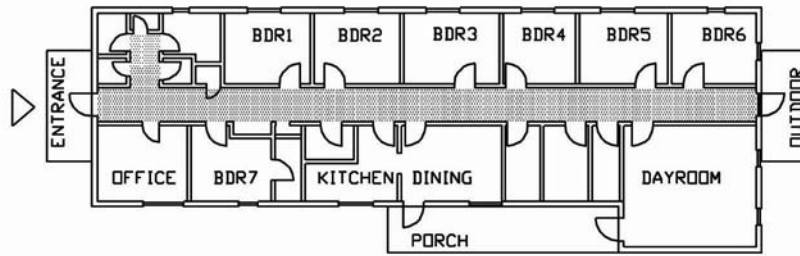


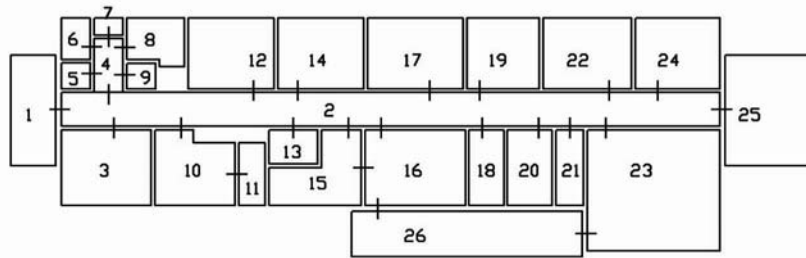
Figure 3: Layout of Plan Type 1 (shaded spaces showing the circulation)

Kitchen and dining areas were directly connected with each other and the dining room opened to the porch. The dayroom was close to the outdoor exit and also provided an exit to the porch. The main outdoor area was at the opposite side of the building. The service areas, such as the laundry room, soil room, and restrooms for visitors and storage were placed at the entrance on the bedroom cluster side. In fact these small spaces formed another cluster and they were connected to the main corridor by a hall. The office space was located opposite of this cluster.

5.6.1.1. Plan Type 1: Drawing the Convex Map and the Graph

The spaces with clear boundaries made drawing the convex map of Plan Type 1 easy. The main circulation is provided by the corridor, which is described as one convex space. The hall between the service spaces is described as another convex space due to the change of direction in the circulation. All other spaces, including the porch and outdoor area, are represented by 26 convex spaces.

In Figure 4, the spaces that are connected to each other are represented by a single line intersecting with the adjacent boundaries of the convex spaces. By using the convex map, the permeability graph was drawn and justified by taking the entrance as the *carrier* (origin).



- | | | | | |
|--------------|---------------|----------------|---------------|------------|
| 1 ENTRANCE | 7 STORAGE | 13 BATHROOM-8 | 19 BEDROOM-4 | 25 OUTDOOR |
| 2 CORRRIDOR | 8 LAUNDRY | 14 BEDROOM-2 | 20 BATHROOM-2 | 26 PORCH |
| 3 OFFICE | 9 BATHROOM-4 | 15 KITCHEN | 21 BATHROOM-6 | |
| 4 HALL | 10 BEDROOM-7 | 16 DINING ROOM | 22 BEDROOM-5 | |
| 5 BATHROOM-5 | 11 BATHROOM-7 | 17 BEDROOM-3 | 23 DAYROOM | |
| 6 BATHROOM-3 | 12 BEDROOM-1 | 18 BATHROOM-1 | 24 BEDROOM-6 | |

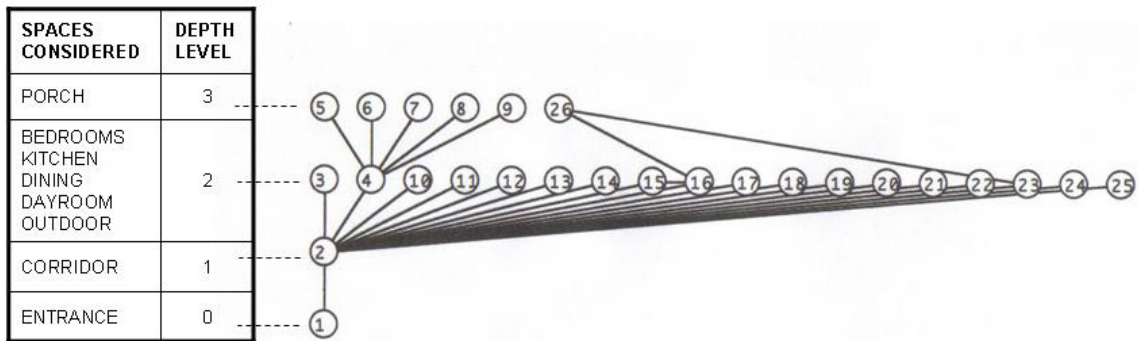


Figure 4: Convex Map (above) and Graph of Plan Type 1

The justified graph shows that there are 3 levels of depth in this plan layout. All common spaces and bedrooms fall into the 2nd depth level when the entrance is selected as the origin. The corridor is the only convex space in the 1st level; and it controls access to the 19 spaces that were connected to it. The dayroom, kitchen, dining room, and outdoors are in the 1st depth level according to all of the bedrooms, whereas the porch is in the 2nd depth level. The connection of the dining room (16) and the dayroom (23) to the porch (26) became crucial in the graph since this relation may provide a choice to the residents to go out when they are already in one of the spaces. Additionally, this relation provides an alternate route between the dayroom and the dining area.

5.6.1.2. Plan Type 1: The Order of Integration Values of Convex Spaces

As noted earlier, global integration values well below 1 indicate a convex space that is strongly integrated while values tending to 1 and above indicate a convex space that is more segregated. When the global integration values of Plan Type 1 were calculated, it was observed that all values are above 1, showing that basically all spaces are segregated. The syntactic calculations, which result in values of control, connectivity, and global and local integration levels, were performed twice, once for considering only interiors and once for including the exteriors. The tables showing the findings for each plan type can be found in Appendix 1. The comparison in this presentation focuses on the syntactic analysis that was done including the exterior space.

When the global integration levels were ranked, the porch was the most integrated space in Plan Type 1 with an integration value of 1.20 (Figure 5). It was followed by the service spaces, which are basically public bathrooms, storage, and the laundry room, which have the same integration value of 1.34.

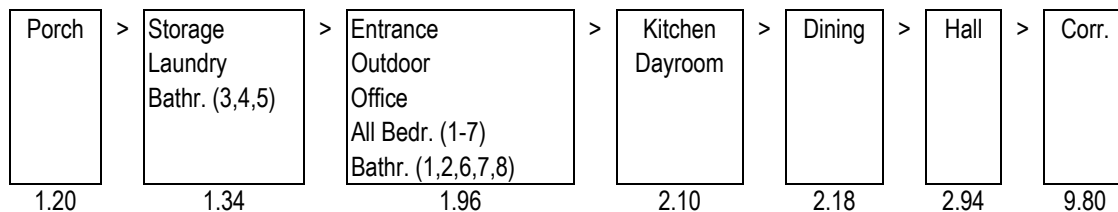


Figure 5: The order of convex spaces in Plan Type 1, where the Porch is the most integrated and the Corridor is the most segregated space.

All of the bedrooms, bathrooms for residents, the outdoor area, and the entrances have the same integration value of 1.96 and ranked 3rd for the integrated space value in Plan Type 1. Kitchen and dining spaces ranked 4th with a value of 2.10, followed by the dining space with a value of 2.18. The hall that connects all the service spaces ranked 6th and the corridor, which acted as the main hub for nearly all spaces, ranked as the least integrated (most segregated) space.

The global integration value of the corridor is 9.80, indicating high segregation. When plan layout is considered, the corridor seems to be integrated by having many connections to spaces with various functions. However, controlling access to nearly all the spaces, the corridor is replacing any possible alternative connections that could have been made. When differences between integration values of consecutively ranked spaces were considered, the corridor was way too high compared to the hall, which is the preceding space. In fact, the hall with the integration value of 2.94 was followed by the dining area with a value of 2.18. This showed the 2nd largest difference between the integration values of two consecutively ranked spaces. This clearly showed that the hall and the corridor were not only least segregated but also have significantly different spatial relations with all other spaces.

Overall, having all global integration values over 1 and a global integration value of the common areas around 2, the spatial configuration of Plan Type 1 can be described as a segregated plan. The level of this segregation will be compared to other plan types upon completion of analyses of all plan types.

5.6.2. Plan Type 2: The General Plan Layout

The plan layout of Plan Type 2 can be roughly described as a *thick L shaped plan* (Figure 6). Entering the building, the first noticeable item is the open space that contains the kitchen and dining areas. The welcoming alcove is opposite of the kitchen and is designed to be a part of this open space. The openness of the plan continues through the space, which allows other common areas to be visually connected with the dining and kitchen areas. The sitting room is the only common place in between the bedrooms and not visually connected with the other common areas.

The main character of this plan layout is a natural transition between common areas. This is achieved by placing 12 private bedrooms to the exterior part of the L shape plan. The common spaces at the inner part of L open to the outdoor areas.

Another important characteristic of Plan Type 2 is providing alternative spaces for some functions. For dining, there are two options: the main dining area and the garden dining area. For indoor recreational activities there are three possible spaces: the dayroom, the parlor, and the sitting room. The dayroom and parlor are adjacent to each other with no separation. The lack of physical separation, in fact, enables a natural transition between these two spaces. The sitting room is much smaller than the dayroom and the parlor and is located between bedrooms at the opposite side of the plan. There is an activities and crafts room that is connected to laundry. There are three exits to the outdoors, which are from the garden dining area, the hall, and the dayroom.

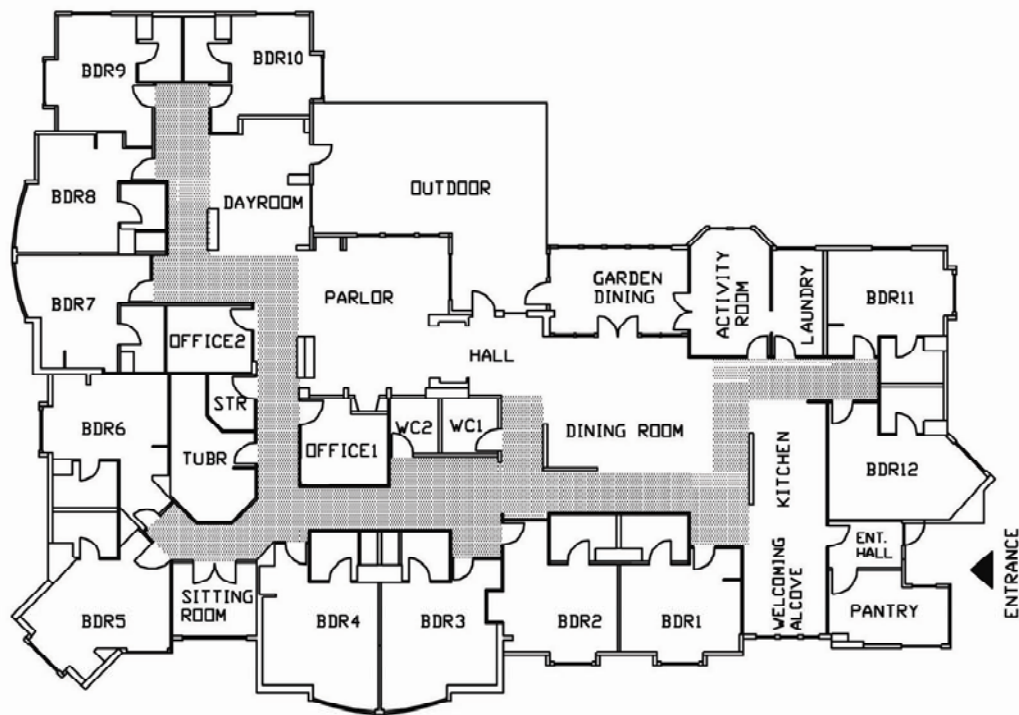


Figure 6: Layout of Plan Type 2 (shaded spaces showing the circulation)

Two offices for the staff, restrooms for visitors, and service spaces (housekeeping and tub room) are placed in the center, thereby forming a corridor for the bedrooms at the corner. This corridor, as the main circulation, is designed more like a series of connected halls rather than a single corridor (see shaded spaces in Figure 6). The boundaries of the dining space are

defined by the kitchen counter and an L-shaped free standing wall. This wall provides some privacy for the entrance of the public restroom, which is facing the dining hall and directs a circulation space around the service area. Due to the presence of alternative common spaces and private bedrooms, Plan Type 2 has a larger circulation space and footprint than all of the other plan types.

5.6.2.1. Plan Type 2: Drawing the Convex Map and the Graph

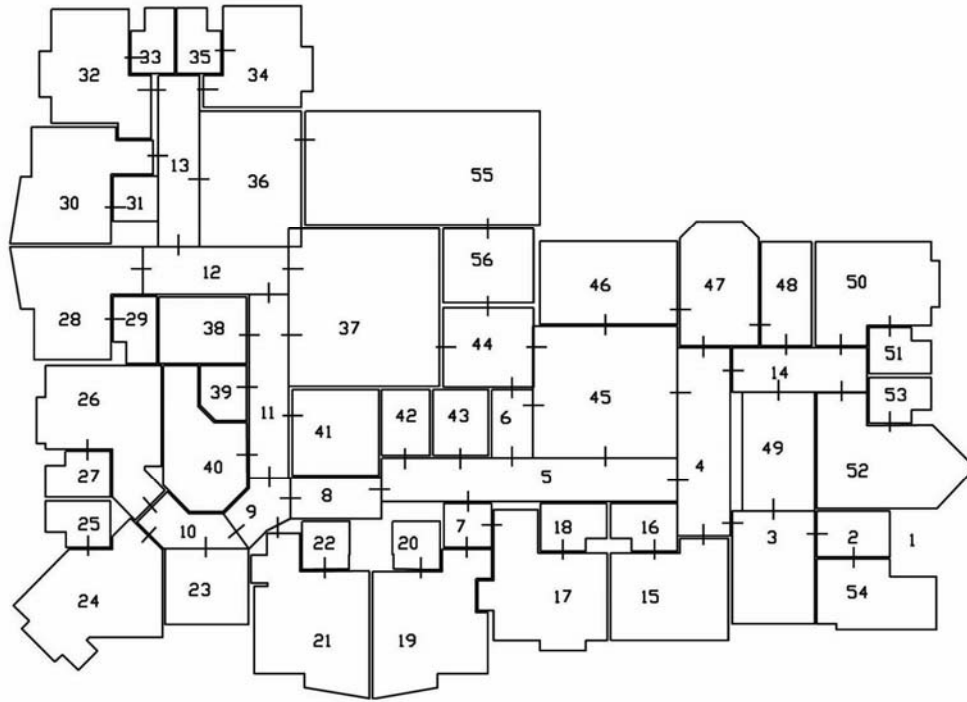
The procedure of drawing a convex map from a given plan layout was previously described as the process of dividing the plan into the convex spaces. This process is started at the area with the best area perimeter ratio, which by analogy is the “fattest”, and then continuing this until the whole plan is covered. Although this procedure seems to be an automated and an analytical way of defining the convex spaces, there’s some intuition involved when making decisions regarding spaces that do not have well-defined boundaries or spaces that are oddly shaped.

Three guidelines have been followed to rationalize the intuition involved in defining the convex spaces that are not well-defined: (1) the function of the space; (2) the environmental cues, such as a fixed and (or) a non-fixed furniture layout; and (3) the change in direction of the movement if the considered space is used for circulation. Use of these methods was often observed in the noteworthy works of Hanson and Hillier (1984) and Hanson (1998). When performing space syntax analyses it is possible to include or exclude the furniture layout. In this study, the furniture layout has been used only to define the boundaries of spaces with different functions, but not necessarily included when performing syntactic analyses.

Plan Type 2 has bedroom and service spaces that are well-defined with four walls and a large open space that has no walls at all but contains different functions. The circulation area between that open space and the bedrooms is maintained by a series of small halls between the bedroom entrances and the corridors. In summary, Plan Type 2 contains spaces whose boundaries are easy to recognize and spaces that require some type of intuition to draw convex spaces.

In order to draw the convex map, first the spaces that have well-defined boundaries were drawn. Then the common spaces that are in the open plan were defined by boundaries according to the first and second guidelines noted earlier.

There are no walls between the kitchen and the dining, but there is a counter that describes the boundary between them. There is no dedicated area to combine the circulation area between the two bedrooms behind the kitchen (convex spaces 50 and 52) and the main circulation, but the dining space adjacent to the kitchen counter is basically used for this purpose. Thus, a separate convex space (4) was determined to be a part of the circulation. The free standing L shaped wall, which is a fixed feature, located near the general dining area not only outlines the boundary of the dining area, but also describes the corridor area in front of the public restroom.



1	ENTRANCE	13	CORRIDOR-9	25	BATHROOM5	37	PARLOR	49	KITCHEN
2	ENTRANCE HALL	14	CORRIDOR-10	26	BEDROOM-6	38	OFFICE-2	50	BEDROOM-II
3	WELCOMING ALC.	15	BEDROOM-I	27	BATHROOM-6	39	STORAGE	51	BATHRRM-II
4	CORRIDOR-I	16	BATHROOM-I	28	BEDROOM-7	40	TUBROOM	52	BEDROOM-I2
5	CORRIDOR-2	17	BEDROOM-2	29	BATHROOM-7	41	OFFICE-I	53	BATHROOM-I2
6	CORRIDOR-3	18	BATHROOM-2	30	BEDROOM-8	42	WC-2	54	PANTRY
7	CORRIDOR-4A	19	BEDROOM-3	31	BATHROOM-8	43	WC-I	55	OUTDOOR-I
8	CORRIDOR-4	20	BATHROOM-3	32	BEDROOM-9	44	HALL	56	OUTDOOR-2
9	CORRIDOR-5	21	BEDROOM-4	33	BATHROOM-9	45	DINING ROOM		
10	CORRIDOR-6	22	BATHROOM-4	34	BEDROOM-10	46	GARDEN DINING		
11	CORRIDOR-7	23	SITTING ROOM	35	BATHROOM-10	47	ACTIVITY ROOM		
12	CORRIDOR-8	24	BEDROOM-5	36	DAYROOM	48	LAUNDRY		

Figure 7: Convex Map of Plan Type 2

When functions are the same but yet boundaries are not clear, the general design elements provide cues about the boundaries between the spaces. For example, it can be determined from the fixed (e.g. large counters) and non-fixed (e.g. sofas, chairs, side tables) furniture in the parlor and the dayroom, that these areas are two convex spaces. The outdoor area contains two convex maps (55 and 56) since one part (56) has two doors and is more like an exterior hall, whereas the other part (55) is a place where residents can sit down and enjoy the outdoors.

The circulation space contains many short corridors and halls between the entrances of adjacent bedrooms. In order to prevent confusion between these halls and two other halls, all spaces that belong to a circulation space were labeled as corridors and given numbers. The spaces that make up the circulation space were defined by 11 convex spaces, when a direction change in the movement occurs. This method also worked well for the oddly shaped hall between the sitting room and three bedrooms (see convex space 9 and 10 in Figure 7)

In summary, in the plan layout of Plan Type 2, there are 56 convex spaces, 24 of which belong to the private bedrooms and bathrooms in each bedroom. Compared to Plan Type 1, the total number of convex spaces in Plan Type 2 is slightly more than double. This inequity in the number of convex spaces will be resolved by converting the integration values of each convex space to global integration values, which allows for the comparison of plan layouts with a significantly different number of convex spaces.

Figure 8 displays the justified permeability graph of Plan Type 2 in which there are 10 depth levels observed. When spaces of primary concern were distributed according to the depth level to which they belong, it was observed that the bedrooms were scattered in different depth levels between 4 and 9. Dividing the circulation area into a small set of convex spaces revealed the bedroom clusters and their relationship to the common areas. The graph demonstrated that for each bedroom cluster in the same depth level, there is a common area in the same depth level, except for bedrooms 8, 9, and 10, which are in the 9th depth level. However, this shouldn't be misinterpreted as each common area that shares the same depth level with a bedroom is close to each other. Instead, sharing the same depth level in a permeability graph that was justified by defining the entrance as the carrier means that an individual should walk through the same depth level to reach to either one of them from the entrance.

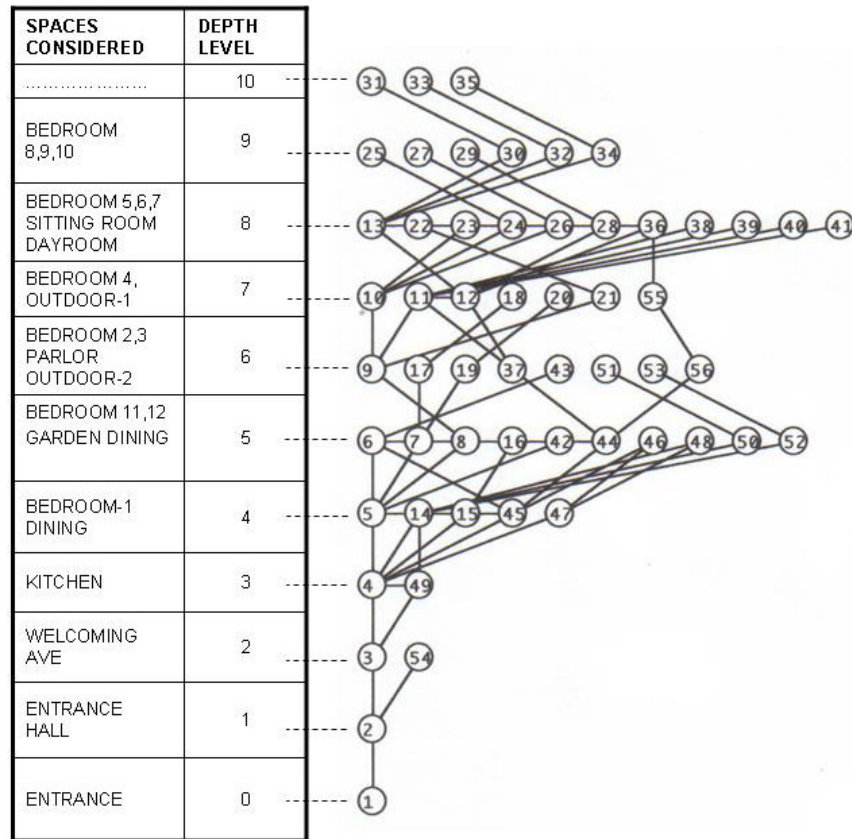


Figure 8: Justified Permeability Graph of Plan Type 2

Thus, observing both bedrooms and common areas scattered in different levels of depth shows the diversity of the spatial relations among spaces. In the graph of Plan Type 1, the main circulation area was represented by a single convex space, which in the graph, became the gatekeeper of other spaces. However, the circulation area of Plan Type 2 was divided into smaller convex spaces since it was designed to be a combination of smaller spaces. The number of depth levels provides some insights about the distances from the entrance. Yet, graphs, as mentioned earlier do not contain metric and geometric data and it would be misleading to interpret a concrete relationship between depth levels and distance. If the circulation area of Plan Type 2 were a single corridor like the circulation area of Plan Type 1, then it would be represented as a single convex space. Plan Type 2 stands out with the presence of alternative common areas and their location in different depth levels of the plan,

thereby showing that any of the common areas are somewhat accessible from any of the bedrooms.

5.6.2.2. Plan Type 2: The Order of Integration Values of Convex Spaces

The global integration values of Plan Type 2 range between 0.61 (Bathrooms 8, 9, and 10) and 1.39 (Corridors 4 and 5). There were 30 different integration values observed for 56 convex spaces that demonstrate the diversity of spatial relations obtained from the graph. The bathrooms and other service areas, such as the storage area and the pantry, could be ignored since they are not considered key elements of the design of this typology. However, in order to provide a full range, all spaces were ordered from the most integrated to the least integrated (Figure 9).

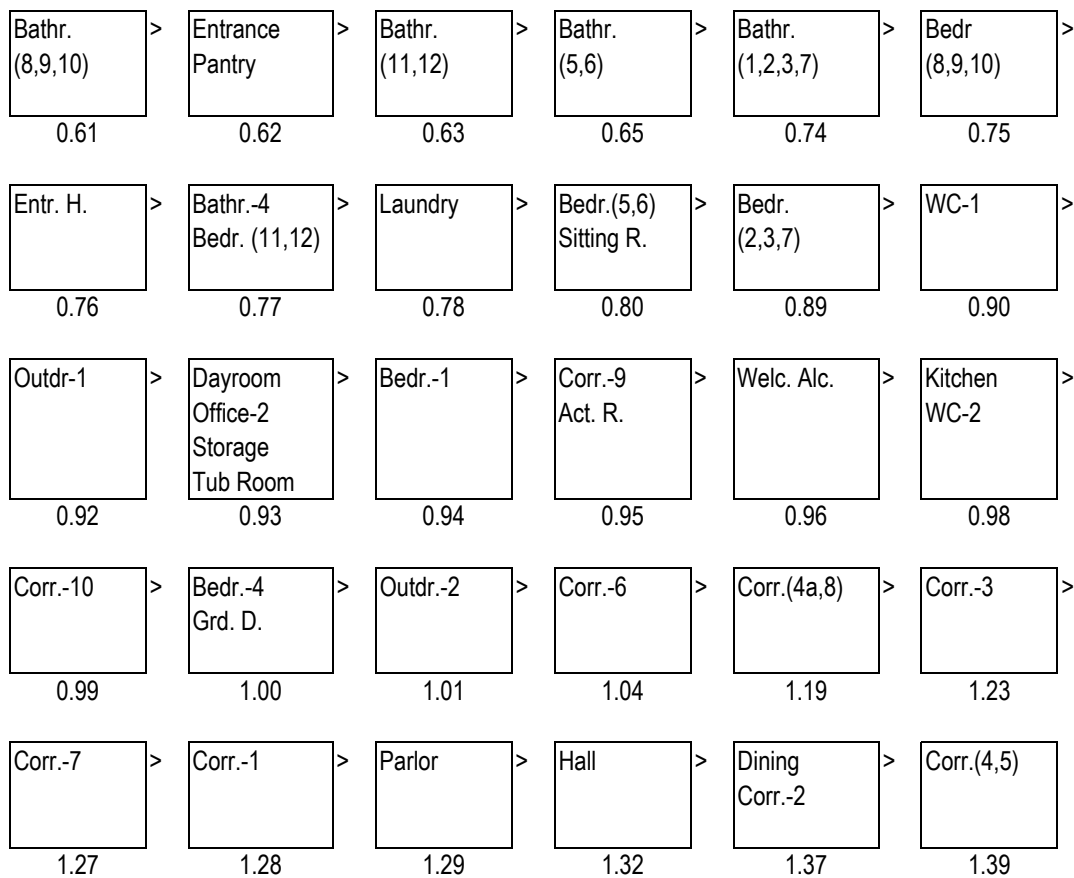


Figure 9: The order of convex spaces in Plan Type 2, where Bathrooms 8, 9, and 10 are the most integrated and Corridors 4 and 5 are the most segregated spaces.

When ignoring the service areas, the entrance is the most integrated with a value of 0.62; followed by a group of bedrooms (8, 9, and 10) with a global integration value of 0.75. Five other bedrooms were observed to have a value below 1, which indicates that they are *somewhat* integrated.

In Plan Type 2, the most integrated common area was observed to be the sitting room (global integration=0.80), which in the plan layout, is the small casual room surrounded by three bedrooms. The outdoor-1 convex space, dayroom, activity room, welcoming alcove, and kitchen have integration values between 0.92 and 0.98, which indicates a very weak integration. The garden dining area and the outdoor-2 convex spaces with global integration values of 1 and 1.01 were followed by the parlor, which has a much higher value of 1.29. The parlor also has a difference of 0.29 when compared to the previous common space (outdoor-2), which indicates a segregation from the former group of common areas. The most segregated three spaces are the parlor, the hall that provides access to the outdoor-2 area, and the dining area. These three spaces had smaller differences between their integration values when compared to the relationship between the parlor and the outdoor-2 area.

One important difference between Plan type-2 and the other plan types is its presentation of alternative spaces for the same functions. There are two dining spaces and three living spaces, which all ended up having different global integration values. This clearly shows that alteration of spaces, which was first observed in the depth levels, continued when integration values were considered. With this information in hand, it is possible to say that Plan Type 2 not only provides alternative common areas that are different from each other in terms of size and shape, but also provides areas that are different based on their spatial relation to all other convex spaces in the system. Having part of the common areas better integrated and part of them being segregated may create common spaces with different levels of privacy. Yet, behavioral distinctions between spaces will be made later by including the actual use.

5.6.3. Plan Type 3: The General Plan Layout

The plan layout of Plan Type 3 is a *square like plan* layout with 6 shared bedrooms equally distributed to each side of the building (Figure 10). The common spaces are clustered in the middle of the plan. The entrance is connected to a small hall that opens to the corridor. The circulation is via an H shaped corridor, which is open to the entrance hall in the front of the building and to the outside at the back of the building. Also, each corridor provides an alternative entrance to one of the common spaces which on one side of the building is next to the kitchen and on the other side of the building is next to the dayroom. Thus, it is hard to say that the plan is symmetric in terms of the relations between the bedrooms and the considered common spaces.

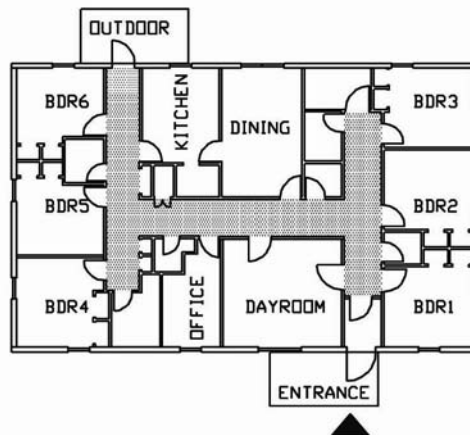
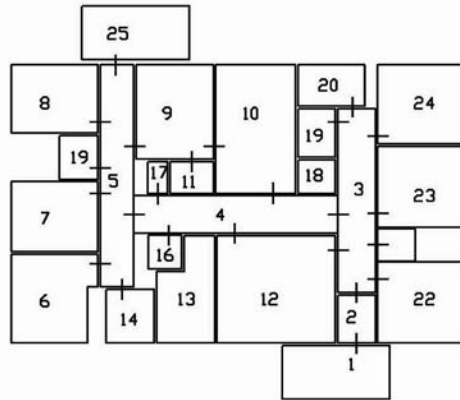


Figure 10: Layout of Plan Type 3 (shaded spaces showing the circulation)

5.6.3.1. Plan Type 3: Drawing the Convex Map and the Graph

All spaces in Plan Type 3 have well defined boundaries, which made the drawing of the convex map fairly easy. Each room is represented by a convex space and given a number. The H shaped corridor is divided to 3 pieces since in each piece there is change in the direction of the movement (Figure 11). Convex spaces 3 and 5 provide circulation from front to the back of the plan, whereas convex space 4 provides circulation between the sides by connecting convex spaces 3 and 5. Convex space 4 is the main circulation space and provides a link between the dayroom and the dining room, as well as connecting other circulation spaces (3 and 5). In summary there are 25 convex spaces counted in this plan layout.



1	ENTRANCE	6	BEDROOM-4	11	PANTRY	16	BATHROOM-C	21	BATHROOM-3
2	ENTRANCE HALL	7	BEDROOM-5	12	DAYROOM	17	STORAGE	22	BEDROOM-1
3	CORRIDOR-1	8	BEDROOM-6	13	OFFICE	18	BATHROOM-2	23	BEDROOM-2
4	CORRIDOR-2	9	KITCHEN	14	BATHROOM-4	19	LAUNDRY	24	BEDROOM-3
5	CORRIDOR-3	10	DINING	15	BATHROOM-5	20	BATHROOM-1	25	OUTDOOR

Figure 11: Convex Map of Plan Type 3

When the graph was drawn based on the relations outlined in the convex map and justified according to the entrance, six depth levels were observed (Figure 12). The only space that was in the 6th depth level was the pantry, which is not a key space to consider. In the graph it can be seen that dividing the three corridor convex spaces (represented by the number 3, 4, and 5) defined different depth levels. According to the bedroom clusters, the dayroom is in 1 and 2 depth levels. However, the bedroom cluster that is two levels deep from the dayroom is only 1 level deep from the kitchen (9) and the outdoors (25). Also an alternative route of passing from one group of bedrooms (convex spaces 6, 7, and 8) to the dining space by passing through the kitchen provides another advantage over the other bedroom cluster.

Locating all the common spaces in the center that provide an entrance and an exit through the corners increased the importance of the side corridors. Linking each of the three corridors (convex spaces 3, 4, and 5) to at least one of the common spaces created nearly equal distribution of spaces in the graph.

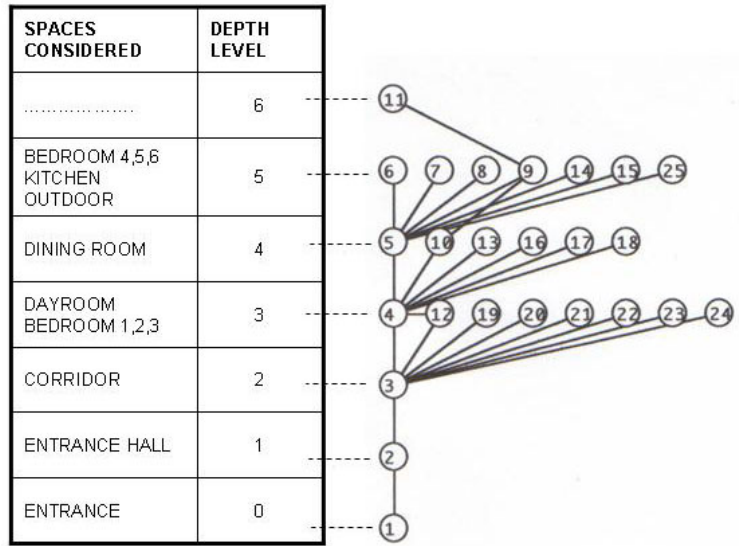


Figure 12: Graph of Plan Type 3

5.6.3.2. Plan Type 3: The Order of Integration Values of Convex Spaces

When integration values were calculated, the entrance is the most integrated space with a value of 0.81, followed by the pantry with a value of 0.81 (Figure 13). The outdoor convex space and the bedroom cluster that was close to the outdoors ranked 3rd with a integration value of 1.15. Whereas, the other bedroom cluster that was close to the entrance ranked 4th with a value of 1.18, followed by the entrance hall. Ignoring a group of service spaces (office, caregiver’s bathroom, bathroom 2, and storage), the order of common spaces from most integrated to the least integrated were as follows: kitchen, dining room, and dayroom. The corridors that mainly provide access to the bedroom clusters have fairly close integration values of 2.21 and 2.30. The corridor that connects these two is the least integrated space with a much higher value of 3.07.

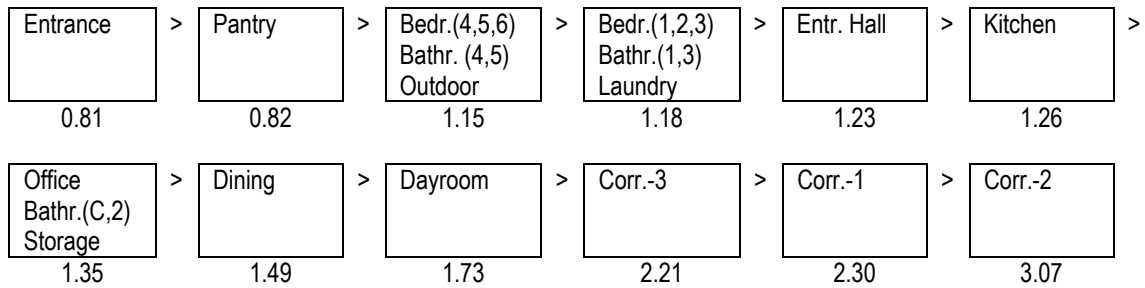


Figure 13: The order of convex spaces in Plan Type 3 where the Entrance is the most integrated space and Corridor 2 is the most segregated space.

In Plan Type 3, based on the order of integration levels of convex spaces, it can be said that providing an entrance and an exit to the outdoors from different corners of the plan layout, as well as providing alternative routes to one of the common areas from each bedroom cluster, made the bedrooms more integrated than common spaces.

5.6.4. Plan Type 4: The General Plan Layout

At first glance, the plan layout of Plan Type 4 is similar to the plan layout of Plan Type 3 by equally distributing six bedrooms to the opposite sides of the building and allocating common areas in the center of the plan (Figure 14). The shape and distribution of the circulation area of both Plan Type 3 and Plan Type 4 is also very similar.

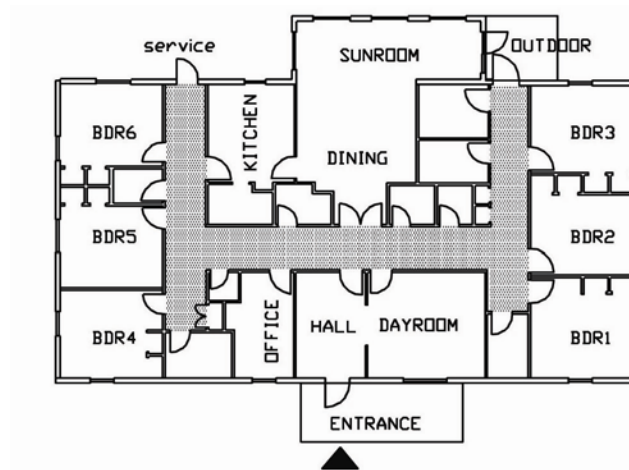


Figure 14: Layout of Plan Type 4 (shaded spaces showing the circulation)

However, it is evident that Plan Type 4 is quite different from Plan Type 3 since it contains a sunroom, which is located at the end of the dining room. The entrance to the building is located at the middle of the building, compared to the entrance of Plan Type 3 which is closer to the side. In fact, locating the entrance at the center allows Plan Type 4 to have a larger entrance hall that has a direct connection with the dayroom. In Plan Type 4, entering from the middle of the front façade strengthens the relationship between the common spaces and the entrance by reducing the distance between them.

The immediate outdoor area is a patio that is accessible through the sunroom or the corridor of the bedroom cluster on the same side of the building. A controlled service exit was considered to be *outside* but this was not intended for use by the residents. Thus it was not counted as an outdoor area and included in the syntactic analyses.

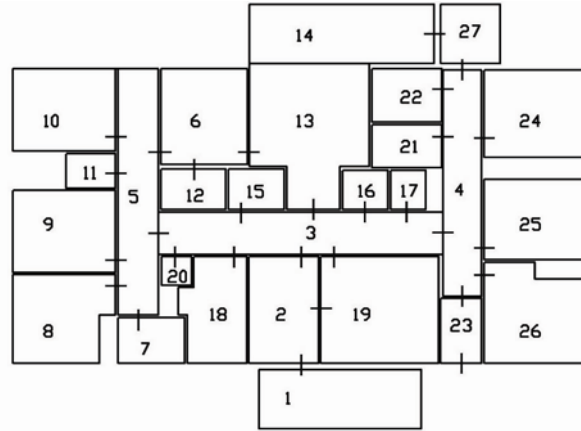
5.6.4.1. Plan Type 4: Drawing the Convex Map and the Graph

The plan layout of Plan Type 4 contains spaces with well-defined boundaries. After the convex maps of rooms with four walls were drawn, two spaces required extra attention. The first one was the circulation space which was made up of three corridors. Following the same logic that was used in Plan Type 3, the circulation area was divided into three convex spaces (numbered 3, 4, and 5).

The second space that required extra effort to define the matching convex space was the sunroom adjacent to the dining room. Since there was no physical separation between these two spaces, these spaces were considered to be in transition with each other. One part of the room (the sunroom) was designed as a living space with comfortable sofas and side tables, whereas the other part (the dining space) was recognizable by the groups of dining table and chairs. The boundaries of the convex spaces were defined by separating the two spaces according to the furniture layouts belonging to different functions.

With the inclusion of two convex spaces derived from one room, 27 convex spaces represent the plan layout of Plan Type 4. According to the relationships between the convex spaces, the permeability graph was drawn and justified by defining the entrance as the carrier (origin). The 6th depth level contains only the pantry, which was not a key space in the configuration of the building type.

The main spaces under consideration were observed in the first 5 levels of depth. With three bedrooms on each side of the building and common spaces in the center, the plan layout of Plan Type 4 is similar to Plan Type 3. The differences as a result of spatial relations were discussed earlier. The graph (Figure 15) makes this distinction even clearer by showing the fact that all bedrooms in Plan Type 4 were in the same depth level when compared to Plan Type 3 in which two group of bedrooms fell in different depth levels.



- | | | | | | | | | | |
|---|------------|----|------------|----|------------|----|------------|----|-----------|
| 1 | ENTRANCE | 7 | BATHROOM-6 | 13 | DINING | 19 | DAYROOM | 25 | BEDROOM-2 |
| 2 | HALL | 8 | BEDROOM-4 | 14 | SUNROOM | 20 | STORAGE | 26 | BEDROOM-1 |
| 3 | CORRIDOR-2 | 9 | BEDROOM-5 | 15 | BATHROOM-4 | 21 | LAUNDRY | 27 | OUTDOOR |
| 4 | CORRIDOR-1 | 10 | BEDROOM-6 | 16 | BARBER | 22 | BATHROOM-2 | | |
| 5 | CORRIDOR-3 | 11 | BATHROOM-5 | 17 | BATHROOM-3 | 23 | BATHROOM-1 | | |
| 6 | KITCHEN | 12 | PANTRY | 18 | OFFICE | 24 | BEDROOM-3 | | |

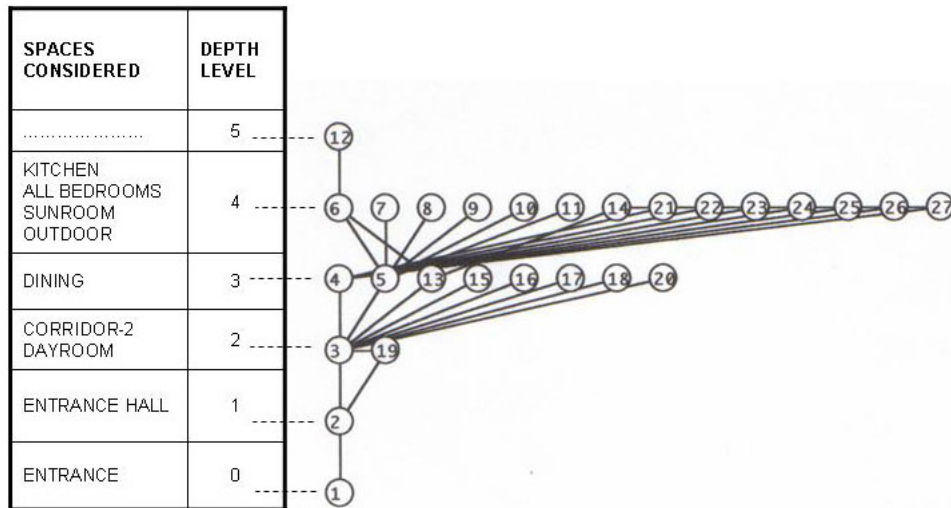


Figure 15: Convex Map (top) and Graph of Plan Type 4

Providing an entrance in the center of the building, instead of on the side as it was in Plan Type 3, Plan Type 4 has the same relation between the two bedroom clusters (convex spaces 8, 9, 10 and 24, 25, 26) and the main corridor (convex space 3). Therefore, in the graph level, all bedrooms made one group under the 4th depth level. Yet, when the spatial relations between the bedrooms and the dining room or (and) the bedrooms and the outdoor area considered, two clusters became observable. One cluster (convex spaces 8, 9, and 10) had the advantage of quick access to the dining area via the kitchen. The other group of bedrooms

(24, 25, and 26) was only 2 levels deep from the outdoors. Considering the connection between the dining room and the sunroom and sunroom's access to the same outdoor area, the residents of this bedroom cluster (24, 25, and 26) have an alternative route to the dining space.

As demonstrated in the graph, the presence of the sunroom as an additional space provided an alternative to the dayroom. The entrance hall, which is linked to the main circulation and the dayroom, provided equal access to the dayroom and the entrance by residents who lives on any side of the building.

5.6.4.2. Plan Type 4: The Order of Integration Values of Convex Spaces

When integration values for the convex spaces of Plan Type 4 were calculated, 14 different values came out for 27 convex spaces (Figure 16). The bedrooms came out in two groups that were at each sides of the building and had global integration value of 1.18 and 1.20. Some of the service areas, such as the barber, the office, the storage area, and two bathrooms formed another group.

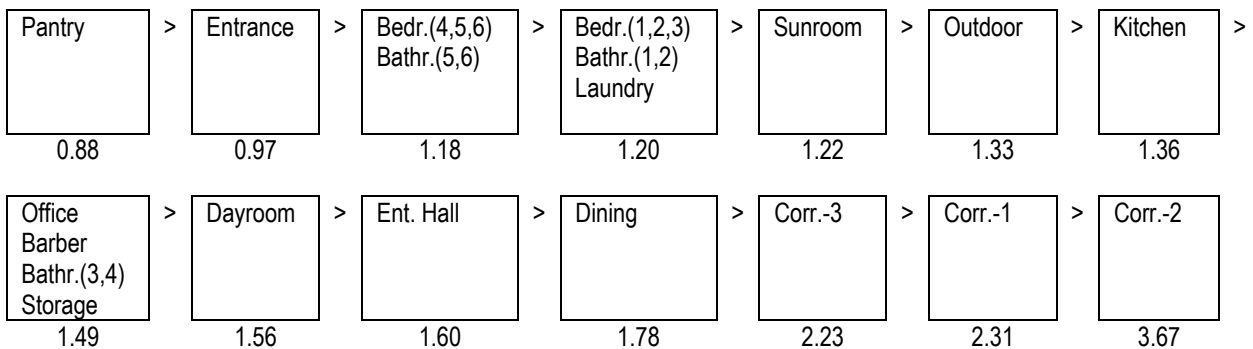


Figure 16: The order of convex spaces in Plan Type 4 where the Pantry is the most integrated space and Corridor 2 is the most segregated space

Ignoring the service areas, including the pantry, which became the most integrated area, the entrance (followed by bedrooms) had higher integration levels than the common areas. The sunroom was followed by the outdoors and the kitchen in their integration levels. These three

spaces had fairly close integration values. The dayroom had an integration value of 1.56, and was less integrated when compared to the kitchen's integration value of 1.36. The entrance hall had a value of 1.60 and was followed by the dining room which had value of 1.78. Considering the differences between the integration values of common spaces, the dayroom was different from the other spaces that ranked higher. The dining room was less integrated than the dayroom in the way that the dayroom was less integrated than the kitchen; this was determined by comparing the difference factor (0.22) between the dining room and dayroom to the difference factor (0.20) between the dayroom and the kitchen. The corridor that connected the two corridors was the least integrated space with a value of 3.67. Among these two corridors which were used to access the bedrooms, the one that provided access to the kitchen had a slightly higher integration level (2.23) than the other at 2.31.

The order of integration levels of Plan Type 4 showed that adding an alternative common space, proposing alternative routes that pass through this space, and providing an entrance that is equally deep from the bedrooms has an impact on the order of the common spaces. The order of spaces according to their integration levels changed from "Outdoor > Kitchen > Dining > Dayroom" (Plan Type 3) to the order of "Sunroom > Outdoor > Kitchen > Dayroom > Dining" in Plan Type 4 with the spatial differences mentioned.

Due to their similarity in the plan layouts, Plan Type 3 and Plan Type 4 were compared here. As an introduction to a general comparison of all plan types, it is presented as an example for the method that was followed in cross comparison of plan types.

5.6.5. Summary of Individual Analyses

At the general plan layout level, all plans have differences related to size and shape, as well as the distribution of the common spaces and bedrooms. However, the differences in spatial configurations became obvious in the graph level. Figure 17 demonstrates how spatial differences in the plan layout relate to differences in the configuration.

In order to perform syntax analyses, first all convex spaces in each plan type were described. Then, connected spaces were represented by connecting adjacent convex spaces with a line. The convex maps and the represented relations were used to draw permeability graphs. When graphs were adjusted by defining the entrance as the carrier, it was observed that all plan types have different depth values that ranged between 3 (Plan Type 1) to 10 (Plan Type 2). Plan Type 3 and 4 had 6 and 5 depth levels respectively. There were differences observed between:

- (1) the depth level of common spaces;
- (2) the spatial relations between bedrooms and the common areas; and
- (3) the distribution of the bedrooms in depth levels (clusters vs. scattered distribution).

These differences can be represented by the visual differences as seen in the graphs, as well as when spaces under consideration were ordered according to their integration value. The detailed cross comparison between plan types will be made in the next section by using the global integration values for each convex space with the same function.

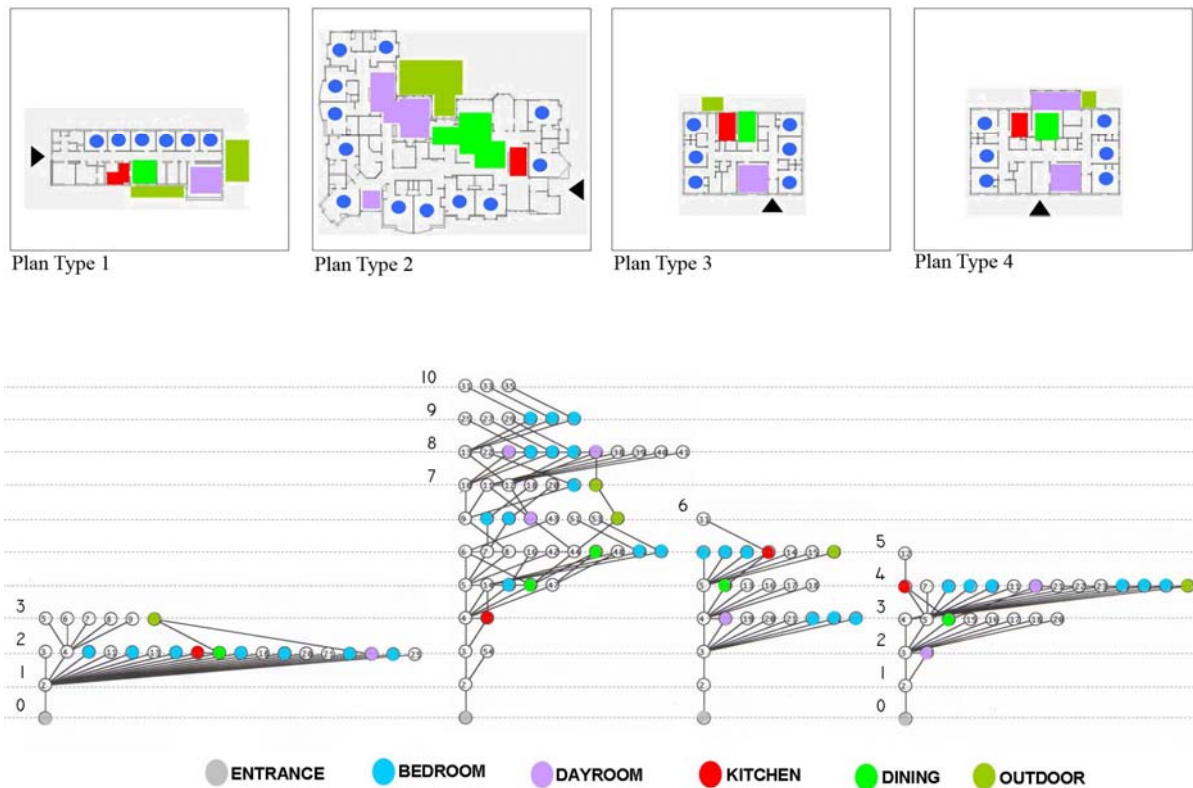


Figure 17: Color coded plan layouts and permeability graphs of all plan types

5.7. Cross Comparison of Plan Types According to the Results of Space Syntax Analysis

The syntactic plan analyses of the individual plan types resulted in two products. The first products were visual representations of the plan layout which were convex maps and permeability graphs. Convex maps were used to draw the graphs, which introduced the concept of depth levels in the plan layout.

Once the graph and the depth levels were clear, integration levels for each convex space were calculated by using the research software. These were transformed into the global integration values which enabled comparison between systems that have a different number of convex spaces. With the global integration levels in hand, there's no longer a need for graphs to make comparisons between plan types. In fact, the integration values of some convex spaces might be the same, but still be represented as different nodes in the diagram. Thus, ordering

spaces from the most integrated to the least integrated provides a list of spaces sharing the same order with equal integration values.

In the individual analyses, it was observed that some of the bedrooms and service spaces generally shared the same integration value and thus, the rank in the order of integration values. Earlier it was explained that when a cross plan type comparison was made, the global integration values of convex spaces with the same functions was taken as a mean. The same rule applied to the bedrooms, which in some analyses were observed in clusters. However, service spaces were omitted from the order since they were not considered to be key elements that play a role in the spatial configuration. On a larger scale, such as nursing homes, the service spaces gain importance since the number and location of service areas must be optimized.

One important point to underline is that dropping any of the spaces from the list does not necessarily change any integration values previously calculated by considering all of the spaces. The integration value, by definition, relies on the mean depth that was calculated by including all of the spaces. Thus, omitting service areas in fact means just not physically seeing them in the orders of global integration levels of convex spaces.

As noted earlier, space syntax analyses will be mainly employed as the plan type selection criteria to show that the selected plan types have different spatial configurations. In the plan type selection process, the results of syntax analyses were used to make three types of cross plan type comparisons. These were:

- (1) The cross plan type comparison of the mean global integration values of each plan type;
- (2) The cross plan type comparison of the order of spaces in terms of their global integration levels; and
- (3) The cross plan type comparison of single spaces with same functions.

Observing differences in any comparisons above indicates differences in the spatial configurations, whereas observing same orders show similarity in the configuration.

5.7.1. The Cross Comparison of the Mean Global Integration Values of Each Plan type

The cross plan type comparison of the mean global integration values of each were calculated by first adding the values of each convex space and dividing the total number by the total number of convex spaces counted. All the values that were used came from the configurational analyses that included exterior outdoor space.

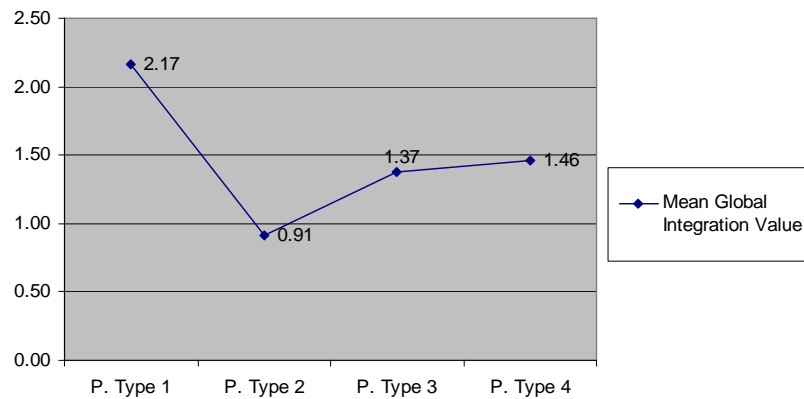


Figure 18: The cross plan type comparison of mean global integration values for each plan type

The order of integration values of plan types from most integrated to least integrated is Plan Type 2 > Plan Type 3 > Plan Type 4 > Plan Type 1 (Figure 18). When the integration values were considered, it can be seen that Plan Type 3 and Plan Type 4 are somewhat close to each other with a 0.09 difference between their means. Plan Type 1 is the most segregated and Plan Type 2 is the most integrated plan type with a 1.26 difference between their means of global integration. As a result, it is possible to say that these two plan types were quite different from each other.

This comparison provided the fact that the selected plan types were configurationally different from each other. Yet, plan types with different means of integration values may still have the same order of spaces or may have the same integration value. Thus, a detailed cross plan type comparison by focusing on the order and the integration value of considered convex spaces is necessary.

5.7.2. Cross Plan type Comparison of the Order of Common Areas

First, to reach to a simplified version of the orders of global integration values, all the service areas were dropped from the list of orders for the reasons explained earlier. Then, the plan types that contain alternative spaces for the same functions were individually simplified by taking mean values of all spaces with the same functions.

The results of these procedures produced new global integration values for those convex spaces that had alternative convex spaces in a given plan type. For example, the global integration value of the dayroom in Plan Type 2 is the mean global integration value of the dayroom, the sitting room, and the parlor. All global integration values for the convex spaces under consideration and the mean value for each plan type are displayed in Table 2. The mean global integration values displayed in table are the same values that were calculated by including all convex spaces in the plan.

Table 2: The global integration values of convex spaces considered for the cross plan type comparison and the mean global integration value of the plan types

Index	Mean	Kitchen	Dining	Dayroom	Outdoor	Entrance	Bedroom
Plan Type 1	2.17	2.10	2.18	2.10	1.58	1.96	1.96
Plan Type 2	0.91	0.98	1.18	1.01	0.96	0.62	0.83
Plan Type 3	1.37	1.23	1.49	1.73	1.15	0.81	1.16
Plan Type 4	1.46	1.36	1.78	1.39	1.33	0.97	1.19

The global integration values below 1 show strong integration. As integration values tend towards 1 or higher, the integration gets weaker and the space is regarded as segregated. Many of the values displayed in the table are over 1 and therefore, are referred to as segregated. Yet, it is possible to make comparisons among plan types relative to each other.

When these values were used to order the six convex spaces of each plan type, it was observed that each order had the same three spaces at the front and at the end of the order. The first part of the orders always contained the outdoor area, the entrance, and the bedroom and the second part contained the kitchen, the dining room, and the dayroom. This made the

order of each plan type appear to be a comparison of two clusters that contain the same spaces with different orders (Figure 19). This also enabled the orders to be broken down into two groups. The orders were based on the overall mean of the *combined* convex spaces that each space in the order from any plan type represented all the convex spaces with the same functions. For example the combined global integration value of dayroom of Plan Type 2 was calculated by evaluating the three spaces that have the same function: the actual dayroom, the sitting room, and the parlor.

With a quick look, it is noticeable that Plan Type 2 and Plan Type 4 have the exact same order of spaces where the dining room was the least integrated space and the entrance was the most integrated space. Plan Type 1 has quite a different order from the rest of the plan types with some convex spaces (entrance, bedroom and kitchen, dayroom) with different functions sharing the same global integration value. Different from all other plan types, Plan Type 3 has the dayroom as the least integrated space.

P.T. 1:	Outdoor	>	(Entrance = Bedroom)	>	(Kitchen = Dayroom)	>	Dining
P.T. 2:	Entrance	>	Bedroom	>	Outdoor	>	Kitchen > Dayroom > Dining
P.T. 3:	Entrance	>	Outdoor	>	Bedroom	>	Kitchen > Dining > Dayroom
P.T. 4:	Entrance	>	Bedroom	>	Outdoor	>	Kitchen > Dayroom > Dining

Figure 19: The cross plan type (P.T.) comparison of the order of spaces in terms of their global integration levels

In sum, when the mean of convex spaces with same functions were ordered for each plan type, Plan Type 2 and Plan Type 4 had the same order whereas Plan Type 1 and Plan Type 3 were different. Observing the same order in convex spaces of Plan Type 2 and Plan Type 4 may raise the question of their eligibility to be treated as separate plan types. It is important to remember that these orders were made by combining convex spaces with the same functions. In fact, Plan Type 2 and Plan Type 4 were the only plan types that have alternative common spaces.

If the individual syntactic analysis for each plan type is revisited, it can be seen that both plan types have different configurations (Figure 20). The orders that are displayed in Figure 20 are based on ranking the global integration value of each common convex space. When Plan Type 1 and Plan Type 3 were added to the list by showing the order of common areas, it was observed that all plan types have different orders and therefore, have distinct configurations.

P.T. 4:	Sunroom	>	Kitchen	>	Dayroom	>	Dining		
P.T. 2:	Dayroom	>	Kitchen	>	Garden D.	>	Parlor	>	Dining
P.T. 1:	Kitchen	=	Dayroom	>	Dining				
P.T. 3:	Kitchen	>	Dining	>	Dayroom				

Figure 20: The cross plan type (P.T.) comparison of the order of spaces in terms of their global integration levels

In the final comparison, the distinctiveness of the spatial relations between the kitchen, the dayroom, and the dining space were taken as the plan type selection criteria. These common spaces were the main required common areas with established building rules for their design. The bedrooms were omitted from the order since there are three different numbers of bedrooms in the four plan types, as well as three different room sharing situation (private rooms only – Plan Type 2; shared rooms only – Plan types 3 and 4; and both – Plan Type 1) among plan types. Additionally, the outdoors and the entrance were dropped from the order. However it was noted that all of the plan types have more integrated outdoor areas and entrances when compared to the interior common spaces.

Figure 20 illustrates that all plan types have different orders of global integration values for the kitchen, the dining room, and the dayroom. Showing the difference in configuration of these three common rooms displays that even all the rest of the spaces had the same global integration values. However, the plan types would still be regarded differently in terms of their spatial configuration. This difference in the order of common areas indicated that the selected plan types were eligible to be studied. This study conceptualized the difference in spatial configuration as an important factor that may lead to differences in the daily use of space, which may affect the well-being of the residents. Since the distinctiveness of the plan

types was confirmed, the plan type selection criterion was proven to be successfully followed.

5.7.3. Cross Plan type Comparison of Convex Spaces with Same Functions

In the previous presentation, comparison of the integration orders of the common areas in each plan type showed that the plan types selected for this study were configurationally different. It is important to acknowledge the fact that all of these orders were based on the global integration values of the convex spaces under consideration.

The task of demonstrating the configurational distinction between plan types was completed. Nevertheless, the answer of possible questions such as “What is the order of the integration levels of the *dayrooms* in all plan types?” were not explicitly answered. The global integration values of spaces under consideration were previously outlined and followed by a discussion of impact of alternative convex spaces on the order. Moreover, the orders were not easily readable from the table.

Yet, the aim of this presentation is beyond enhancing the communication of a table used to answer possible questions related to cross plan type comparison of a given space. Figure 21 displays this information and clearly emphasizes the relations between spaces with the same functions. All orders were consistent with the order based on the mean total global integration value. When the integration value of individual spaces were considered, Plan Type 2 had all the convex spaces classified as the most integrated and Plan Type 1 had all the convex spaces at the end of the order, showing that they were the most segregated areas. The order for all individual convex spaces that belong to different plan types but have the same functions is same for all and is as follows: Plan Type 2 > Plan Type 3 > Plan type4 > Plan Type 1.

In fact, focusing on single spaces in each plan type and comparing their syntax values opens new discussions about linking the syntax findings to the actual use of these spaces. The

answers for questions like “Is there any consistency between the actual use of dayrooms in all plan types and the order of their global integration values?” is worth investigating.

It is evident that these inquiries were beyond the scope of this chapter, but still this is where to start an initial conversation between syntax variables and other outcomes. The relation between space syntax values of considered convex spaces and actual use, as well as other outcomes, will be discussed later.

Spaces	Order of Plan Types						
Kitchen	P.T. 2 0.98	>	P.T. 3 1.23	>	P.T. 4 1.36	>	P.T. 1 2.10
Dining	P.T. 2 1.18	>	P.T. 3 1.49	>	P.T. 4 1.78	>	P.T. 1 2.18
Dining <i>combined</i>	P.T. 2 1.37	>	P.T. 3 1.49	>	P.T. 4 1.78	>	P.T. 1 2.18
Dayroom	P.T. 2 0.93	>	P.T. 3 1.56	>	P.T. 4 1.73	>	P.T. 1 2.10
Dayroom <i>combined</i>	P.T. 2 1.01	>	P.T. 3 1.39	>	P.T. 4 1.73	>	P.T. 1 2.10
Outdoor	P.T. 2 0.96	>	P.T. 3 1.15	>	P.T. 4 1.33	>	P.T. 1 1.58
Entrance	P.T. 2 0.62	>	P.T. 3 0.81	>	P.T. 4 0.97	>	P.T. 1 1.96
Bedroom	P.T. 2 0.83	>	P.T. 3 1.16	>	P.T. 4 1.19	>	P.T. 1 1.96
Mean	P.T. 2 0.91	>	P.T. 3 1.37	>	P.T. 4 1.46	>	P.T. 1 2.17

Figure 21: The cross plan type (P.T.) comparison of global integration values of considered convex spaces. Notice that the dayroom and the dining space have two comparisons, one of which included the effect of alternative spaces with the function.

5.8. Summary

Looking at the plan layouts of the plan types, one can spot differences in them. Such differences include the inequality in the number of bedrooms or the presence of alternative

common area(s) in Plan Type 2 and Plan Type 4. Yet, these differences were isolated observations and insufficient to explain the effect of these differences on all other spaces. Thus, selecting plan types based on spotting differences in single spatial relations is not reliable due to the lack of information on how this difference affects the whole system.

Spatial configuration is a better way of describing the relations in a space since it is a compressed piece of information that contains all the interrelations between spaces, instead of a single relation or a purposefully selected set of relations. This study conceptualized the difference in spatial configuration as an important factor that may lead to differences in the daily use of space that may affect the well-being of adult care home residents.

Space syntax theory and methods were utilized to analyze the plan layouts in order to show that selected plan types were configurationally different from each other. First, each plan type was studied individually by transforming the relations between spaces of each plan type into a graph. This was done by employing an interface called a convex map, which defines the boundary of each activity space in the plan layout. Then, the syntactic values were calculated for each space. Mainly the global integration value was used to make orders of spaces in each plan type with higher values indicating segregation and lower values indicating integration. Then, cross comparisons between plan types were made in order to show that selected plan types have different spatial configurations.

In the cross comparison, the mean global integration values of all spaces were calculated for each plan type and resulted in different values. Then, the order of convex spaces of each plan type was compared by first including the effect of alternative spaces. This showed that two plan types (Plan Type 2 and 4) with alternative spaces have the same order when the convex spaces under consideration were ordered from the most integrated to the least integrated. However, the global integration values of the spaces of Plan Type 2 and Plan Type 4 were different, indicating a distinction between the two. The other plan types (Plan Type 1 and 3) displayed different orders from each other and plan types 2 and 4.

Final cross plan type comparison was made by focusing on the global integration values of the common areas that were present in each plan type. The alternative common spaces in Plan Type 2 and Plan Type 4 were omitted. This analysis showed that the spatial relations between the kitchen, the dining room, and the dayroom were different in each plan type, thereby confirming their eligibility to be selected for this research. An additional analysis was also made by comparing the global integration values of the same convex spaces in different plan types. This analyses showed that each space under consideration had different global integration values in each plan type and followed the same order of Plan Type 2 > Plan Type 3 > Plan Type 4 > Plan Type 1.

CHAPTER 6: FINDINGS OF THE CAREGIVERS' SURVEY

This chapter presents the findings of the caregivers' survey which was utilized to gather various types of information about each resident. In the scope of this chapter, first a descriptive analysis of the responses is reported to provide general information about the residents of each plan type. Second, the responses to questions with rating scales were converted to quantitative values by assigning scores for each scale and the dataset of survey responses was formed. Then, another data set that included the metric (area and distances) and non-metric (space syntax variables) spatial information of each resident's bedroom was collected from the findings of the space syntax analysis and the plan layout. Two data sets were joined to run series of statistical analyses to test:

- (1) Whether there were expected correlations between outcomes;
- (2) Whether the cases were significantly different from each other in terms of the outcomes of each resident; and
- (3) To what extent these outcomes can be explained by metric or non-metric attributes.

6.1. Descriptive Findings of the Caregivers' Survey

The descriptive findings of the caregiver survey for each plan type were calculated simply by:

- (1) Calculating means for the questions with quantitative responses, such as length of stay and number of hours spent outdoors; and
- (2) Counting the number of responses and calculating the percentages for questions with rating scales, such as competence in Activities of Daily Living (ADLs) and mood of the resident.

When reporting findings of different plan types together, the mean competence in the six ADLs, the five IADLs, and the seven symptoms of depression were reported.

6.1.1. Background of the Residents

6.1.1.1. Plan Type 1: Background of the Residents

Twenty one (21) residents were staying at the plan type 1 facility, which was represented by three 12 bed adult care homes. All residents were female, with a mean age of 80 years. Two (9.5%) residents were separated or divorced, five (23.8%) were single, and fourteen (66.7%) of them were widowed. All residents were born in the United States and spoke English. Twenty (20) of the residents (99.5%) were White and one person was Black or African American. The average length of stay in the facility was approximately 2.5 years (127.3 weeks) with a range between 2 months and 10 years.

6.1.1.2. Plan Type 2: Background of the Residents

Thirteen (13) residents were staying at the plan type 2 facility which was represented by two 12 bed adult care homes. Five (38.5%) residents were male and eight (61.5%) residents were female. The mean age of the residents was 88.85 years. Two (15.4 %) residents were single, five (38.5%) were married, and six (46.1%) residents were widowed. All residents were White, born in the United States and spoke English.

The average length of stay in the facility was approximately 2.2 years (113.6 weeks) with a range between 1.25 months and 7 years. Two cases that represented plan type 2 were in a retirement community. The residents from this community who participated in this study lived in this community an average of 12.2 years with a range between 3 to 23 years. These residents were relocated from either the independent apartments or the assisted living apartments in the same community.

6.1.1.3. Plan Type 3: Background of the Residents

Twenty three (23) residents were staying at the plan type 3 facility which was represented by three 12 bed adult care homes. Four (17%) residents were male and 19 (63%) residents were female. The mean age of the residents was 80.6 years. Three (13%) residents were single, ten (43.5%) were separated or divorced, and ten (43.5%) were widowed. Two (8.7%) residents were Black or African American and twenty one (91.3%) residents were White. All residents were born in the United States and spoke English. The average length of stay in the

facility was approximately 2.2 years (114.9 weeks) with a range between 0.5 months and 9 years.

6.1.1.4. Plan Type 4: Background of the Residents

Twenty three (23) residents were staying at the plan type 4 facility, which was represented by three 12 bed adult care homes. Six (26%) residents were male and seventeen (74%) residents were female. The mean age of the residents was 75.8 years. One (4.3%) resident was married, three (13%) were separated or divorced, four (17.5) were single, and fifteen (65.2%) were widowed. Five (21.7%) residents were Black or African American and eighteen (79.3%) residents were White. All residents were born in the United States and spoke English. The average length of stay in the facility was approximately 2.2 years (112.8 weeks) with a range between 3 weeks and 6 years.

6.1.1.5. Overall Comparison of Background of the Residents

Table 1 shows the background information of all residents from the four plan types. Except for the cases that were in the plan type 1, all cases contained some male population. The mean age of the populations of the different plan types was greater than 75 years old. The length of stay of residents in three of the plan types was approximately the same (2.2) years, except for plan type 1 where it was slightly longer (2.5 years). Generally the majority of the residents were widowed, separated, or divorced. Plan type 2, which contained 38.5% married residents, contained two couples and a married resident. The majority of residents from the three plan types (1, 3, and 4) and all residents of plan type 2 were White. Only plan type 4 housed nearly 22% Black or African American residents, followed by 8.7% Black or African American residents at plan type 3.

Table 1: Background of residents by plan type

	Σ #R	Gender				Mean of (years)		Marital Status								Ethnicity			
		Male		Female		Age	Length of Stay	Married		Single		Sep. or Div.		Widowed		White		Black or Af. Ame.	
		%	#	%	#			%	#	%	#	%	#	%	#	%	#	%	#
p.t. 1	21	0.0	0	100.0	21	80	2.5	0	0	23.8	5	9.5	2	66.7	14	99.5	20	0.05	1
p.t. 2	13	38.5	5	61.5	8	88.8	2.2	38.5	5	15.4	2	0	0	46.1	6	100	13	0	0
p.t. 3	23	17.0	4	63.0	19	80.6	2.2	0	0	13	3	43.5	10	43.5	10	91.3	21	8.7	2
p.t. 4	23	26.0	6	74.0	17	75.8	2.2	4.3	1	17.5	4	13	3	65.2	15	79.3	18	21.7	5

6.1.2. Competence of Residents in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs)

6.1.2.1. Plan Type 1: Competence of Residents in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs)

The competence of the residents of plan type 1 in ADLs and IADLs were displayed as percentages in Table 2 All 21 of the residents were able to eat, get out bed/chair, walk, and use the toilet without any assistance. However, all of them need some help in bathing and dressing. In performing IADLs, resident were not able to prepare meals and one resident (5%) was not able to manage her money. Twelve residents (57%) were able to manage their money without help, whereas eight residents (38%) still needed some help. Eleven (52%) of the residents were able to go shopping without help however the rest of the ten residents (48%) needed some help. All 21 residents were able to do some light or heavy housework without any help and nearly all of them (95%) were able to use the telephone, however, one resident (5%) needed some help.

Table 2: Competence of residents of plan type 1 in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL)

Activity Types	Activities	No Help Needed		Some Help Needed		Cannot Do at all		Total	
		%	#	%	#	%	#	% of R	# R
Activities of Daily Living (ADL)	Bathing	0%	0	100%	21	0%	0	100%	21
	Dressing	0%	0	100%	21	0%	0	100%	21
	Eating	100%	21	0%	0	0%	0	100%	21
	Getting in/out of bed/chair	100%	21	0%	0	0%	0	100%	21
	Walking	100%	21	0%	0	0%	0	100%	21
	Using the toilet	100%	21	0%	0	0%	0	100%	21
Instrumental Activities of Daily Living (IADL)	Using telephone	95%	20	5%	1	0%	0	100%	21
	Light/ Heavy Housework	100%	21	0%	0	0%	0	100%	21
	Meal Preparation	0%	0	0%	0	100%	21	100%	21
	Shopping	52%	11	48%	10	0%	0	100%	21
	Managing Money	57%	12	38%	8	5%	1	100%	21

6.1.2.2. Plan Type 2: Competence of Residents in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL)

The competence of the residents of plan type 2 in ADL and IADL were displayed as percentages in Table 3. There was not any single ADL or IADL that residents of Plan Type 2 could not do at all. The majority of the residents were able to perform all ADL without any help. Only five residents (38%) needed some help in bathing and three (23%) needed some help in dressing. Two residents (15%) needed some help in eating and using the toilet and one resident needed some help in getting out of a bed/chair.

Shopping and housework were the only items where more than half of the residents (54% for housework and 69% for shopping) needed some help. Nearly all residents (92%) were able to use the telephone, nine of them (69%) were able to prepare meals, and eight of them (62%) were able to manage money without help.

Table 3: Competence of residents of plan type 2 in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL)

Activity Types	Activities	No Help Needed		Some Help Needed		Cannot Do at all		Total	
		%	#	%	#	%	#	% of R	# R
Activities of Daily Living (ADL)	Bathing	62%	8	38%	5	0%	0	100%	13
	Dressing	77%	10	23%	3	0%	0	100%	13
	Eating	85%	11	15%	2	0%	0	100%	13
	Getting in/out of bed/chair	92%	12	8%	1	0%	0	100%	13
	Walking	85%	11	15%	2	0%	0	100%	13
	Using the toilet	92%	12	8%	1	0%	0	100%	13
Instrumental Activities of Daily Living (IADL)	Using telephone	92%	12	8%	1	0%	0	100%	13
	Light/ Heavy Housework	46%	6	54%	7	0%	0	100%	13
	Meal Preparation	69%	9	31%	4	0%	0	100%	13
	Shopping	31%	4	69%	9	0%	0	100%	13
	Managing Money	62%	8	38%	5	0%	0	100%	13

6.1.2.3. Plan Type 3: Competence of Residents in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL)

The competence of the residents of plan type 3 in ADL and IADL are displayed as percentages in Table 4. Among all the ADL, the bathing activity required the most assistance with only 4 (17%) out of 23 residents able to bathe without any help. Fourteen (61%) or more of the residents were able to perform other activities without any help. All residents were able to eat without any help, except one resident (4%). Nine residents were not able to bathe (39%) and four residents (17%) were not able to dress at all. One resident (4%) also required full assistance to use the toilet. In summary, nearly one third of the residents required some help in performing ADL except eating.

With the exception of using the telephone, nearly all residents were not able to perform any of the IADL. Only one resident (4%) was able to manage his/her money and do some housework without any help. Two residents (9%) were able to do some housework, do shopping, and manage their money with some help.

Table 4: Competence of residents of plan type 3 in Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL)

Activity Types	Activities	No Help Needed		Some Help Needed		Cannot Do at all		Total	
		%	#	%	#	%	#	% of R	# R
Activities of Daily Living (ADL)	Bathing	17%	4	43%	10	39%	9	100%	23
	Dressing	61%	14	22%	5	17%	4	100%	23
	Eating	96%	22	4%	1	0%	0	100%	23
	Getting in/out of bed/chair	70%	16	30%	7	0%	0	100%	23
	Walking	74%	17	26%	6	0%	0	100%	23
	Using the toilet	70%	16	26%	6	4%	1	100%	23
Instrumental Activities of Daily Living (IADL)	Using telephone	57%	13	26%	6	17%	4	100%	23
	Light/ Heavy Housework	4%	1	9%	2	87%	20	100%	23
	Meal Preparation	0%	0	0%	0	100%	23	100%	23
	Shopping	0%	0	9%	2	91%	21	100%	23
	Managing Money	4%	1	9%	2	87%	20	100%	23

6.1.2.4. Plan Type 4: Competence of Residents in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs)

The competence of the residents of plan type 4 in ADLs and IADLs are displayed as percentages in Table 5. Among all the ADLs, bathing was the only activity in which most of the residents sought some or full assistance. Eight (35%) residents needed some help and eleven (48%) residents required full assistance for bathing. Dressing was the second activity in which nearly half of the residents required half or full assistance. At least 14 (61%) or more residents were able to use the toilet, get in/out of a bed/chair, and walk. Nearly all residents (96%) were able to eat without any help.

When it came to competence in IADLs, except for using the telephone, most of the residents required full assistance. Fifteen (65%) residents were able to use telephone without any help and the rest of the residents either required some assistance (4 residents, 17%) or were not able to use the telephone at all (4 residents, 17%). With the exception of one resident (4%) who was able to help around the house and two residents (8%) who were able to manage their money with some help, all other residents were not able to prepare meals, do shopping, do some sort of housework, or manage money at all.

Table 5: Competence of residents of plan type 4 in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs)

Activity Types	Activities	No Help Needed		Some Help Needed		Cannot Do at all		Total	
		% of R	# R	% of R	# R	% of R	# R	% of R	# R
Activities of Daily Living (ADL)	Bathing	17%	4	35%	8	48%	11	100%	23
	Dressing	52%	12	22%	5	26%	6	100%	23
	Eating	96%	22	0%	0	4%	1	100%	23
	Getting in/out of bed/chair	61%	14	35%	8	4%	1	100%	23
	Walking	74%	17	17%	4	9%	2	100%	23
	Using the toilet	61%	14	26%	6	13%	3	100%	23
Instrumental Activities of Daily Living (IADL)	Using telephone	65%	15	17%	4	17%	4	100%	23
	Light/ Heavy Housework	4%	1	4%	1	91%	21	100%	23
	Meal Preparation	0%	0	0%	0	100%	23	100%	23
	Shopping	0%	0	0%	0	100%	23	100%	23
	Managing Money	0%	0	4%	1	96%	22	100%	23

6.1.2.5. Overall Comparison of Competence of Residents in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs)

The mean of the six ADLs that residents were able to perform without help, perform with some help, or could not perform at all were calculated for each plan type by dividing the number of people in each category by the total number of residents of the plan type (Table 6). Residents of plan type 2 were quite independent with the mean of five ADLs that they were able to perform without any help. Residents of plan types 1, 3, and 4 also had means of about four ADLs that residents were able to perform independently. All cases had residents who needed some help in 1.08 (plan type 2) to 2.00 (plan type 1) ADLs. Plan type 1 and plan type 2 did not have any residents who required full assistance in any ADL. Plan type 4 and plan type 3 had a few residents who could not perform some ADLs at all, which resulted in means of 1.04 (for plan type 4) and 0.61 (plan type 3) activities per resident.

Table 6: Overall comparison of plan types in residents' competences in performing Activities of Daily Living (ADL)

	No Help Needed	Some Help Needed	Cannot Do at all	Σ ADLs
plan type 1	4.00	2.00	0.00	6.00
plan type 2	4.92	1.08	0.00	6.00
plan type 3	3.87	1.52	0.61	6.00
plan type 4	3.61	1.35	1.04	6.00

The mean of five IADLs that residents were able to perform without help, perform with some help, or could not perform at all were calculated for each plan type by dividing the number of people in each category by the total number of residents of the plan type (Table 7). Plan type 1 and plan type 2 residents had a mean of 3.05 and 3.00 IADLs that they could perform independently. Plan type 2 residents were also able to do the rest of the IADLs with some help. However, residents of plan type 3 and plan type 4 were not able to perform the majority of the IADLs, which averaged to a mean of 3.83 IADLs for plan type 3 and a mean of 4.04 IADLs for plan type 3. Residents of plan type 3 and plan type 4 were able to perform less than one of the IADLs with some help or independently.

In summary, according to the competence in ADLs, residents of plan type 1 and plan type 2 were more independent than residents of plan type 3 and plan type 4. This difference was even more distinguished in IADLs, with nearly the same mean of activities under the completely opposite competence categories of “no help needed” and “cannot do at all”.

Table 7: Overall comparison of plan types in residents' competence in performing Instrumental Activities of Daily Living (IADL)

	No Help Needed	Some Help Needed	Cannot Do at all	Σ IADLs
plan type 1	3.05	0.90	1.05	5.00
plan type 2	3.00	2.00	0.00	5.00
plan type 3	0.65	0.52	3.83	5.00
plan type 4	0.70	0.26	4.04	5.00

6.1.3. Caregiver's Evaluation of Residents' Participation in Social Events

6.1.3.1. Plan Type 1: Caregiver's Evaluation of Residents' Participation in Social Events

Residents of plan type 1 participated in 4.43 hours of social events during the average week of 14 hours of social events that were required to be organized by the caregiver. This resulted in a 68.3% absence in social events. The caregiver did not provide any data for participation in social events outside the community. According to the caregiver in plan type 1, among the 21 residents, six (28.6%) attended social events "very willingly", nine (42.9%) attended "willingly", five (23.8%) attended "somewhat willingly", and one resident (4.8%) attended "not willingly". Seven residents (33.3%) were rated as "very friendly", twelve residents (57.1%) were "friendly", and two residents (9.5%) were rated as "somewhat friendly" with other residents. None of the residents were rated as "not friendly" with other residents.

6.1.3.2. Plan Type 2: Caregiver's Evaluation of Residents' Participation in Social Events

Residents of plan type 2 participated in 2.54 hours of social events during the average week of 14 hours of social events in total. This resulted in an 81.9% absence in social events. Residents also attended slightly less than one (0.92 hours) social event outside their community per week. According to the caregivers in plan type 2, among the 13 residents, two (15.4%) attended social events "willingly" and eleven (84.6%) attended "somewhat willingly". The caregivers rated none of the residents attending social events "very willingly" or "not willingly". All residents were rated as "friendly" with other residents.

6.1.3.3. Plan Type 3: Caregiver's Evaluation of Residents' Participation in Social Events

Residents of plan type 3 participated in 6.13 hours of social events during the average week of 14 hours of social events in total. This resulted in a 56.2% absence in social events. Residents also attended 1.5 hours of social events outside their community per week. According to the caregiver of plan type 3, among the 23 residents, three (13.0%) attended social events "very willingly", six (26.1%) attended "willingly", seven (30.4%) attended "somewhat willingly", and seven residents (30.4%) attended "not willingly". Seven residents

(30.4%) were rated as “very friendly”, thirteen residents (56.5%) were “friendly”, and three residents (13.0%) were rated as “somewhat friendly” with other residents. None of the residents were rated as “not friendly” with other residents.

6.1.3.4. Plan Type 4: Caregiver’s Evaluation of Residents’ Participation in Social Events

Residents of plan type 4 participated in 5.13 hours of social events during the average week of 14 hours of social events in total. This resulted in a 63.4% absence in social events. Residents also attended 0.87 hours of social events outside their community per week. According to the caregiver of plan type 4, among the 23 residents, one (4.3%) attended social events “very willingly”, three (13.0%) attended “willingly”, thirteen (56.5%) attended “somewhat willingly”, and six residents (26.1%) attended “not willingly”. Four residents (17.4%) were rated as “very friendly”, sixteen residents (69.6%) were “friendly”, two residents (8.7%) were rated as “somewhat friendly”, and one resident (4.3%) was rated as “not friendly” with other residents.

6.1.3.5. Overall Comparison of Caregivers’ Evaluations of Residents’ Participation in Social Events

Table 8 displays the summary of means of hours of participation in social events, the percentages of absence in social events, and the hours of participation in events outside the community. According to the caregivers’ observations and the records from the previous 6 months from the application of the survey, residents of plan type 3 were the most active participants in weekly social events. The residents of plan type 3 participated in nearly half (6.13 hours) of the 14 hours of social events that were prepared by the caregiver for each week. Plan type 4 residents were ranked second in terms of their participation in social events in the facility with 5.12 hours of weekly participation on average. Residents of plan type 1 were ranked third with nearly 4.5 hours of participation per week and residents of plan type 2 were the least active with only 2.54 hours of participation per week in social events in the facility.

In the survey, caregivers were asked the total number of events per week that the resident attended inside and outside the community. In the very first information session, it was explained to the caregivers that “inside the community” referred to the whole facility which housed cluster of group homes with identical plan types. It was also explained that events “outside the community” referred to the events that were outside the facility and required residents to leave the facility grounds. Each time residents left the grounds, they were required to sign out; this could be counted as an indicator of the number of times they left the grounds. The inside community events were generally left blank or repeated the same information that was given for the resident’s participation in weekly social events of the adult care home where he/she stayed. Thus, this information was not evaluated.

Except for the caregiver in plan type 1, all caregivers reported the number of attendance in outdoor events. Residents of plan type 3 were the most outgoing residents with 1.5 events in the average week (6 events per month). Residents of plan type 4 and plan type 2 participated in 3 to 4 events per month, which counted as slightly less than one event per week.

Table 8: The summary of means of hours of participation in social events, the percentages of absence in social events, and the hours of participation in events outside the community (based on the caregivers’ responses)

	Mean		
	# Hours of Participation	% of Absence in Soc. Events	# Outside Events in which Residents Participated
plan type 1	4.43	68.3%	no data
plan type 2	2.54	81.9%	0.92
plan type 3	6.13	56.2%	1.50
plan type 4	5.13	63.4%	0.87

The caregivers’ evaluation on the residents’ willingness to attend social events are displayed in Table 9. Table 10 presents the caregivers’ evaluation of the residents’ friendliness with other residents. Compared to other variables, such as number of hours of participation in social events, these rating scales were designed to enable caregivers to reflect their personal opinion about the residents. In plan type 2, where compared to other plan types, the residents

had the least attendance in social events, the caregivers rated nearly 85% of residents as attending social events “somewhat willingly”. In spite of having the two highest rankings in the number of hours of attendance in social events, 1/3 of the residents of plan type 3 and plan type 4 were rated as attending social events “not willingly”. Plan types 3 and 4 also contained over 1/3 of the residents who were rated as attending social events “somewhat willingly”, indicating that over 5 hours of weekly attendance in social events did not raise the caregiver’s perception of the residents’ willingness to attend social events.

Table 9: The summary of the caregivers’ evaluation of the residents’ willingness to attend social events

	Very Willingly		Willingly		Somewhat Willingly		Not Willingly		Total	
	% of R	# R	% of R	# R	% of R	# R	% of R	# R	% of R	# R
plan type 1	28.6%	6	42.9%	9	23.8%	5	4.8%	1	100.0%	21
plan type 2	0.0%	0	15.4%	2	84.6%	11	0.0%	0	100.0%	13
plan type 3	13.0%	3	26.1%	6	30.4%	7	30.4%	7	100.0%	23
plan type 4	4.3%	1	13.0%	3	56.5%	13	26.1%	6	100.0%	23

As it can be seen in Table 10, the caregivers generally rated residents’ friendliness levels with other residents as “very friendly” or as “friendly”. In plan type 2, all residents were rated as “friendly”. Similarly in all plan types, the majority of the residents’ friendliness levels with other residents were rated as “friendly”, which was followed by “very friendly” and “somewhat friendly”. Only 4.3% of the residents of plan type 4 were rated as “not friendly” with other residents.

Table 10: The summary of the caregivers’ evaluation of the residents’ friendliness with other residents

	Very Friendly		Friendly		Somewhat Friendly		Not Friendly		Total	
	% of R	# R	% of R	# R	% of R	# R	% of R	# R	% of R	# R
plan type 1	33.3%	7	57.1%	12	9.5%	2	0.0%	0	100.0%	21
plan type 2	0.0%	0	100.0%	13	0.0%	0	0.0%	0	100.0%	13
plan type 3	30.4%	7	56.5%	13	13.0%	3	0.0%	0	100.0%	23
plan type 4	17.4%	4	26.1%	6	52.2%	12	4.3%	1	100.0%	23

6.1.4. Caregiver’s Evaluation of Residents’ Moods

6.1.4.1. Plan Type 1: Caregiver’s Evaluation of Residents’ Moods

The caregiver’s evaluation of the residents’ moods in adult care homes that represented plan type 1 are displayed in Table 11. With the exception of one resident (5%) that the caregiver observed as having a decline in an ability to think or concentrate, none of the residents gave the impression that they “always” had any of the depression symptoms. However, nearly half (9 residents, 43%) of the residents “sometimes” appeared to caregivers to have diminished interest and fatigue or loss of energy. Similarly slightly above one third (7 or 8 residents out of 21) of the residents were rated as “sometimes” having problems sleeping or waking up, a declining ability to think or concentrate, and displaying a depressive mood. Yet, the vast majority of the residents (19) never showed significant weight loss or gain, which was one of the seven depression symptoms. Twelve to fourteen residents also “never” gave the impression of any other symptoms of depression.

Table 11: Caregiver’s Evaluation of Plan Type 1 Residents’ Moods

Depression Symptoms	Always		Sometimes		Never		Total	
	%	#	%	#	%	#	% of R	# R
Depressive Mood	0%	0	33%	7	67%	14	100%	21
Diminished Interest	0%	0	43%	9	57%	12	100%	21
Diminished Pleasure	0%	0	38%	8	62%	13	100%	21
Weight loss/gain	0%	0	10%	2	90%	19	100%	21
Problem in Sleeping/Waking up	0%	0	33%	7	67%	14	100%	21
Decline in Ability to Think/Conc.	5%	1	33%	7	62%	13	100%	21
Fatigue/Loss of Energy	0%	0	43%	9	57%	12	100%	21

6.1.4.2. Plan Type 2: Caregiver’s Evaluation of Residents’ Moods

The caregiver’s evaluation of the residents’ moods in adult care homes that represented plan type 2 are displayed in Table 12. According to the observations of the caregiver, none of the 13 residents showed any of the depression symptoms all the time. Yet, three (23%) to one (8%) residents “sometimes” appeared to have a depressive mood (3 residents), a decline in the ability to think/concentrate (3 residents), problem in sleeping/waking up (2 residents, 23%), diminished pleasure (1 resident), and diminished interest (1 resident). Thus, residents who “never” had any of the symptoms ranged from 10 (77%) to 12 (92%).

Table 12: Caregiver’s Evaluation of Plan Type 2 Residents’ Moods

Depression Symptoms	Always		Sometimes		Never		Total	
	%	#	%	#	%	#	% of R	# R
Depressive Mood	0%	0	23%	3	77%	10	100%	13
Diminished Interest	0%	0	8%	1	92%	12	100%	13
Diminished Pleasure	0%	0	8%	1	92%	12	100%	13
Weight loss/gain	0%	0	8%	1	92%	12	100%	13
Problem in Sleeping/Waking up	0%	0	15%	2	85%	11	100%	13
Decline in Ability to Think/Conc.	0%	0	23%	3	77%	10	100%	13
Fatigue/Loss of Energy	0%	0	15%	2	85%	11	100%	13

6.1.4.3. Plan Type 3: Caregiver’s Evaluation of Residents’ Moods

The caregiver’s evaluation of the residents’ moods in adult care homes that represented plan type 3 are displayed in Table 13. According to the caregiver, one (4%) to five (22%) residents always had one of the depression symptoms. Among all the residents (23), three (13%) residents always appeared to the caregivers that they had a depressive mood, diminished pleasure, and a decline in ability to think/concentrate. Four (17%) residents were rated as “always” displaying a diminished interest and five (22%) residents “always” had fatigue and/or loss of energy.

The caregiver sometimes noticed some of the depression symptoms in 6 to 12 residents. Twelve (52%) residents “sometimes” had two (diminished pleasure and interest) symptoms and 11 (48%) were rated as “sometimes” showing a decline in their ability to think and/or concentrate. Ten residents (43%) “sometimes” had a depressive mood and fatigue/loss of energy. Nine residents (39%) “sometimes” gained or lost weight and six of them sometimes had problems with sleeping or waking up.

Despite having nearly half of the residents of plan type 3 mostly being evaluated as “sometimes” and some residents as “always” having symptoms of depression, seven (30%) to sixteen (70%) residents “never” had these symptoms. Over half of the residents “never” appeared to the caregiver to have weight loss/gain (13 residents, 57%) and/or a problem with

sleeping or waking up (16 residents, 70%). Around one third of the residents also were “never” observed to have fatigue/loss of energy (8 residents, 35%), diminished pleasure (8 residents, 35%), or a diminished interest (7 residents, 30%). Slightly less than half of the residents of plan type 3 never had a depressive mood (10 people, 43%) or a decline in the ability to think/concentrate (9 people, 39%).

Table 13: Caregiver’s Evaluation of Plan Type 3 Residents’ Moods

Depression Symptoms	Always		Sometimes		Never		Total	
	%	#	%	#	%	#	% of R	# R
Depressive Mood	13%	3	43%	10	43%	10	100%	23
Diminished Interest	17%	4	52%	12	30%	7	100%	23
Diminished Pleasure	13%	3	52%	12	35%	8	100%	23
Weight loss/gain	4%	1	39%	9	57%	13	100%	23
Problem in Sleeping/Waking up	4%	1	26%	6	70%	16	100%	23
Decline in Ability to Think/Conc.	13%	3	48%	11	39%	9	100%	23
Fatigue/Loss of Energy	22%	5	43%	10	35%	8	100%	23

6.1.4.4. Plan Type 4: Caregiver’s Evaluation of Residents’ Moods

The caregiver’s evaluation of the residents’ moods in adult care homes that represented plan type 4 are displayed in Table 14. According to the caregiver’s ratings, at least one resident (4%) and at most five (22%) residents “always” displayed one of the depression symptoms. Five residents “always” displayed a decline in an ability to think or concentrate. Among 23 residents, the symptoms of diminished interest, diminished pleasure, and weight loss/gain were “always” seen in two residents (9%). More than half of the residents of plan type 3 were rated as “sometimes” having a depressive mood (18 residents), diminished interest (18 residents), diminished pleasure (13 residents), and/or fatigue/loss of energy (12 residents). One third of the residents “sometimes” gained/lost weight (8 residents, 35%) and had a decline in the ability to think/concentrate (7 residents, 30%).

Problems with sleeping/waking up and weight loss/gain were the two depression symptoms that more than half of the residents “never” had (17 residents for problems with sleeping/waking up, 13 residents for weight loss/gain). Eleven residents, which made up the 48% of the residents of plan type 3, also “never” had a decline in their ability to

think/concentrate and ten residents (43%) were “never” observed to complain of fatigue/loss of energy. Three to eight residents also “never” appeared to caregivers to have a depressive mood, diminished interest, or diminished pleasure.

Table 14: Caregiver’s Evaluation of Plan Type 4 Residents’ Moods

Depression Symptoms	Always		Sometimes		Never		Total	
	%	#	%	#	%	#	% of R	# R
Depressive Mood	4%	1	78%	18	17%	4	100%	23
Diminished Interest	9%	2	78%	18	13%	3	100%	23
Diminished Pleasure	9%	2	57%	13	35%	8	100%	23
Weight loss/gain	9%	2	35%	8	57%	13	100%	23
Problem in Sleeping/Waking up	4%	1	22%	5	74%	17	100%	23
Decline in Ability to Think/Conc.	22%	5	30%	7	48%	11	100%	23
Fatigue/Loss of Energy	4%	1	52%	12	43%	10	100%	23

6.1.4.5. Overall Comparison of Caregivers’ Evaluations of Residents’ Moods

Table 15 displays the mean of the depression scores that were calculated by dividing the total number of each frequency (always, sometimes, never) by the total number of residents in each plan type. Generally, the majority of the symptoms were “never” observed in the residents of all plan types. Residents of plan type 2, with a mean of 6 symptoms “never” observed per each resident, had the fewest symptoms. Residents of plan type 1 had 4.62 “never” observed symptoms per each resident and were ranked second in “never” observed depression symptoms. Residents of plan type 3 and plan type 4 had a mean of 3.09 and 2.87 “never” observed symptoms, respectively. Plan type 3 and plan type 4 had nearly the same amount of depression symptoms that were “sometimes” observed. Plan type 3 and plan type 4 also had a mean of 0.87 and 0.61 symptoms of depression per resident that were “always” observed, respectively.

Table 15: Overall Comparison of Caregivers’ Evaluations of Residents’ Moods

	Always	Sometimes	Never	∑Depr. Symptoms
plan type 1	0.05	2.33	4.62	7.00
plan type 2	0.00	1.00	6.00	7.00
plan type 3	0.87	3.04	3.09	7.00
plan type 4	0.61	3.52	2.87	7.00

6.1.5. The Caregiver's Evaluation of the Residents' Use of the Outdoors

6.1.5.1. Plan Type 1: The Caregiver's Evaluation of the Residents' Use of the Outdoors

According to the caregiver in plan type 1, in a typical week with appropriate weather conditions, residents spent 3.86 hours outdoors. Five (23.8%) residents were “very” often seen outdoors, fourteen (66.7%) were “somewhat” often seen outdoors, and two (9.5%) residents were “never” seen outdoors.

6.1.5.2. Plan Type 2: The Caregiver's Evaluation of the Residents' Use of the Outdoors

According to the caregiver in plan type 2, in a typical week with appropriate weather conditions, residents spent 1.65 hours outdoors. Five (38.5%) residents were “very” often seen outdoors, seven (53.8%) were “somewhat” often seen outdoors, and one (7.7%) residents were “never” seen outdoors.

6.1.5.3. Plan Type 3: Caregiver's Evaluation of the Residents' Use of the Outdoors

According to the caregiver in plan type 3, in a typical week with appropriate weather conditions, residents spent 4.83 hours outdoors. Ten (43.5%) residents were “very” often seen outdoors, eight (34.8%) were “somewhat” often seen outdoors, and five (21.7%) residents were “never” seen outdoors.

6.1.5.4. Plan Type 4: Caregiver's Evaluation of the Residents' Use of the Outdoors

According to the caregiver in plan type 4, in a typical week with appropriate weather conditions, residents spent 4.07 hours outdoors. Seven (30.4%) residents were “very” often seen outdoors, twelve (52.2%) were “somewhat” often seen outdoors, and four (17.4%) residents were “never” seen outdoors.

6.1.5.5. Overall Comparison of Caregivers' Evaluations of the Residents' Use of the Outdoors

The summary of the caregivers' evaluations of the residents' use of the outdoors are displayed in Table 16. The residents of plan type 3 were the most active users of the outdoor with 4.83 hours in the average week. This is followed by the residents of plan type 4 who used the outdoors for 4.07 hours in the average week. Residents of plan type 1 followed

closely with 3.86 hours of outdoor use in the average week. Finally, residents of plan type 2 had the least amount of outdoor use with only 1.65 hours per week.

Caregivers rated the residents’ frequency of use of the outdoors by using a three point scale (very, somewhat, never). Similar to the results of the residents’ number of hours spent outside in an average week, when compared to other plan types, residents of plan type 3 had the highest (43.5%) rating for their outdoor use. Plan type 3 also had the highest percentage (21.7%) of residents who were rated poorly (never seen outdoors), thereby indicating that the active users of the outdoors, in fact, had more than 4.83 hours of use of the outdoors per week. In spite of the fact that residents of plan type 2 spent less time at outdoors than the residents of plan type 4 and plan type 1, the rating of the caregiver for frequency of use of outdoors was higher (38.5% of very often seen residents for plan type 2, compared to 23.8% and 30.4% for plan type 1 and 4). Except for plan type 3, the majority of the residents in each plan type were given a “somewhat” rating for their frequency of use of outdoor that ranged from 52.2% (plan type 4) to 66.7% (plan type 1).

Table 16: The summary of the caregivers’ evaluations of the residents’ use of the outdoors

	# Hours Spent Weekly	Very		Somewhat		Never		Total	
		% of R	# R	% of R	# R	% of R	# R	% of R	# R
plan type 1	3.86	23.8%	5	66.7%	14	9.5%	2	100.0%	21
plan type 2	1.65	38.5%	5	53.8%	7	7.7%	1	100.0%	13
plan type 3	4.83	43.5%	10	34.8%	8	21.7%	5	100.0%	23
plan type 4	4.07	30.4%	7	52.2%	12	17.4%	4	100.0%	23

6.1.6. Residents’ Bedroom Sharing Status

As discussed earlier, any bedroom of an adult care home can be private or can be shared between two residents. Naturally, the cost of the private rooms is higher than the semi-private rooms. Yet, determining room sharing status based on the resident’s payment plan could be misleading. This is a result of the fact that a number of residents were enrolled in the semi-private payment plan but stayed alone in their room due to the facility operating under full occupancy. Thus, the residents’ bedroom sharing status was decided by the absence or presence of a roommate. Some exceptions were made in those cases where the roommate

was temporarily out of the facility for a short hospital stay. Sometimes, a facility did not allow residents to use the space even if he/she did not have a roommate as the facility wanted them to live ready to welcome a roommate. In these cases, residents who did not have a roommate or whose roommate was away temporarily were still regarded as staying in a shared room.

Among the selected cases that represented four distinctive plan types, there were also different choices of bedrooms available for the residents. In plan type 1, there were 7 bedrooms that could be private or shared. Plan type 2 offered only private bedrooms; conversely plan type 3 and plan type 4 contained only semi-private bedrooms.

The bedroom sharing status of residents of different plan types is displayed in Table 17. The majority of residents of plan type 1 and plan type 2 had private rooms, whereas all residents of plan type 3 and plan type 4 had shared rooms. A married couple in plan type 2 were paying for two private rooms but modified their rooms to have a separate living room and a shared bedroom. Plan type 3 and plan type 4 contained 6 bedrooms per building that was designed for double occupancy. The current number of residents of each representative type was 23 residents in two buildings, leaving one resident at each plan type with no roommate. Yet, these residents were counted as having a shared room since they were reported as having roommates by the caregiver.

Table 17: The bedroom sharing status of residents of different plan types

	Private		Shared		Total	
	% of R	# R	% of R	# R	% of R	# R
plan type 1	71.4%	15	28.6%	6	100.0%	21
plan type 2	84.6%	11	15.4%	2	100.0%	13
plan type 3	0.0%	0	100.0%	23	100.0%	23
plan type 4	0.0%	0	100.0%	23	100.0%	23

6.2. Converting Rating Scales of Caregiver Survey to Scores

The rating scales that were used to measure physical competence (ADLs and IADLs), mood, willingness (to attend social events), level of friendliness (with other residents), and

frequency of use of the outdoors were converted to scores to be used in statistical models. Following are the formulas that were used to convert the results of rating scales to quantitative scores; this allowed for the use of gathered data in statistical analyses.

(1) The formulas that were used to calculate score of ADL and IADL were adopted from Moss and Lemke (1996). The responses collected for all six of ADLs and five of IADLs for each resident were converted by using the formulas below:

$$\begin{aligned} \text{ADL Score} &= 2 \text{ (No Help Needed)} + 1 \text{ (Some Help Needed)} + 0 \text{ (Cannot Do At All)} \\ \text{IADL Score} &= 2 \text{ (No Help Needed)} + 1 \text{ (Some Help Needed)} + 0 \text{ (Cannot Do At All)} \end{aligned}$$

The formulas result in 12 for ADLs and 10 for IADLs for a fully independent person and 0 for a person who seeks the maximum amount of assistance.

(2) A formula that was similar to the one used to calculate ADL and IADL scores was used for calculating the depression scores. This formula is as follows:

$$\text{Depression Score} = 2 \text{ (Always)} + 1 \text{ (Sometimes)} + 0 \text{ (Never)}$$

The depression score ranges between a maximum score of 14 for a person who always has seven of the symptoms and a 0 for a person who never presents any symptoms.

The scores for the other items were calculated by assigning a 0 value for the negative tendency (attended social events not willingly, not friendly with other residents, never seen using outdoors) and increasing it by 1 for each positive step in the scale. Thus the score for the willingness of the residents to attend social activities could be from 3 (very willingly) to 0. The data from the survey was coded to assign 1 for the corresponding cell of the selected rating and 0 for the others. The formulas that were used to convert the survey responses to scores are presented next:

Willingness (of Resident to Attend Social Events) Score
= 3(Very Willingly) + 2(Willingly) + 1(Somewhat Willingly) + 0 (Not Willingly)

Resident's Level of Friendliness with other Residents Score
= 3(Very Friendly) + 2(Friendly) + 1(Somewhat Friendly) + 0 (Not Friendly)

Resident's Use of Outdoors Score
= 2 (Very) + 1(Somewhat) + 0 (Never)

With the use of the formulas, the resident had one of four (3, 2, 1, or 0) scores for his/her willingness to attend social events and his/her level of friendliness with other residents based on the rating. Each resident also had one of three scores (2, 1, or 0) for his/her frequency of use of the outdoors.

6.3. Calculating the Distances between Bedrooms and Common Areas

As extensively discussed in the previous chapter, the spatial configuration is independent from the metric properties of the plan type. According to Space Syntax theory, as soon as the plan layout is represented by a graph that outlines the spatial configuration embedded in the plan, then there is no need for the physical plan layout. Thus, once the plan layout is converted to the graph, the metric information (distance and area) is lost.

However, in the scope of this study, these metric properties may be a factor for the outcomes tested. The plan types selected for this study were sampled from the same pool by controlling the number of beds, regulations, and building codes that apply to them. Yet, all plan types studied came in different size and scales (Table 18). This difference in scale of the building came from the difference in number of bedrooms (7 bedrooms in plan type 1, 12 bedrooms in plan type 2, and 6 bedrooms in plan types 3 and 4,) and the difference in plan configuration which may effect walking distances. Considering the bedroom of each resident as the origin and common spaces as the destination, the length of the route may be a factor of use, which was conceptualized as an outcome of well-being. Thus, walking distances were included as a variable in the statistical tests performed.

Table 18: Comparison of area of each plan type

≈ Area (sq feet)	Plan Type 1	Plan Type 2	Plan Type 3	Plan Type 4
Total Area	5089.39	16594.72	4867.76	6423.26
Area per Resident	424.12	1382.89	405.65	535.27
Comparison of Areas	≈ 1.05a	≈ 3.4a	a	≈ 1.32a

The distances between each resident’s bedroom and common spaces (kitchen, dining, dayroom) the outdoors, and the entrance of the facility were calculated (Figure 1). The following criteria were adhered to in drawing the routes between the bedrooms and destinations:

- (1) All routes should start from the center of the convex space of the bedroom;
- (2) All routes should leave and enter each room from the midpoint of the door span;
- (3) If paths are passing through convex spaces with no surrounding walls, then the route should pass through the center of that convex space; and
- (4) In the case where there are two or more routes available for a destination, the shortest path should be drawn.

When there is more than one common space or outdoor area, the mean distance of all routes that were between the bedroom and spaces with the same function was used. For example, in plan type 2 there were three rooms (dayroom, parlor, and sitting room) with the function of the dayroom. When the distance between the dayroom and each resident’s dayroom was calculated, first each route between all bedrooms and all three rooms was drawn and measured. Then the mean of all three routes (bedroom-dayroom, bedroom-sitting room, bedroom-parlor) were calculated for each resident and taken as the distance between the dayroom and the resident’s bedroom.

The area of each resident’s bedroom was also calculated based on plan layouts and included as a variable. There were two other variables calculated by using walking distances between bedrooms and common spaces (including the outdoors and the entrance) and the area of bedrooms:

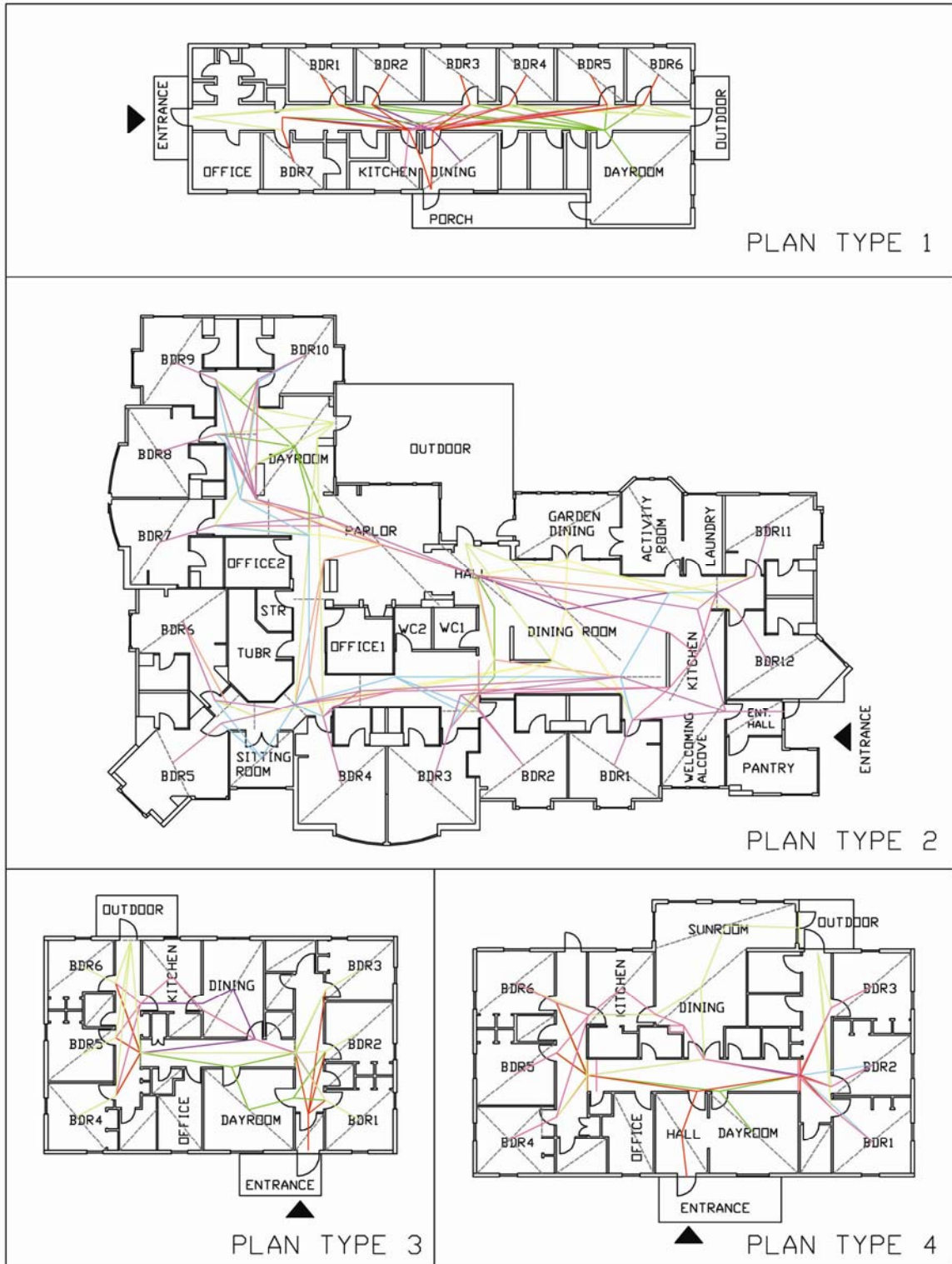


Figure 1: The distances between bedrooms and common areas, the entrance, and outdoor spaces

(1) Percentage of walking distances: This study added the walking distances as a variable and made the basic assumption that the shortest path between two spaces was taken. Yet, there might be several factors effecting the route selection. Examples include a resident's individual characteristics and social factors (e.g. their relations with other residents). Investigating these factors and including them as a variable is beyond the scope of this research. However, the rank that a resident's room had in terms of its proximity to one of the destinations might be a factor for the use of that destination for a particular case. For example, when distances between residents' bedrooms and the entrance were considered only as an actual distance, there was only one bedroom among the 4 representative plan types with the closest distance to any of the common spaces considered. Nevertheless, when the rank of this distance was considered for each plan type, there were one or more residents from each plan type whose rooms were the closest to the entrance, resulting in 4 or more residents in total. The use of this information as a variable is to test whether having the closest (or most distant) bedroom in the building was associated with any of the outcomes, such as absence from social events. If this information was considered to be ordinal data by assigning ranks (e.g. 1st, 2nd, 3rd...etc.), then the data would not fit into the model. Thus, the percentages of distances for each resident were calculated by dividing the length of routes by the total walking distances from each resident's bedroom to the same destination in the plan type.

(2) Percentage of bedroom areas: Considering the percentage of bedroom areas as a variable was due to a similar logic that led to the inclusion of percentages of walking distances when actual walking distances were already included as a variable. By only considering areas of bedrooms, the effect of the plan type would be ignored in the regression model that was built based on the data from all residents. In other words, having a larger room in a plan type may effect spending more time there and using other spaces less, resulting poor attendance in social events and outdoor use. Thus, the rank of each resident's bedroom area in a plan type was defined as a variable to be included. The percentage that

represented each resident's bedroom area with respect to the total area of the plan type was calculated in order to avoid ordinal ranking.

6.4. The Syntactic Variables Included in Statistical Analyses

The logic, process, and results regarding the syntax analyses were reported in an earlier chapter that concluded that all selected plan types had distinct spatial configurations. The space syntax values of 80 bedrooms that were calculated earlier were exported to the data table to be used for statistical analyses. Connectivity, control, and global and local integration values of each bedroom were included in the data table that contained findings of survey and metric variables of each plan type (areas and distances).

Depth values of bedrooms from common spaces (kitchen, dayroom, and dining room), including the entrance and the outdoors, were also added to the model. The graph of each plan type was justified several times in order to define each of the destinations as the carrier (origin) and the depth level of each bedroom was determined. In plan type 2 and plan type 4, where there was more than one convex space for the same function, the mean depths of all alternative spaces were calculated.

It is common in space syntax studies to consider a statistically comparable amount (changing from 5 to 30 plan layouts according to the analyses) of plan types and compare the quantitative findings of the syntax analysis by means of statistical methods. The total number of bedrooms studied satisfied the minimum numbers for a regression model and cross comparisons among models. Yet, the variability among the syntax values of the bedrooms of the same plan type was not so much that it could decrease the power of tests. In the case of finding associations between space syntax values of bedrooms and the outcomes, in spite of the missing variability among values (each bedroom did not have different syntax values), this association was expected to be a strong one; this indicated that there might also be other associations if the data represented a wider spectrum of variability.

However, in either case it will still be a valid effort to run statistical analysis with the data provided from various resources (caregivers, records, plan layout, space syntax analyses) considering the fact that studies that incorporate space syntax applications mainly rely on syntax analyses.

6.5. Comparison of the Survey Variables

The respondents of this study were selected by convenience sampling. Yet, there were rigorous measurements to exclude ineligible cases and select a somewhat random sample. In order to apply inferential statistics, the population of this study was assumed to be a random sample with a normal distribution.

The statistical method that was used to compare means of different variables of the four plan types is called a One-Way Analysis of Variance (ANOVA). The heart of this analysis is a significance test (F test), which tests whether there were at least two means that are unequal. Observing p values below .05 indicates that the null hypothesis that all means were equal should be rejected. The mean that was considered in the ANOVA test is called the sample adjusted mean, which is also called the least square mean. The sample adjusted mean of Y for a particular group is the prediction equation for that group evaluated at the overall mean of the X values for all the groups (Agresti and Finlay, 1999).

An ANOVA test reports only the presence or absence of a significant difference in means but not the groups that are different from each other. In the case of a significant difference between means, the Tukey-Kramer multiple comparison method was used to define the plan types that were different. The Tukey-Kramer method compares all the pairs of means. For example, six pair comparisons were made to determine the differences between the means of variables produced from the four plan types (Agresti and Finlay, 1999). SASTM and JUMPTM software were used to run statistical analyses and produce plots.

6.5.1. Comparison of the Age of Residents from Different Plan Types

The order of the means that were obtained from a least square estimation of the age associated with residents of the four plan types can be seen in Figure 2. Plan type 2 housed

the residents, who were older than the residents of the other plan types, with a least square mean of age of 88.85 (std error: 2.98). Whereas, residents of plan type 4 were younger than the rest of the population of this study with a least square mean age of 75.78 (std error: 2.24).

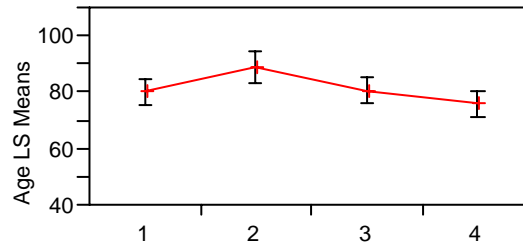


Figure 2: Least Square Means Plot of the Age of Residents

When a significance test was performed (RMSE = 10.75999) by using data associated with 80 residents from the four plan types, it was found that at least two plan types housed residents with significantly different least square means of age ($p < 0.0095$).

The Tukey-Kramer method was used to adjust for multiple comparisons of all the pairs of means of ages associated with residents from the different plan types. The results showed that residents of plan type 2 and residents of plan type 4 had a significant difference in least square means of ages of the residents (Table 19). Whereas, the least square means differences of the age of the residents were not significant in comparison with the other plan types.

Table 19: Least Square Means Differences of the Age of Residents

Level	Least Sq Mean
2 A	88.846154
3 A B	80.608696
1 A B	80.000000
4 B	75.782609

Levels not connected by same letter are significantly different.

6.5.2. Comparison of the Length of Stay Associated with Residents from Different Plan Types

The order of the means that were obtained from a least square estimation of the length of stay associated with residents of the four plan types can be seen in Figure 3. The least square

mean of the length of stay of residents were relatively close to each other, with the least square mean of 127.33 weeks (std error: 26.38) for residents of plan type 1 as the longest stay and 112.79 weeks (std error: 25.20) for residents of plan type 4 as the shortest stay of the four plan types.

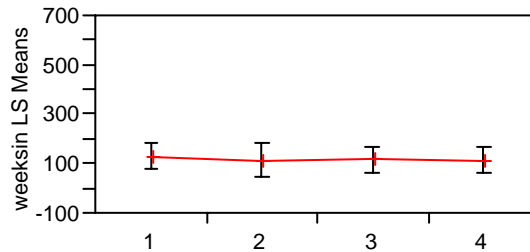


Figure 3: Least Square Means Plot of the Length of Stay of Residents

When a significance test was performed (RMSE = 120.8786) by using data associated with 80 residents from the four plan types, it was found that the difference in least square means of outdoor use scores was statistically insignificant ($p = 0.9777$). Since there weren't any two pairs that had significantly different means, no further comparisons were performed as a follow up by using the Tukey-Kramer method.

6.5.3. Comparison of ADL Scores Associated with Residents from Different Plan Types

The order of the means that were obtained from the least square estimation of ADL scores of residents from the four plan types can be seen in Figure 4. The residents of plan type 2 were the most competent in performing ADL with the highest least square mean score of 10.92 (std error: 0.65). Whereas, compared to other plan types, residents of plan type 4 needed the most help in ADL with the least square mean ADL score of 8.57 (std error: 0.49).

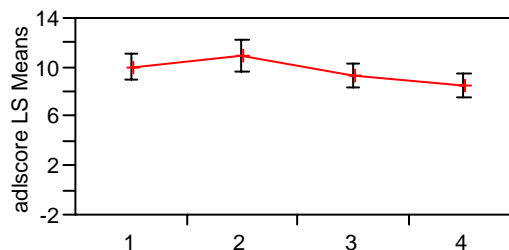


Figure 4: Least Square Means Plot of ADL Scores

When significance test was performed (RMSE = 2.336805) by using data associated with 80 residents from the four plan types, it was found that at least two plan types housed residents with significantly different least square means of ADL scores ($p = 0.0269$).

The Tukey-Kramer method was used to adjust for multiple comparisons of all the pairs of means of ADL scores associated with residents from the different plan types. The results showed that residents of plan type 2 and plan type 4 had a significant difference in ADL scores (Table 20). Yet, the comparisons between pairs that included the least square means differences of ADL scores associated with residents of plan type 1 and (or) plan type 3 and any of the other plan types were insignificant.

Table 20: Least Square Means Differences of ADL Scores

Level		Least Sq Mean
2	A	10.923077
1	A B	10.000000
3	A B	9.260870
4	B	8.565217

Levels not connected by the same letter are significantly different.

6.5.4. Comparison of IADL Scores Associated with Residents from Different Plan Types

The order of the means that were obtained from a least square estimation of IADL scores associated with residents from the four plan types can be seen in Figure 5. The residents of plan type 1 and plan type 2 had the same least square mean of 8.00 (plan type 2 std error: 0.34; plan type 1 std error: 0.26), which was higher than plan type 3 and plan type 4. The residents of plan type 4 needed the most help in performing IADL with the least square mean of 1.65 (std error: 0.25).

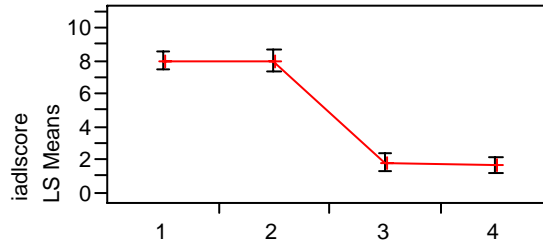


Figure 5: Least Square Means Plot of IADL Scores

When a significance test was performed (RMSE = 1.227544) by using data associated with 80 residents from the four plan types, it was found that at least two plan types housed residents with significantly different least square means of ADL scores ($p < 0.0001$).

The Tukey-Kramer method was used to adjust for multiple comparisons of all the pairs of means of IADL scores associated with residents from the different plan types. The results showed that the differences between the least square means of IADL scores associated with residents of plan type 2 and plan type 1 were insignificant. Similarly, the differences between the least square means of IADL scores associated with residents of plan type 3 and plan type 4 were also insignificant. Yet, the differences between the least square means of IADL scores associated with residents who stayed in one of the groups (plan types 2 and 1 vs. plan types 3 and 4) were significant (Table 21).

Table 21: Least Square Means Differences of IADL Scores

Level		Least Sq Mean
2	A	8.000000
1	A	8.000000
3	B	1.826087
4	B	1.6521739

Levels not connected by the same letter are significantly different.

6.5.5. Comparison of the Number of Hours of Absence from Social Events Associated with Residents from Different Plan Types

The order of the means that were obtained from a least square estimation of the number of hours of absence from social events associated with residents of the four plan types can be

seen in Figure 6. The residents of plan type 1 had the smallest least square mean hours of absence from social events with only 4.43 hours missed per week (std error: 0.69). Whereas, residents of plan type 2 had a least square mean absence of 11.46 hours (std error: 0.88), indicating that compared to other plan types, they generally missed the most of the 14 hour weekly social activity program.

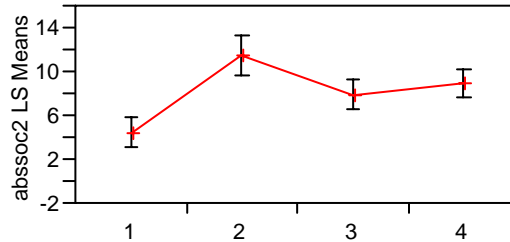


Figure 6: Least Square Means Plot of the Number of Absence Hours of Residents from Social Events

When a significance test was performed (RMSE = 3.175181) by using data associated with 80 residents from the four plan types, it was found that at least two plan types housed residents with significantly different least square means of social willingness scores ($p < 0.001$).

The Tukey-Kramer method was used to adjust for multiple comparisons of all the pairs of means of absence hours associated with residents from different plan types. The results showed that residents of plan type 1 had significantly different least square means of the number of hours of absence from social events than the residents of the other three plan types (Table 22).

Table 22: Least Square Means Differences of the Number of Absence Hours of Residents from Social Events

Level		Least Sq Mean
2	A	11.461538
4	A B	8.869565
3	B	7.869565
1	C	4.433333

Levels not connected by same letter are significantly different.

6.5.6. Comparison of Willingness (to Attend Social Events) Scores Associated with Residents from Different Plan Types

The order of the means that were obtained from a least square estimation of willingness (to attend social events) scores associated with residents of the four plan types can be seen in Figure 7. The residents of plan type 1 had the highest least square mean social willingness score of 1.95 (std error: 0.18). Whereas, compared to other plan types, residents of plan type 4 were less willing with the smallest least square mean “social” willingness score of 0.95 (std error: 0.17).

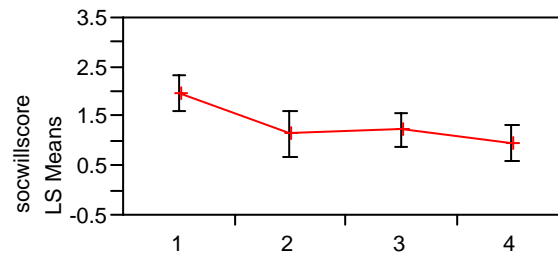


Figure 7: Least Square Means Plot of Willingness Scores

When a significance test was performed (RMSE = 0.839127) by using data associated with 80 residents from the four plan types, it was found that at least two plan types housed residents with significantly different least square means of social willingness scores ($p = 0.0014$).

The Tukey-Kramer method was used to adjust for multiple comparisons of all the pairs of means of willingness scores of residents from different plan types. The results showed that the differences between least square means of social willingness scores of residents from plan types 2, 3, and 4 were insignificant. However, the residents of plan type 1 had significantly higher least square mean of “social” willingness scores compared to the rest of the population of the study (Table 23).

Table 23: Least Square Means Differences of Willingness Scores

Level		Least Sq Mean
1	A	1.9523810
3	B	1.2173913
2	B	1.1538462
4	B	0.9565217

Levels not connected by the same letter are significantly different.

6.5.7. Comparison of Friendliness (with other Residents) Scores Associated with Residents from Different Plan Types

The order of the means that were obtained from least square estimation of friendliness (with other residents) scores associated with residents of the four plan types can be seen in Figure 8. The residents of plan type 1 had the highest least square mean friendliness score of 2.24 (std error: 0.13). Residents of plan type 2 and plan type 4, which housed less friendly residents compared to all participants, had the same least square mean friendliness score of 2.00 (plan type 2 std error: 0.16; plan type 4 std error: 0.12).

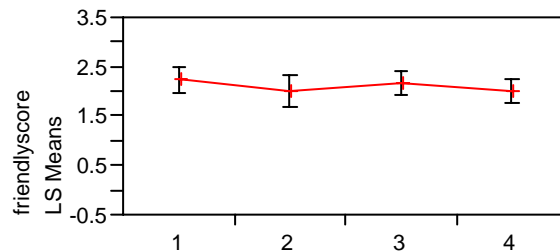


Figure 8: Least Square Means Plot of Friendliness Scores

When significance test was performed (RMSE = 0.597295) by using data associated with 80 residents from the four plan types, it was found that the difference in least square means of friendliness scores is statistically insignificant ($p = 0.4888$). Since there weren't any two pairs that had significantly different means, no further comparisons were performed as a follow up by using the Tukey-Kramer method.

6.5.8. Comparison of Depression Scores Associated with Residents from Different Plan Types

The order of the means that were obtained from the least square estimation of depression scores of residents from the four plan types can be seen in Figure 9. The residents of plan type 3 had the highest least square mean depression score of 4.78 (std error: 0.53), indicating they had more depression symptoms. Whereas, compared to other plan types, residents of plan type 2 were in a better mood with the least square mean depression score of 1.00 (std error: 0.70).

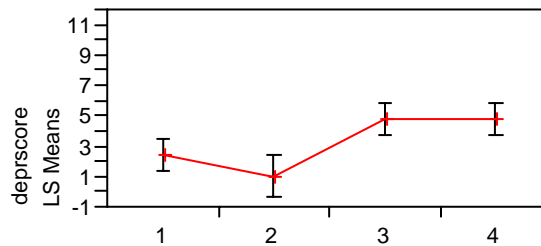


Figure 9: Least Square Means Plot of Depression Scores

When a significance test was performed (RMSE = 2.532675) by using data associate with 80 residents from the four plan types, it was found that at least two plan types housed residents with significantly different least square means of depression scores ($p < 0.0001$).

The Tukey-Kramer method was used to adjust for multiple comparisons of all the pairs of means of depression scores associated with residents from the different plan types. The results showed that the differences between the least square means of depression scores associated with residents of plan type 3 and plan type 4 were insignificant. Similarly, the differences between the least square means of depression scores associated with residents of plan type 1 and plan type 2 were insignificant. Yet, the differences between the least square means of the ADL scores of residents who stayed in one of the plan types (plan types 3 and 4 vs. plan types 1 and 2) were significant (Table 24).

Table 24: Least Square Means Differences of Depression Scores

Level		Least Sq Mean
3	A	4.7826087
4	A	4.7391304
1	B	2.4285714
2	B	1.0000000

Levels not connected by the same letter are significantly different.

6.5.9. Comparison of the Least Square Mean of Hours that Residents Spent Outdoors

The order of the means that were obtained from a least square estimation of the hours that residents of the four plan types spent outdoors during a usual week can be seen in Figure 10. Residents of plan type 3 spent the most time outdoors during a normal week with a least square mean of 4.83 (std error: 0.67) hours. Whereas, when compared to other residents of the other plan types, residents of plan type 2 spent the least amount of time outdoors with a least square mean of 1.65 (std error: 0.90) hours.

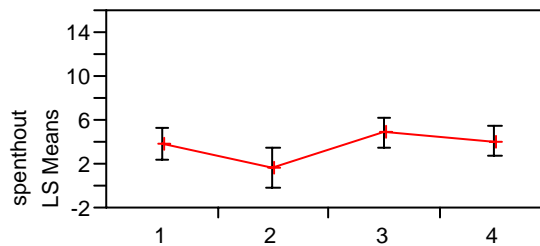


Figure 10: Least Square Means Plot of the Hours that Residents Spent Outdoors

When a significance test was performed (RMSE = 3.233041) by using data associated with 80 residents from the four plan types, it was found that at least two plan types housed residents with significantly different least square means of hours that those residents spent outdoors ($p < 0.0491$).

The Tukey-Kramer method was used to adjust for multiple comparisons of all the pairs of means of weekly outdoor use hours from the different plan types. The results showed that residents of plan type 3 and residents of plan type 2 had a significant difference in least square means of weekly outdoor use hours. Whereas, in comparison, the least square means

differences of hours of weekly outdoor use of residents of other plan types were not significant (Table 25).

Table 25: Least Square Means Differences of the Hours that Residents Spent Outdoors

Level		Least Sq Mean
3	A	4.8260870
4	A B	4.0869565
1	A B	3.8571429
2	B	1.6538462

Levels not connected by the same letter are significantly different.

6.5.10. Comparison of Outdoor Use Scores Associated with Residents from Different Plan Types

The order of the means that were obtained from a least square estimation of outdoor use scores associated with residents of the four plan types can be seen in Figure 11. The residents of plan type 2 had the highest least square mean outdoor use score of 1.31 (std error: 0.15). Whereas, residents of plan type 4 had the lowest least square mean outdoor use score of 1.13 (std error: 0.14); this indicates that when compared to other residents, residents of plan type 4 were seen using the outdoors less frequently.

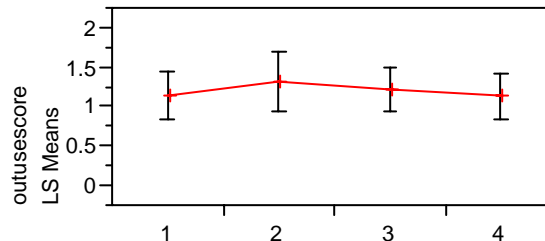


Figure 11: Least Square Means Plot of Outdoor Use Scores

When a significance test was performed (RMSE = 0.686931) by using data associated with 80 residents from the four plan types, it was found that the difference in least square means of outdoor use scores was statistically insignificant ($p = 0.8755$). Since there weren't any two pairs that had significantly different means, no further comparisons were performed as a follow up by using the Tukey-Kramer method.

6.5.11. Summary of One Way ANOVA of Survey Variables and Plan Type Comparisons

Table 26 displays the summary of ANOVA tests done by using the least square means of each variable for each plan type. The p values that were less than 0.05 were reported as significant, indicating that there were at least two plan types with a significant difference between their least square means of the considered variable. The root means square was the error of the ANOVA tests performed.

The plots of the least square means that were presented earlier provided an order of the means, however, they did not indicate which plan type(s) was(were) significantly different. The Tukey-Kramer tests were performed as a follow up to the ANOVA tests that concluded significant p values. Table 26 contains letters used to represent the relations between the plan types (1, 2, 3, and 4) and should only be compared with each other within the row of the same variable. Plan types that contain at least one common letter (e.g., B and AB) are not significantly different from each other. Yet, plan types that are represented with different letters (e.g. A and B) have a significant difference in their least square mean of the variable under consideration.

The data that was collected from caregivers can be viewed under two main categories, according to the content of the information they contained. The first category was the part that contained information about the residents. The second category contained the variables that were conceptualized as the “outcomes” of design features of the adult care home environment. The variables that fall under the “outcomes” category required the subjective assessment of caregivers, as well as the objective data reported from records.

In the first part, it was a nice coincidence that the least square means of the length of stay of residents (weeks) of all plan types were not significantly different from each other. This could be perceived that the “length of stay” variable that might affect a resident’s friendliness, participation in social events, and mood was controlled naturally. In terms of comparing the least square means of ages, ADL, and IADL scores, there were only two plan

types that were significantly different from each other. Having two plan types with significantly different residents gave the opportunity to control the competence and age variables by only focusing on the pairs that did not have a significant difference. However, relying on the salutogenic perspective, this study assumed that it was within the resident's will (sense of coherence) to benefit from the environment, regardless of his/her physical competence. Thus, a categorization based on physical competence or age was not done.

The main hypothesis of this study was set up on the basic assumption that residents of plan types with different spatial configurations would have different well-being outcomes. Thus, observing at least one significant difference in the least square means of one of the outcome variables will prove the hypothesis. Four of the outcome variables that were tested were reported to be a significantly different ($p < 0.05$) pair of plan types according to comparison of the least square means of the considered variable. The least square mean scores of friendliness and outdoor use frequency were insignificant. Yet, these were two variables that contained the subjective ratings of caregivers who might simply have reported similar subjective responses for all residents.

Table 26: Summary of ANOVA Results of Survey Variables by Plan Type and Summary of Plan Type Comparisons by using the Tukey-Kramer Method

	Survey Variables	One Way ANOVA		Order of Least Square Means	Tukey-Kramer			
		p	Root MSE		1	2	3	4
Resident Information	Age	0.0095*	10.75999	2>3>1>4	AB	A	AB	B
	Length of Stay	0.9777	120.8786	1>3>2>4	A	A	A	A
	ADL Score	0.0269*	2.336805	2>1>3>4	AB	A	AB	B
	IADL Score	<.0001*	1.227544	2>1>3>4	A	A	B	B
Outcomes	# Hours of Abs. in Soc. Ev.	<.0001*	3.175181	2>4>3>1	C	A	B	AB
	Social Willingness Sc.	0.0014*	0.839127	1>3>2>4	A	B	B	B
	Friendliness Score	0.4888	0.597295	1>3>2>4	A	A	A	A
	Depression Score	<.0001*	2.532657	3>4>1>2	B	B	A	A
	# Hours of Outdoor Use	0.0491*	3.2330441	3>4>1>2	AB	B	A	AB
	Outdoor Use Freq. Score	0.8755	0.686931	2>3>1>4	A	A	A	A

(1) * indicates statistical significance; (2) Root MSE is the estimated standard deviation of Analysis of Variance test; (3) In the Tukey-Kramer summary, each row is independent and the plan types that do not contain any common letter are significantly ($p < 0.05$) different from each other.

The least square mean of the number of hours of absence from social events was significantly different ($p < 0.0001$) in three plan types (1, 2, and 3). The other variables that were found to have at least one significant difference in least square means defined two groups among the plan types. The Tukey-Kramer tests showed that in comparisons of the least square means of willingness, depression, and the number of hours of outdoor use, one plan type was significantly different from the other three plan types.

By observing four outcome variables that reported a significant difference ($p < 0.05$) in at least one of the plan types (and three at most), it can be concluded that the main hypothesis of the study is correct. Thus, the hypothesis that “residents of plan layouts with different spatial configurations have difference in outcomes” was accepted at $p < 0.05$ level.

6.6. Comparison of Spatial Variables of Bedrooms in the Four Plan Types

Chapter 5 presented that each selected plan type was configurationally unique by having different orders according to the global integration levels of common spaces. The spatial configuration and the graph of the plan layout, as the representation technique, are independent from the metric (area and distance) properties of the plan layout. Yet, the importance of including these variables in the complexity of the phenomena studied was underlined.

The distinctive spatial configuration was used to explain the differences in behaviors of the residents of adult care homes. The configuration of space was employed as information to categorize the residents who were living in buildings that were in the same category in their capacity and level of caregiving. In the general comparison of spatial configurations of plan type, only the levels of integrations of common areas in the four plan types were taken into consideration. The bedrooms were ignored in the final comparison due to the fact that the global integration values of bedrooms change even within the same plan type.

Nevertheless, a resident's bedroom could be the only spatial information that was individually attached to each respondent. This information, as is the rest of the information derived from plan layout, is twofold: the first type of information is the results from the syntax analyses (non-metric information); the second type of information is the metric information (distance and area). The next series of analyses will compare each plan type according to these two types of spatial information associated with each resident's bedroom.

The findings of the caregivers' survey concluded that outcomes of the residents of the four configurationally unique plan types were significantly different from each other. The additional analysis including the metric and non-metric information of each resident's bedroom will serve two main purposes:

- (1) The analysis will show whether there were additional space oriented links that relate the difference in outcomes (if there are differences in the means of walking distances and the means of syntax variables of the bedrooms this will also be additional explanation of the difference in the means of outcomes);
- (2) By questioning the difference between spatial variables of bedrooms, the analysis will explain whether including these variables in a regression model would contribute to the variability (if there is no significant difference between means of metric and non-metric values of bedrooms in different plan types, there won't be any rationale to add these to the regression model).

6.6.1. Comparison of the Least Square Means of Walking Distances between Bedrooms and Common Areas of the Four Plan Types

As explained earlier, two types of walking distances were considered for analysis. The first one is the actual walking distance, which was measured from each bedroom to one of the possible destinations. These destinations, in the context of a 12 bed adult care home, were the dining room, dayroom, kitchen, entrance, and outdoors. The second type of distance considered was the distribution of walking distances between all bedrooms and one common space, which explained what percentage of the walking distance each resident had to walk to reach to the same destination.

The consideration of actual distances will answer the basic question regarding which plan type had shorter walking distances to common spaces. There's also a possibility to observe a statistically significant difference in walking distances. If the results of the outcome variables are in favor of the plan type with significantly shorter walking distances, then additional space-related variability will be explained.

However, when percentages were considered, the total distance between residents' bedrooms and the common space, for which the calculation was made, was perceived as equal. For example, a resident who walked 15% of the total walking distances between a bedroom and the dining room might have walked 50 feet in one plan type, whereas the resident might have walked 75 feet in another. As explained earlier, the logic behind including the percentages of walking distances was to add the rank of proximity of residents' bedrooms of different plan types to common spaces. Yet, this was done by calculating percentages, which would result in better data by being quantitative and continuous. The percentages of walking distances, in fact, were to provide a link to ranks, which were ordinal and directly dependent on the total number of residents of each plan type. Thus, including the percentage of walking distances between a resident's bedroom to any of the bedrooms would not be logically meaningful.

6.6.1.1. Comparison of Actual Walking Distances between Bedrooms and Common Areas of the Four Plan Types

Figure 12 displays the plots of least square means of walking distances between bedrooms and common areas in the four plan types. At a glance, it is highly noticeable that plan type 2 had the longest walking distances between bedrooms and all the common spaces, including the outdoors and the entrance. Whereas, the shortest walking distances were shared by plan type 1, which had the shortest walking distances to the entrance and outdoors and plan type 3, which had the shortest walking distances to the dining room, kitchen, and the dayroom.

The least square mean of measurements of the routes for the shortest and longest walking distances are presented in Table 27. The difference in the shortest and the longest routes

ranged from a minimum of around 20 feet in the distances between bedrooms and the outdoors (of plan type 2 and 1) to a maximum around 3.6 times the shortest distance, in the distances between bedrooms and the entrances (of plan type 2 and 1).

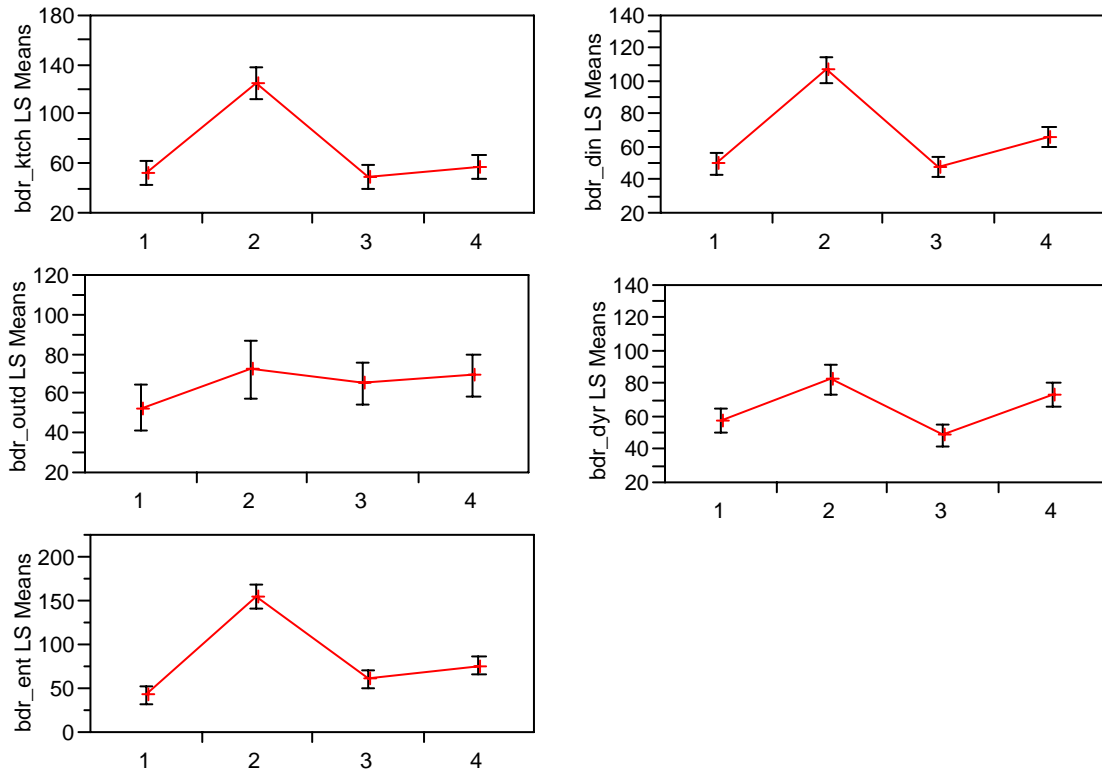


Figure 12: Least Square Means Plots of Walking Distances between Bedrooms and Common Areas

Table 27: Least Square Means of Plan Types with the Longest and Shortest Walking Distances

Walking Distances (feet)	Longest Walk. Dist.			Shortest Walk. Dist.		
	Plan Type	Least Sq Mean	Std Error	Plan Type	Least Sq Mean	Std Error
Bedr.-Dining	2	106.87	4.01	3	47.36	3.02
Bedr.-Dayroom	2	82.49	4.73	3	48.59	3.56
Bedr.-Kitchen	2	124.85	6.38	3	48.67	4.80
Bedr.-Entrance	2	153.77	6.68	1	42.60	5.26
Bedr.-Outdoor	2	72.15	7.33	1	52.77	5.77

Analysis of variance test results showed that, except the least square means of distances between the bedrooms and outdoors, there were at least two plan layouts with significantly ($p < 0.0001$) different least square means of distances for each route category (Table 28).

The Tukey-Kramer method was used to adjust for multiple comparisons of all the pairs of least square means of distances for each route type in the different plan layouts. When the difference between the least square means of walking distances between the bedroom and dining room were considered, it was found that plan type 1 and plan type 3 were not different from each other. Yet, plan type 4 and plan type 2 were significantly different from each other and different from plan type 1 and 3.

In comparison with the least square mean differences of the distances between bedrooms and dayrooms of the four plan types, there were two groups (plan types 2 and 4 vs. plan types 1 and 3) formed that were significantly different from each other. Yet, the difference between the members of each group was insignificant.

The Tukey-Kramer comparison of least square mean differences of the distances between bedrooms and kitchens of four plan types showed that plan type 2 was significantly different from the rest of the plan types. Whereas the least square mean differences of the same route in the other plan types were insignificant.

The comparison of the least square mean differences of the distance between bedrooms and entrances in the four plan types concluded that plan types 1, 2, and 4 were significantly different from each other. The test resulted in insignificance when it came to comparing the least square means of the length of the same route in pairs that contained plan type 3 with either plan type 1 or plan type 4.

Since there weren't any two pairs that had significantly different means of distances between bedrooms and outdoors, no further follow up comparisons using the Tukey-Kramer method were performed.

Table 28: Summary of ANOVA Results of Actual Walking Distances and Summary Comparison of Plan Types by using the Tukey-Kramer Method

Walking Distances (feet)	One Way ANOVA		Order of Least Square Means	Tukey-Kramer			
	p	Root MSE		1	2	3	4
Bedr.-Dining	<.0001*	14.47316	2>4>1>3	C	A	C	B
Bedr.-Dayroom	<.0001*	17.07341	2>4>1>3	B	A	B	A
Bedr.-Kitchen	<.0001*	22.99766	2>4>1>3	B	A	B	B
Bedr.-Entrance	<.0001*	24.08502	2>4>3>1	C	A	BC	B
Bedr.-Outdoor	0.1269	26.44391	2>4>3>1	A	A	A	A

(1) * indicates statistical significance; (2) Root MSE is the estimated standard deviation of Analysis of Variance test; (3) In the Tukey-Kramer summary, each row is independent and the plan types that do not contain any common letter are significantly ($p < 0.05$) different from each other.

6.6.2. Comparison of the Least Square Means of Syntax Values Associated with Bedrooms in the Four Plan Types

The comparison of syntax values was done in two categories. The first category of comparison included the least square means of global and local values of bedrooms of each plan type. The second comparison category compared the least square means of depth values between bedrooms and common areas.

6.6.2.1. Comparison of Global and Local Integration Values of Bedrooms in the Four Plan Types

The integration as the main value of space syntax analysis was extensively discussed in Chapter 5. The integration values that were calculated for each space were transformed into global integration values. This was done to make comparisons across the four plan types which had different numbers of convex spaces. Then, a comparison of each system was done according to the level of integration of common spaces to the whole system. The methodology followed in the initial configurational analysis has been widely used in research that incorporated Space Syntax.

However, comparing the least square means of integration values of the bedrooms associated with 80 residents from the four different plan layouts is not a common analysis. The result of this analysis will indicate whether plan types that were selected to be studied contained bedrooms with significantly different integration values. The original comparison of spatial comparison was done by including the outdoor areas as convex spaces to the syntax analysis. This time, in order to observe the effect of outdoor areas on the integration values of bedrooms, global and local integration values that were derived from the convex maps that included and excluded the outdoors were added.

Figure 13 displays the plots of the least square means of global and local integration values of bedrooms, which were calculated by including and excluding the outdoors (exteriors) of the four plan types. At a glance, it was obvious in the plots that in terms of the least square mean of bedrooms, plan type 1 had the highest and plan type 2 had the lowest values in four of the comparison categories (Table 29). The least square means of global integration values (with and without exteriors) of the bedrooms in plan type 4 were slightly higher than plan type 3. Yet, plan type 3 and plan type 4 switched in this order when the least square means of the local integration values (with and without exteriors) were considered. The orders displayed in the table were done by considering the numerical value. The interpretation of the level of integration these values indicate will be performed if these variables came out associated with any of the outcome variables tested.

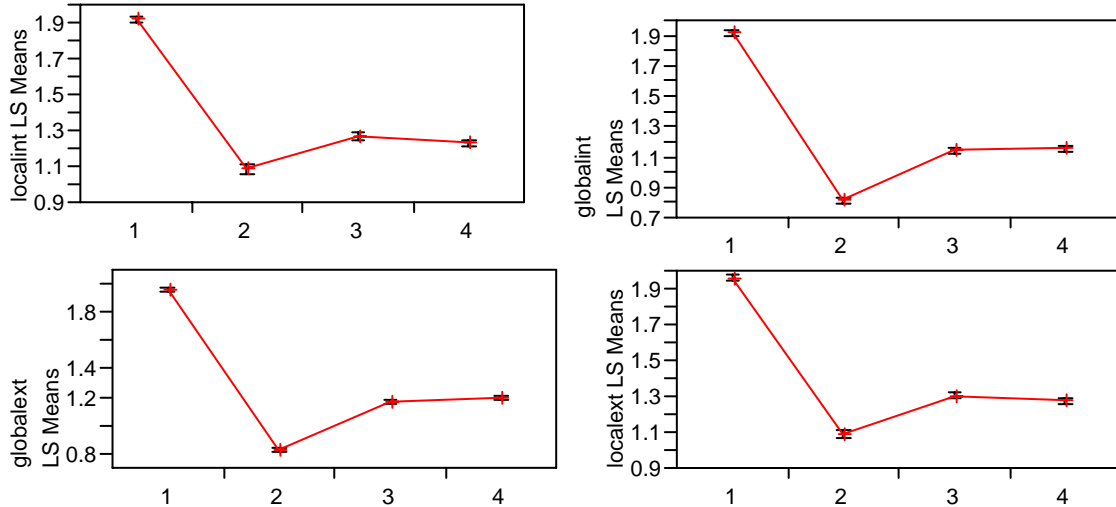


Figure 13: Least Square Means Plots of Percentages of Global and Local Integration Values of Bedrooms (With and Without Including the Outdoors)

Table 29: Least Square Means of Plan Types with the Highest and Lowest Integration Values of Bedrooms

Integration Values of Bedrooms	Highest Value			Lowest Value		
	Plan Type	Least Sq Mean	Std Error	Plan Type	Least Sq Mean	Std Error
global integration	1	1.92	0.01	2	0.81	0.01
global int. (with ext.)	1	1.96	0.01	2	0.83	0.01
local int.	1	1.92	0.01	2	1.08	0.01
local int. (with ext.)	1	1.96	0.01	2	1.09	0.01

ANOVA tests for each of the syntax values concluded that there were at least two plan layouts with significantly ($p < 0.0001$) different least square means of the same syntax variable (global or local distances including or excluding the outdoors) (Table 30). The Tukey-Kramer comparison test was performed as a follow up to reveal significantly different plan layouts.

In a comparison of the least square mean differences of both global integration values of bedrooms (including and excluding the outdoors) and local integration values of bedrooms (including and excluding the outdoors) of plan type 1 and plan type 2 were different from each other and plan type 3 and 4. Whereas, the difference in the least square means of the

global integration values of plan types 3 and 4 was not significant. When the least square mean differences of local integration values calculated without the outdoors (exterior) were compared, all plan types had significant differences.

Since the difference of the least square means of global integration variables stayed the same when the outdoors was excluded, a secondary finding was that the outdoors of the plan types were not designed to make a difference in the global integration levels of the studied plan types. Yet, when the local integration was not taken into consideration, the least square mean difference of local integration values of the bedrooms in plan type 3 and plan type 4 became significant. It is evident that the outdoors of plan types 3 and 4 played a significant role in the local integration values of the bedrooms.

Table 30: Summary of ANOVA Results of Integration Values and Summary Comparison of Plan Types by Using the Tukey-Kramer Method

Integration Values of Bedrooms	One Way ANOVA		Order of Least Square Means	Tukey-Kramer			
	p	Root MSE		1	2	3	4
global integration	<.0001*	0.040776	1>4>3>2	A	C	B	B
global int. (with ext.)	<.0001*	0.032417	1>4>3>2	A	C	B	B
local integration	<.0001*	0.045477	1>3>4>2	A	D	B	C
local int. (with ext.)	<.0001*	0.038081	1>3>4>2	A	C	B	B

(1) * indicates statistical significance; (2) Root MSE is the estimated standard deviation of Analysis of Variance test; (3) In the Tukey-Kramer summary, each row is independent and the plan types that do not contain any common letter are significantly ($p < 0.05$) different from each other.

6.6.2.2. Comparison of Depth Values of Bedrooms from Common Spaces in the Four Plan Types

The concept of depth, which was introduced in Chapter 5, is the core concept of space syntax. As a reminder, depth between two spaces is the number of convex spaces that a person passes thorough in order to walk from one to another. In the simplest sense, depth can be roughly described as the number of doors that you need to pass in a plan layout when you want to walk between two rooms. Yet, this may be an oversimplification considering the fact that the change in direction of the route, as well as the change in function of the spaces that were not divided by walls (open plans), can define the number of convex spaces.

Figure 14 shows the least square mean plot of depth values of bedrooms from common spaces, including the entrance and the outdoor areas. It is highly noticeable that in all plots the least square mean of depth values of the bedrooms in plan type 2 was the highest and the least square mean of depth value of the bedrooms in plan type 1 was the lowest. Plan types 3 and 4 had least square means of depth values that fell in between the values of plan type 1 and 2. In consideration of the least square means of depth values between the bedrooms and two common areas (dining room and outdoors), plan types 3 and 4 had the same depth value (Table 31) Whereas, in another comparison, the least square means of depth values of plan type 4 were higher than values of plan type 3 in two (dayroom and entrance) of the three comparisons.

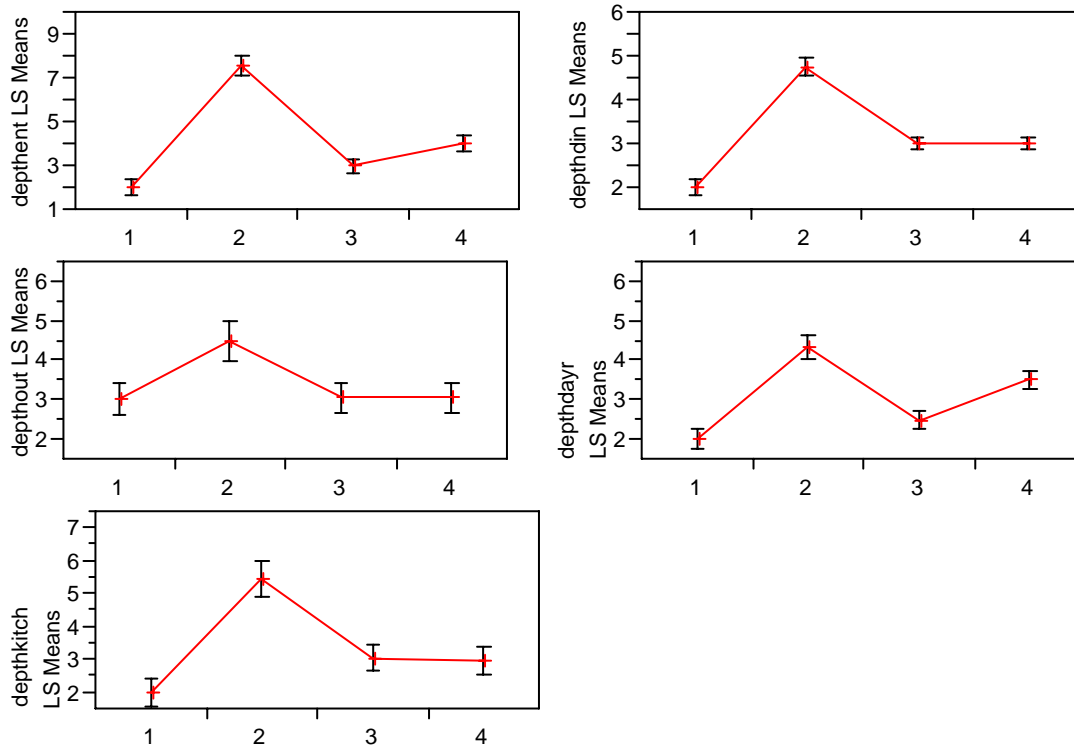


Figure 14: Least Square Means Plots of Depth Values of Bedrooms from Common Spaces

Table 31: Least Square Means of Plan Types with the Highest and Lowest Depth Values

Depth Values	Highest Depth Value			Lowest Depth Value		
	Plan Type	Least Sq Mean	Std Error	Plan Type	Least Sq Mean	Std Error
Bedr.-Dining	2	4.73	0.10	1	2.00	0.08
Bedr.-Dayroom	2	4.33	0.16	1	2.00	0.12
Bedr.-Kitchen	2	5.46	0.28	1	2.00	0.22
Bedr.-Entrance	3	7.54	0.22	1	2.00	0.17
Bedr.-Outdoor	3	4.46	0.26	2	3.00	0.2

ANOVA tests for each of the depth values concluded that there were at least two plan layouts with significantly ($p < 0.0001$) different least square means of the same depth value (Table 32). The Tukey-Kramer comparison test was performed as a follow up to reveal significantly different plan layouts.

In comparison of the least square means differences of depth values of bedrooms from two of the common spaces (dayroom and entrance), all four of the plan types were significantly different from each other. In terms of the least square mean differences of depth values of bedrooms from two other common spaces (dining room and kitchen), plan type 3 and plan type 4 were not significantly different from each other. However, plan type 1 and plan type 2 were significantly different from each other and both were significantly different from plan types 3 and 4.

When the least square mean differences of depth values of bedrooms and the outdoors were considered, the bedrooms of plan type 2 had a significantly higher depth level than the rest of the plan types.

Table 32: Summary of ANOVA Results of Depth Values and Summary Comparison of Plan Types by Using the Tukey-Kramer Method

Depth Values	One Way ANOVA		Order of Least Square Means	Tukey-Kramer			
	p	Root MSE		1	2	3	4
Bedr.-Dining	<.0001*	0.368276	2>(3=4)>1	C	A	B	B
Bedr.-Dayroom	<.0001*	0.561499	2>4>3>1	D	A	C	B
Bedr.-Kitchen	<.0001*	0.99435	2>3>4>1	C	A	B	B
Bedr.-Entrance	<.0001*	0.779569	2>4>3>1	D	A	C	B
Bedr.-Outdoor	<.0001*	0.925827	2>(3=4)>1	B	A	B	B

(1) * indicates statistical significance; (2) Root MSE is the estimated standard deviation of Analysis of Variance test; (3) In the Tukey-Kramer summary, each row is independent and the plan types that do not contain any common letter are significantly ($p < 0.05$) different from each other.

6.6.3. Evaluation of Findings from the Differences of the Least Square Means of Outcomes and Spatial Variables

The results of the one way ANOVA and the Tukey-Kramer tests showed the relations between the least square means of the residents' reported outcomes and spatial attributes of the four plan types. The statistical analysis provided the evidence to reject or accept the null hypothesis that whether there were at least two plan types with significantly different means. Yet, this test only reports the absence or presence of the significance but it describes nothing specific to the plan types, except the least square means of each plan type. In the case of a significant difference, the Tukey-Kramer test was performed to reveal the plan types that had significant differences.

Now, that all of the test are reported, there is enough information for a general evaluation by including the results of different sources. Only the variables that were reported to have a significant p value ($p > 0.05$) will be included in this general evaluation. A closer look at the results by excluding a few of the variables (friendliness score $p = 0.49$; outdoor use frequency score $p = 0.87$; and bedroom-outdoor distance $p = 0.13$) revealed the similarities in orders of least square means of outcome and spatial variables (Table 33)

Table 33: Summary of the Cross Analysis of Findings from Differences of Least Square Means of Outcomes and Spatial Variables

Data Source		Similarity of Orders	Variables	One Way ANOVA		Order of L. Sq Means	Tukey-Kramer				# Sig. Diff. Groups	
				p	Root MSE		1	2	3	4		
Survey	Outcomes	S	# Hours of Abs. in Soc. Ev.	<.0001*	3.18	2>4>3>1	C	A	B	AB	3	
		S	Social Willingness Sc.	0.0014*	0.84	1>3>2>4	A	B	B	B	2	
		S	Depression Score	<.0001*	2.53	3>4>1>2	B	B	A	A	2	
		S	# Hours of Outdoor Use	0.0491*	3.23	3>4>1>2	AB	B	A	AB	2	
from Plan Layout	Dist.	S	Bedr.-Entrance	<.0001*	24.09	2>4>3>1	C	A	BC	B	3	
		Qs	Qs	Bedr.-Dining, Dayr., Kitch.	<.0001*	various	2>4>1>3	various			3,2,2	
	Intg	S		local int	<.0001*	0.05	1>3>4>2	A	D	B	C	4
		S		local int. (with ext.)	<.0001*	0.04	1>3>4>2	A	C	B	B	4
	Depth	S		Bedr.-Dayroom	<.0001*	0.56	2>4>3>1	D	A	C	B	4
		S		Bedr.-Entrance	<.0001*	0.78	2>4>3>1	D	A	C	B	4
		Qs		Bedr.-Dining & Outdoors	<.0001*	various	2>(3=4)>1	various			3	
		Qs		Bedr.-Kitchen	<.0001*	0.99	2>3>4>1	B	A	B	B	2

S: Same Order, Qs: Quite Similar Order

Before going through the details of the similarities between variables of different data sources, two important observations related to the orders of least square means of variables of outcomes should be identified. The first observation is that the order of the least square means of the willingness to participate in social events score came out as the exact opposite order of the least square means of the hours of absence from social events variable. The observation is that two variables, which were the depression score and the number of hours of outdoor use, had the same exact order when the least square means of the corresponding plan layout were ordered from lowest to highest.

The reverse similarity of the subjective (willingness) and objective (number of hours) variables of social interaction was purely logical and expected. In fact, the reverse relation between these two variables showed that caregivers poorly rated the residents who had more absence hours than the others. Yet, the Tukey-Kramer tests identified three significantly different groups for the number of hours and two significantly different groups for the social willingness variable. Nevertheless, this might be related to the fact that there was more

variability for absence in social events, ranging between 0 and 14 hours, compared to the willingness to participate in social events, which ranged between 0 and 3. Thus, the change in the number of significantly different plan types did not decrease the emphasis on the observation, which indicated a negative correlation between these two variables.

The least square means of the depression score and the number of hours of weekly outdoor use turned out to be exactly the same. The outdoor use was generally associated with reduced stress. Although the same relation was expected between depression and outdoor use, the results of the caregiver survey provided the same orders for the least square means of these two variables. According to this result, the residents who had more depression symptoms in each plan layout were the residents who were spending more time outdoors. When considered in detail, this proposal sounded reasonable in that residents who had more than average symptoms of depression tended to use the outdoors to cope with their current status. The order of the least square means of distances between bedrooms and three of the common spaces (kitchen, dayroom, and dining room) were reversely similar to the mean of the depression scores (and the number of hours of outdoor use) by resulting in the opposite plan types with the highest and lowest means. Yet, this could not be taken as an enough evidence for a possibility of an association without running further analysis. More discussion on the findings related to the depression variable will be provided upon introducing the other similarities between the variables of different sources (survey and plan layout).

The order of the least square means of distances between the bedroom and the entrance, the depth values from the dayroom to the bedroom, and the depth values from the bedroom to the entrance were the same as the order of the least square means of the number of hours of absence from social events. The order of other depth values (except the depth from the outdoors, which was omitted earlier) were quite similar by having the same plan type at the end (lowest) and beginning (highest) of the order. The same was true for the order of the least square mean of distances between bedrooms and three common spaces (dining room, kitchen, and dayroom). Observing the same and quite similar orders between distance (and

depth) values was a clear indicator of a possible positive association between distance (and depth) and the absence from social events. In other words, the plan type with the largest distances between residents' bedrooms and common areas also housed the residents who had significantly more hours of absence from weekly social events. The same relation was also true primarily for the depth levels from residents' bedrooms to the dayroom and entrance. Yet, a quite similar order with other depth levels indicated possible associations between the depth values of bedrooms from the dining room, the outdoors, and the kitchen. These results underlined the impact of the walking distances and the depth value of resident's bedroom from the common spaces on his/her participation in the social activity program of the facility.

The orders of least square means of both local integration variables (including and excluding the outdoors) had the same order in reverse as the means of the number of hours of absence from social events. Observing the same order in reverse indicated a relation that the residents who had bedrooms with high local integration values had less hours of absence from social events. No similarity was observed between the orders of means of global integration values. The local integration values were calculated according to the three convex spaces around each resident's bedroom. Thus, the evidence of associations between local integration values and variables of social integration emphasizes the importance of spatial relations between a resident's bedroom and the surrounding environment.

The similarities between orders of least square means of variables from different sources provided some insight about possible associations. The next series of analyses will investigate these associations in further detail and the question the absence or presence of correlations.

6.7. Linear Associations between the Variables

When all respondents of the four plan types were assumed to be a random sample group of residents from 12 bed adult care homes, a new series of statistical methods became available for further analysis of the associations between the survey and spatial variables. The three main purposes for these analyses are identified below with the statistical methods employed:

- (1) Checking the reliability of the caregivers' responses by questioning expected associations between survey variables (Linear Regression-Correlation);
- (2) Questioning possible associations between single variables from the survey and variables derived from one of the (distance or space syntax) spatial analyses (Linear Regression-Correlation); and
- (3) Questioning whether there were a meaningful number of variables that could jointly be used to predict any of the outcome variables (Multiple Regression).

As discussed earlier, in the case of relying on the subjective opinions of other people, there's always possibility of encountering bias. The design of the survey instrument was such that it attempted to reduce bias by including questions that required both objective and subjective opinions. In questions that required objective opinions, the caregivers were asked to consult their records, whereas they were also asked to rate the residents in terms of their friendliness with others, willingness to participate in social events, frequency in the use of the outdoors, and mood. Among these survey variables, there were pairs, such as the number of hours of absence from social events and the willingness to participate in those events, which were expected to be correlated (negative for the hours of absence and willingness to participate). Thus, observing expected associations between survey variables will be a clear indicator of reliability of the caregivers' responses. Moreover, there were also expected associations between spatial variables (distances, depth, and integration values) and outcome variables of the survey.

In order to pursue the first two goals, linear regression models were used. The linear regression model uses a straight-line prediction equation to describe the relationship between two quantitative variables. The *correlation* is a standardized version of the slope of this equation, which is not dependent on the units of measurement (Agresti and Finlay, 1999).

6.7.1. Correlations between Survey Variables

The Spearman Correlations (r) between three variables of social interaction were displayed in Table 34. For each row, the first line of numbers is the correlation coefficient (r) and the second line of numbers is the p . The p value is the probability of the hypothesis that there is no linear association between the two considered variables. Observing all p values below 0.05 means that 95% of the time there is a linear association between the two considered variables. If the p value is above 0.05, then the two variables are independent from each other (Agresti and Finlay, 1999).

The strength of the correlation will be assessed according to the value of r and the criteria for the assessment will be done by assigning one of the three degrees (low, medium, high) according to the absolute value of r (Table 34). The Spearman Correlation method was preferred to the better known Pearson correlation. Spearman's correlation coefficient is computed on the ranks of the data using the formula for the Pearson's correlation and average ranks are used in case of ties (Jump User Guide 2005).

Table 34: Assessing the Strength of Correlation

Absolute Value of Spearman Correlation Coefficient	Strength of Correlation
$.40 < r < .60$	LOW
$.60 < r < .80$	MEDIUM
$.80 < r < 1.0$	HIGH

6.7.1.1. Spearman Correlation between the Survey Variables of Social Interaction

Considering the three variables of social interaction that were included in the survey, there were three expected associations. These three expected associations were as follows:

- (1) Residents who had more hours of absence from social events were expected to have less willingness to participate in social events;
- (2) Residents who had more hours of absence from social events were expected to be less friendly with other residents; and

- (3) Residents who were less willing to participate in social events were expected to be less friendly with other residents.

Figure 15 presents the plots of the regression models. In the first two models that used absence from social events as the response (Y) variable, the negative association between the variables is noticeable based on the direction of the slope of the prediction line. Whereas, the positive association between willingness to participate in social events scores (Y) and friendliness scores (X) was represented with a positive direction of the slope. The regression plots showed that expected associations were observed between the pairs of social interaction variables of the survey. This is an indicator that caregivers' responses to two different questions were consistent with each other. Yet, with the data in hand, it is also possible to talk about the strength of these associations.

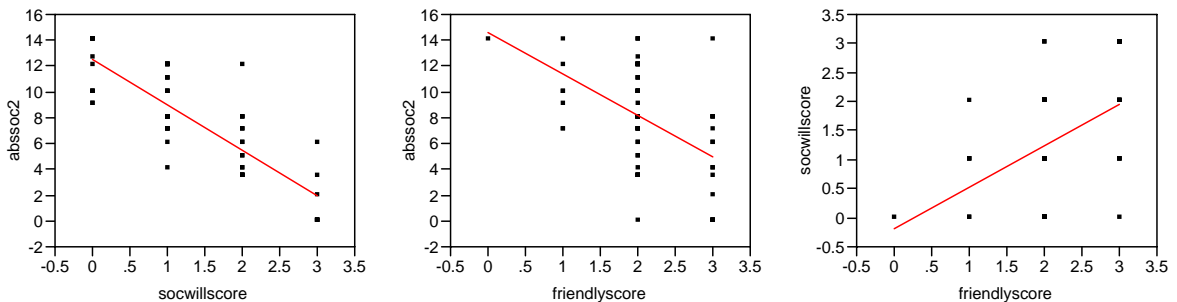


Figure 15: Regression Plot of survey variables of social interaction

Table 35 displays the results of the statistical independence (p), strength of the association (r) between response (Y) and the explanatory (X) variables, and the percentage of the variability (r^2) that the explanatory variable can predict in the response variable.

Table 35: Spearman Correlations of survey variables of social interaction

# ROW	Y	X	p	r	Strength of r	r ²
1	absoc2	socwillscore	<.0001	-0.79605	MEDIUM	0.634
2	absoc2	friendlyscore	<.0001	-0.45031	LOW	0.203
3	Socwillscore	friendlyscore	<.0001	0.44851	LOW	0.201

absoc2: number of hours of absence from social events; **socwillscore**: willingness to participate in social events score; **friendlyscore**: friendliness with other residents score.

When absence from social events was defined as the response variable and the social willingness score was the explanatory variable, the result of the p value was below 0.0001. This indicates that two variables have an association. The Spearman correlation coefficient was -0.80, which indicates a negative and high correlation between social willingness and absence from social events. An increase in one standard deviation in the social willingness score corresponds to a decrease in 0.80 standard deviation in the absence from social events score. Since the correlation is high, the social willingness score could be used as a predictor of absence from social events. For predicting the number hours of absence from social events, the social willingness score has 63.4% less prediction error than using the sample mean of Y. In other words, 63.4% variability in the hours of absence from social events (Y) was explained by the willingness to participate in social events score (X).

The second row of Table 35 outlines the results for the pair that contains hours of absence from social events and friendliness scores as the response and explanatory variables. The significance test shows that these two variables were associated. The Spearman correlation coefficient of 0.45 indicated a positive medium correlation between the two variables. The friendliness score can explain 20.3% of the response variable (number of hours of absence from social events)

The third row of Table 35 displays the results for the association between willingness to participate in social events (Y) and the friendliness with other residents score (X). The significance test resulted in a p value well below 0.05, indicating a linear association between the explanatory and response variable. The Spearman correlation coefficient of 0.44 refers to

a positive low correlation between the two considered variables. The 0.201 value of r^2 provides further explanation that the friendliness (with other residents) scores can predict 20.1% of the variability in the social willingness scores.

6.7.1.2. Spearman Correlation between the Survey Variables of Depression and Outdoor Use

When considering the survey scores of depression and outdoor use, there were three expected associations. These three expected associations were as follows:

- (1) Residents who had lower depression scores were expected to be more frequent users of outdoors;
- (2) Residents who had lower depression scores were expected to spend more time outdoors; and
- (3) Residents who were reported to be more frequent users of the outdoors were expected to have a greater number of hours spent outdoors.

Figure 16 presents the plots of the regression models. The negative association between the depression scores and the outdoor scores (frequency of use of the outdoors) can be easily noticed based on the direction of the slope of the prediction line. The second model, which displayed scattered data, resulted in a nearly horizontal prediction line. This indicated a lack of association between the depression scores and number of hours of weekly outdoor use. The significance test reinforced this by returning a p value of 0.11, concluding that there was no linear association between depression scores of residents and the number of hours they spent outdoors per week (see row 2, Table 36). The positive association between the number of hours of outdoor use and the outdoor use score can also be noticed from the direction of the slope of the prediction line.

Two of the three expected associations were observed in the regression plots and confirmed by significance tests. The association between the two measures of outdoor use (number of hours and frequency of use) shows that the caregivers' responses to both questions were

consistent. However, only the frequency of outdoor use scores was associated with depression. Thus, the lack of association between the depression scores and the number of hours spent outdoors can be best explained by considering the strength of the observed associations.

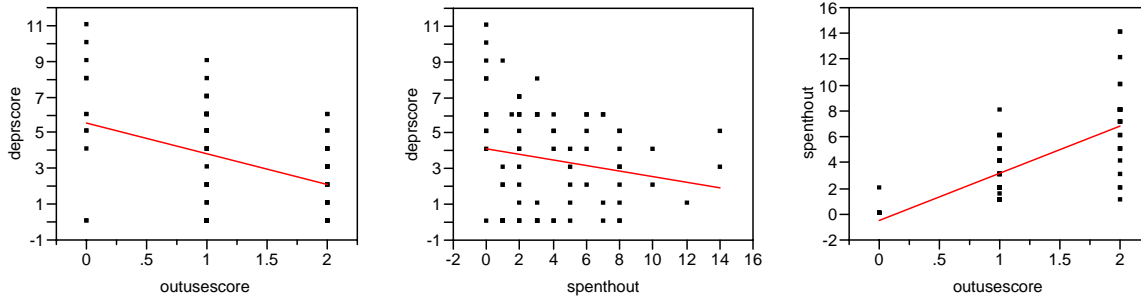


Figure 16: Regression Plot of survey variables of depression and outdoor use

Table 36 displays the result of statistical independence (p), strength of the association (r) between response (Y) and the explanatory (X) variables, and the percentage of the variability (r^2) that the explanatory variable can explain in the response variable. The Spearman correlation coefficient of -0.36 indicated a very low correlation between the depression score and the outdoor use score. The outdoor use scores of residents can only explain 12.7% of the variability in the depression scores, underlining the fact that there may be various reasons associated with depression. The lack of association between the depression scores and the number of hours spent outdoors can be explained by the fact that the correlation observed for the outdoor score was too low.

Table 36: Spearman Correlations of survey variables of depression and outdoor use

# ROW	Y	X	p	r	Strength of r	r^2
1	deprscore	outusescore	0.0012	-0.35684	very low	0.127
2	deprscore	spentout	0.1068	na	na	na
3	spentout	outusescore	<.0001	0.77814	MEDIUM	0.606

deprscore: depression score; **outusescore:** frequency of use of the outdoors score; **spentout:** number of hours of outdoor use per week.

An alternate explanation might simply be the fact that caregivers responded to the three point rating scale for the frequency of outdoor use better than for the number of hours of outdoor

use. Yet, there still is a medium strength association between the number of hours spent outdoors score and the outdoor use score. For predicting the number of hours that a resident spends outdoors in average week, the least squares equation using frequency of outdoor use has 60.6% less prediction error than the sample mean.

6.7.1.3. Spearman Correlation between the Survey Variables of Different Outcomes

When considering the variables of social interaction, the use of the outdoors, and depression, the presence of the following associations between the variables of different outcomes were queried:

- (1) Did residents who had a greater number of absences from social events have higher depression scores?
- (2) Did residents who were less willing to participate in social events have higher depression scores?
- (3) Did residents who were less friendly with other residents have higher depression scores?
- (4) Was there any (positive or negative) association between the number of hours that residents spent outdoors and their absence from social events?
- (5) Was there any (positive or negative) association between the frequency of the residents' use of the outdoors and their absence from social events?

Figure 17 presents the plots of the regression models. The p test resulted in significance at $p < 0.05$ level, indicating that there were associations between the expected variables. Looking at the direction of the prediction lines in five of the plots, it was noticeable that only the depression score and the absence from social events were positively associated with each other. The first three plots confirmed the expected associations that residents with higher depression scores were also the ones with higher levels of absence from social events, were less willing to participate, and were less friendly with others.

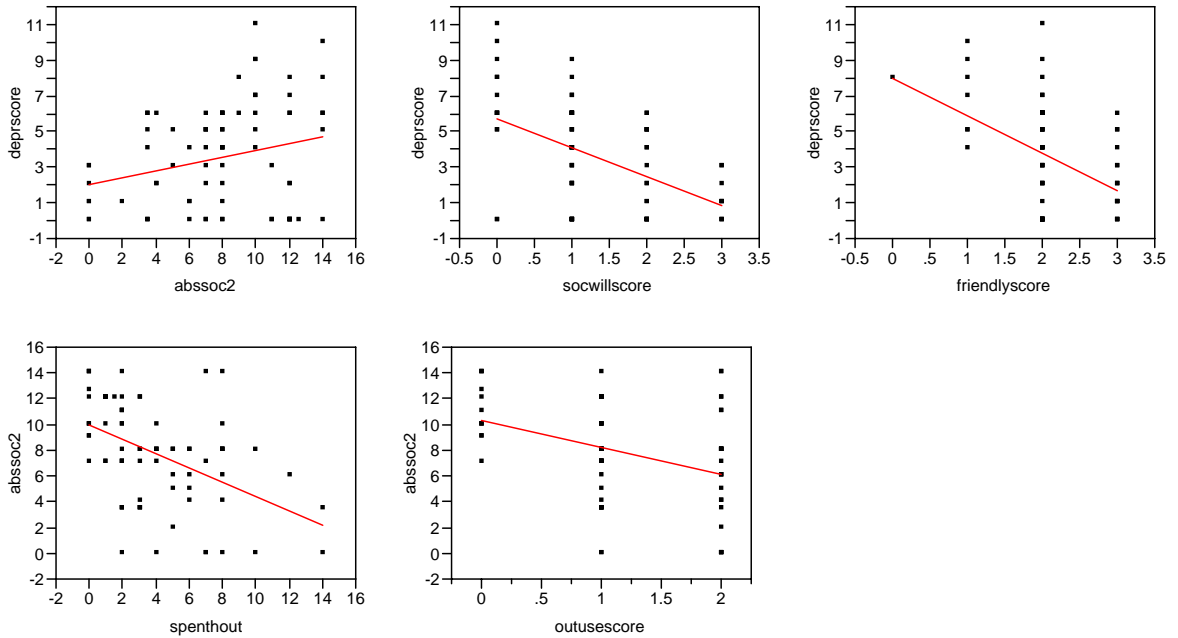


Figure 17: Regression Plot of Survey Variables of Different Outcomes

There was also a negative association when two of the variables of outdoor use (number of hours and frequency of use) were queried for an association with the number of hours of absence from social events. Observing the associations may lead various judgments, such as that those residents who were not willing to socialize with other residents preferred to spend that time outdoors. However, a better reasoning will be available upon the presentation of the strength of the associations.

Table 37 displays the result of statistical independence (p), strength of the association (r) between response (Y) and the explanatory (X) variables, and the percentage of the variability (r^2) that the explanatory variable can explain in the response variable.

Table 37: Spearman Correlations of survey variables of different outcomes

# ROW	Y	X	p	r	Strength of r	r ²
1	deprscore	absoc2	0.0513	0.21872	very low	0.048
2	deprscore	socwillscore	<.0001	-0.48268	LOW	0.233
3	deprscore	friendlyscore	0.0004	-0.38379	very low	0.147
4	absoc2	spentout	<.0001	-0.50841	LOW	0.258
5	absoc2	outusescore	0.0016	-0.34775	very low	0.121

absoc2: number of hours of absence from social events; **socwillscore**: willingness to participate in social events score; **friendlyscore**: friendliness with other residents score; **deprscore**: depression score; **outusescore**: frequency of use of the outdoors score; **spentout**: number of hours of outdoor use per week.

The Spearman correlation between the depression score and the absence from social events score was 0.22. This indicates a very low association between the two variables. A resident's number of hours of absence from social events can only explain 4.8% of the variability in the depression score. Friendliness with other residents, which had a p value of -0.38, was also a weakly correlated variable with the depression score. The association between the absence from social events and the frequency of use of the outdoors was very weak (row 5, r:-0.35). There were better, but still low, correlations between two of the pairs (r: -0.48 for depression and willingness score; r: -0.51 for absence from social events and the number of hours spent outside). Observing very low and low correlations between the different groups of outcome variables indicates that, when considered in pairs, the variables were weak in terms of predicting each other. The resulting weak correlations can be best explained by the complexity of the underlying reasons for each outcome. The role of the environment in this complexity will be investigated by querying a series of associations between the outcome variables and spatial attributes calculated earlier.

6.7.1.4. Spearman Correlation between the Survey and Spatial Variables

The spatial variability that corresponded to each resident was conceptualized with the metric (distance and area) and non-metric (values of space syntax) values of his/her bedroom. Any associations between these spatial variables and survey outcomes will not only confirm the link between the two but also will highlight the important spatial features.

When each outcome variable was separately paired with all 17 of the metric and non-metric variables, 22 pairs were found to be associated with each other. In 14 of these pairs, absence from social events was the response variable and willingness to attend social events score was the response variable in the rest of the pairs (Table 38). In the earlier analyses, these were the two variables that were also found to have the highest correlation with each other ($r: 0.79$). Among all the observed associations, nine of them were very low, going well below 0.40 (see row 18, $r: -0.23$) and the rest of the pairs were still weakly associated with r values by going as high as -0.585 (see row 11).

Absence from social events was associated with three metric variables, two of which were distances and one of which was the bedroom areas. The length of the walking distances, measured from a resident's bedroom to the dining room and from a resident's bedroom to the entrance of the building was found to be associated but weakly correlated with the absence from social events. The positive association indicates that as the walking distance from residents' bedrooms to one of the destinations increased, the number of hours of absence from social events increased. A similar association was also found between the areas of the bedrooms and absence from social events. Specifically, the residents who had bigger rooms tended to attend a fewer number of hours of social events. Yet, when considered independently, these three metric variables could only explain, at most, 23.1% of the factors that contribute to the variability of reasons of absence from social events.

The depth of bedrooms from three of the common spaces (dayroom, dining room, kitchen) and the entrance was found to be positively associated with the number of hours of absence from social events. The depth values corresponding to the relation between bedrooms and two of the spaces (bedroom and entrance) had slightly higher r values (row 7 and 9, $r: 0.54$) than the correlations calculated for the distances of the same kind (row 1, $r: 0.46$; row 3, $r: 0.48$). The two variables were also better in explaining the variability in the absence from social events with a value of nearly 30.0%. Observing the positive associations between

nearly all variables of depth (except the depth from outdoors) concludes that as the number of convex spaces between the origin and destination increases, the absence from social events increases as well.

Table 38: Spearman Correlations between survey and spatial variables

# ROW	Y	X	p	r	Strength of r	r ²
1	Abssoc2	bdr_din	<.0001	0.46564	LOW	0.217
2	Abssoc2	bdr_dyr	0.0132	0.27599	very low	0.076
3	Abssoc2	bdr_ent	<.0001	0.48093	LOW	0.231
4	Abssoc2	bdr_kitch	0.0008	0.36717	very low	0.135
5	Abssoc2	bdrarea	<.0001	0.46564	LOW	0.217
6	Abssoc2	bdrarea_ (%)	0.00015	-0.34865	very low	0.122
7	Abssoc2	depthdin	<.0001	0.54197	LOW	0.294
8	Abssoc2	depthdayr	<.0001	0.47784	LOW	0.228
9	Abssoc2	depthent	<.0001	0.5432	LOW	0.295
10	Abssoc2	depthkitch	0.0002	0.41049	LOW	0.169
11	Abssoc2	globalint	<.0001	-0.58595	LOW	0.343
12	Abssoc2	localint	<.0001	-0.57841	LOW	0.335
13	Abssoc2	globalext	<.0001	-0.58285	LOW	0.340
14	Abssoc2	localext	<.0001	-0.57782	LOW	0.334
15	socwillscore	depthdin	0.021	-0.25775	very low	0.066
16	socwillscore	depthdayr	0.0248	-0.25079	very low	0.063
17	socwillscore	depthent	0.0368	-0.23388	very low	0.055
18	socwillscore	depthkitch	0.0397	-0.23054	very low	0.053
19	socwillscore	globalint	0.0005	0.38246	very low	0.146
20	socwillscore	localint	0.0002	0.41026	LOW	0.168
21	socwillscore	globalext	0.0006	0.37466	very low	0.140
22	socwillscore	localext	0.0003	0.39636	LOW	0.157

absoc2: number of hours of absence from social events; **socwillscore:** willingness to participate in social events score; **bedr_din:** distance between bedroom and dining room; **bedr_dyr:** distance between bedroom and dayroom; **bedr_ent:** distance between bedroom and entrance; **bedr_kitch:** distance between bedroom and kitchen; **bdrarea:** area of bedroom; **bdrarea_:** the percentage of residents bedroom area in the total area; **depthdin:** depth from bedroom to dining room; **depthdayr:** depth from bedroom to dayroom; **depthent:** depth from bedroom to entrance; **depthkitch:** depth from bedroom to kitchen; **globalint:** global integration of bedroom; **localint:** local integration of bedroom; **globalext:** global integration of bedroom calculated by excluding the outdoors; **localext:** local integration of bedroom calculated by excluding the outdoors.

Absence from social events was negatively associated with all four of the integration values of bedrooms. As presented in the Chapter 5, the smaller integration values represent better integration; convex spaces with higher values of (global and local) integration tend to be

segregated from the system. Based on the interpretation of integration values and the observed association, as residents' bedrooms became more segregated, their absence from social events increased. The Spearman correlation coefficient (r) of the syntactic variables and absence from social events were nearly the same but weak in terms of the strength of the relationship ($r < 0.60$). When considered separately, the global and local integration values (with and without including the effect of the outdoors) can only explain around 34% of the variability in the residents' number of hours of absences from social events.

A set of similar associations were also observed between the willingness to participate in social events score and the same variables of depth and integration. The depth from the dining room, dayroom, entrance, and kitchen to the residents' bedrooms was found to be negatively associated with their willingness to participate in social events. Yet, these associations were very weak with the Spearman correlation coefficient going as low as -0.23. The willingness to participate in social events score was also found to be positively associated with all four of the integration values. However, only local integration values (calculated by including and excluding the outdoors) were weakly correlated. The willingness of residents to participate in social events increased as their bedroom got locally segregated from the other spaces. Yet, the local integration of bedrooms can explain only 16 or 17% of the variability in the factors that play a role in the residents' willingness to attend social events.

The Spearman correlations between the spatial variables and the outcomes were generally low in strength, showing that one spatial variable is not enough to predict any of the outcome variables. This situation is consistent with the earlier findings that resulted in lack of strength in correlations between the survey variables. Although nearly all of the expected associations were observed between selected variable pairs, there is still a need to construct models that can explain the relations between the survey and spatial variables.

6.7.2. Studying Complex Relations Between the Survey and Spatial Variables

For each outcome variable, a multiple regression model was developed. For the variables that were used to measure the same outcome, only one of the variables was selected as the dependent variable (Y). The independent (explanatory) variables (X) were selected from the list of correlated outcome and spatial variables. First other correlated variables of survey, metric (distance and area) and non-metric (depth and integration values) variables were added to the model. Then, by employing the backwards elimination method, the variables that had insignificant contribution to the model were dropped.

The mixed procedure was used to fit the regression model by employing Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) (SAS User Guide 2003). The analyses were done by using the SAS statistical software package. Eighty observations from four different plan types were used in the analyses. Three outcome variables resulted in meaningful fitted regression models:

6.7.2.1. Multiple Regression Model I: Absence in Social Events as the Dependent Variable

Table 39 displays the solution for the fixed effects of Regression Model I, which employed the number of hours of absence from social events as the dependent variable. As it can be seen in the table, seven variables were left in the fitted model, four of which were plan types.

According to the solution, the following equation can be written:

$$\begin{aligned} \text{Absence in Social Events} = & \beta_0 + \beta_1 (\text{plan type 1}) + \beta_2 (\text{plan type 2}) + \beta_3 (\text{plan type 3}) + \beta_4 \\ & (\text{Willingness to attend Soc. Events Score}) + \beta_5 (\text{distance between Bedroom and Dining Room}) \\ & + \beta_6 (\text{distance between Bedroom and Kitchen}) \end{aligned}$$

This multiple regression equation can be used for two main purposes. First it provides important information between the dependent variables and the variables that remained in the fitted model. Second, by using the equation and assigning desired values to the estimate variables, the estimated mean value for the absence in social events can be calculated. Since this model contains the plan type as the categorical variable, the estimated mean of hours of absence from social events can be calculated for each plan type.

Table 39: Solution for Fixed Effects of Regression Model-I (Dependent variable: Absence from Social Events)

Solution for Fixed Effects						
Effect	case	Estimate	Standard Error	DF	t Value	Pr > t
Intercept		9.5268	1.0607	73	8.98	<.0001
Plan type	1	-0.3597	0.6446	73	-0.56	0.5786
Plan type	2	2.8001	0.8278	73	3.38	0.0012
Plan type	3	0.7570	0.6014	73	1.26	0.2122
Plan type	4	0
socwillscore		-3.1833	0.2307	73	-13.80	<.0001
bdr_din		0.06438	0.02282	73	2.82	0.0062
bdr_ktch		-0.03262	0.01440	73	-2.27	0.0265

socwillscore: willingness to participate in social events score;
bdr_din: distance between bedroom and dining room;
bdr_kitch: distance between bedroom and kitchen.

According to the fixed model, absence from social events is predicted by the plan type (categorical variable) and three other variables. Two of these variables were the length of the routes from bedrooms to the dining area and kitchen. The other variable was the resident's willingness to attend social activities. Controlling all the variables, the relationship between each of these variables and the hours of absence from social events is as follows:

(a) If the willingness to attend social events score increases by 1, the expected decrease in the number of hours of absence from social events is 3.18.

(b) If the distance between the bedroom and dining room increases by 1 (foot), the expected increase in absence from social events is 0.06 hours. More simply, for every 16.6 feet of increase in distance between the bedroom and dining room, the expected increase in number of hours of absence from social events is 1 hour.

(c) If the distance between the bedroom and kitchen increases by 1, the expected decrease in absence from social events is 0.03 hours. More simply, for every 33.3 feet of increase in distance between the bedrooms and kitchen, the expected decrease in number of hours of absence from social events is 1 hour.

Figure 18 displays the plot of least square means of hours of absence from social events. The least square means that were used to draw this graph were calculated by using the multiple regression equation and thus, different from the one presented earlier in this chapter. From the plot, it is noticeable that residents of plan type 2 had the most and residents of plan type 1 had the least hours of absence from weekly social events. Table 40 outlines the actual values of the estimated means.

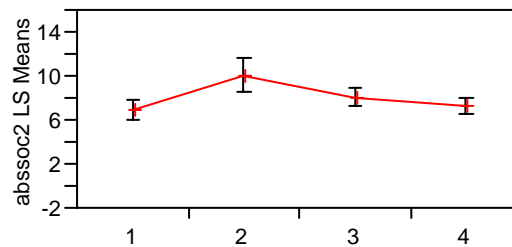


Figure 18: Plot of Least Square Mean of *predicted* Absence from Social Events

Table 40: Least Square Means of *predicted* Absence from Social Events

Least Squares Means						
Effect	case	Estimate	Standard Error	DF	t Value	Pr > t
P. t.	1	6.9008	0.4369	73	15.80	<.0001
P. t.	2	10.0606	0.7476	73	13.46	<.0001
P. t.	3	8.0175	0.4141	73	19.36	<.0001
P. t.	4	7.2605	0.3987	73	18.21	<.0001

A Tukey-Kramer comparison of the least square differences of absence from social events showed that residents of plan type 2 were significantly different from residents of plan types

1 and 4 (Table 41). Whereas, when plan types 2 and 3 was considered, the least square mean of residents' absences from social events were not significantly different. The same was true for the comparison of the least square mean of absences of residents of plan types 3 and 4. The difference in the least square means of residents' absences from social events was insignificant in plan types 4 and 1.

Table 41: Least Square Means Differences of *predicted* Absence from Social Events

Level		Least Sq Mean
2	A	10.060616
3	A B	8.017529
4	B	7.260506
1	B	6.900818

Levels not connected by same letter are significantly different.

The plan types were selected according to their distinctiveness in configuration. Having the plan type as a variable in the prediction equation and observing significant differences in the least square means indicates that a difference in spatial configurations can lead to a significance difference in the studied outcome. Observing the walking distance from bedrooms to two of the common spaces (dining room and kitchen) emphasizes the importance of metric variables over the non-metric variables (depth and integration values). Among the two relations, the positive link between the walking distance from the bedroom to the dining room and the absence from social events is clearer. Yet, both of the relations that appeared here can be best explained after the analyses of the field observations.

6.7.2.2. Multiple Regression Model II: Depression Score as the Dependent Variable

Table 42 displays the solution for the fixed effects of Regression Model II which employed the depression score of residents as the dependent variable. As it can be seen in the table, seven variables were left in the fitted model, four of which were plan types. Although metric (distance and area) and non-metric (depth and integration values) were included in the model, they were dropped in the elimination process due to their weak relation. Yet, two outcomes and one descriptive (activities of daily living) variable remained. According to solution, the following equation can be written:

Depression Score = $\beta_0 + \beta_1$ (plan type 1) + β_2 (plan type 2) + β_3 (plan type 3) + β_4 (Activities of Daily Living Score) + β_5 (Willingness to Attend Social events) + β_6 (Friendliness with other residents)

Table 42: Solution for Fixed Effects of Regression Model II (Dependent variable: Depression Score)

Solution for Fixed Effects						
Effect	case	Estimate	Standard Error	DF	t Value	Pr > t
Intercept		10.7208	1.1634	73	9.21	<.0001
Plan type	1	-0.6370	0.6608	73	-0.96	0.3382
Plan type	2	-2.9352	0.7229	73	-4.06	0.0001
Plan type	3	0.7228	0.5900	73	1.23	0.2245
Plan type	4	0
adlscore		-0.2600	0.09875	73	-2.63	0.0103
socwillscore		-0.9677	0.3070	73	-3.15	0.0024
friendlyscore		-1.4147	0.4261	73	-3.32	0.0014

adlscore: activities of daily living score;
socwillscore: willingness to participate in social events score;
friendlyscore: friendliness with other residents score.

By using the multiple regression prediction equation, the following interpretations can be made:

- (a) If the activities in daily living score increases by 1, the expected decrease in the depression score is 0.26.
- (b) If the willingness to participate social events increases by 1, the expected decrease in depression score is 0.97.
- (c) If the friendliness with other residents score increases by 1, the expected decrease in depression score is 1.41.

Figure 19 displays the plot of the least square means of the depression scores. The least square means that were used to draw this graph were calculated by using the multiple regression equation and thus, different from the one presented earlier in this chapter. From the plot, it is noticeable that residents of plan type 3 had the highest and residents of plan type 2 had the lowest depression scores. Table 43 outlines the actual values of the estimated means.

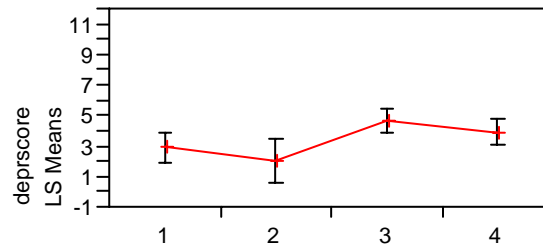


Figure 19: Plot of Least Square Mean of *predicted* Depression Scores

Table 43: Least Square Means of *predicted* Depression Scores

{tc "Least Squares Means " \f C \l 2}Least Squares Means						
Effect	case	Estimate	Standard Error	DF	t Value	Pr > t
P. t.	1	2.8877	0.4914	72	5.88	<.0001
P. t.	2	2.0472	0.7053	72	2.90	0.0049
P. t.	3	4.6140	0.4050	72	11.39	<.0001
P. t.	4	3.8966	0.4193	72	9.29	<.0001

A Tukey-Kramer comparison of the least square differences of depression scores showed that residents of plan type 3 was significantly different from residents of plan type 1 and 2 (Table 44). However, when the plan types were compared as separate pairs, such that plan type 4 was compared with plan type 3, and plan type 1 was compared with plan type 2, the least square mean of residents' depression scores were not significantly different.

Table 44: Least Square Means Differences of *predicted* Depression Scores

Level		Least Sq Mean
3	A	4.6140371
4	A B	3.8966412
1	B	2.8876638
2	B	2.0471891

Levels not connected by same letter are significantly different.

Observing plan type as the categorical variable but not observing any of the spatial variables (metric or non-metric) in the regression prediction equation can be evaluated as an indicator of other factors that impact depression scores. Simply, the factors that may play a role on a resident's mood are many.

Among the variables studied, the link between competence in activities of daily living (ADL) and depression is not a new one (Grann, 2000). However, the links between depression and two outcomes (willingness to participate in social events and friendliness with other residents) are important since these two factors were underlying the importance on social interaction. Yet, when an association between social interaction and depression may still not appear when the following were considered: (1) a lack of expected correlations between variables of outdoor use (number of hours spent and frequency of use) and depression; (2) the complexity of the non-spatial variables (such as socio-economical status) that change from one plan type to another; (3) a possibility of bias due to caregivers' responses; and (4) the limited variability of the seven scale depression instrument developed for this study.

6.7.2.3. Multiple Regression Model III: Number of Hours Spent Outdoors as the Dependent Variable

Table 45 displays the solution for the fixed effects of Regression Model III, which employed the number of hours spent outdoors as the dependent variable. As it can be seen in the table, three variables were left in the fitted model and the plan types, as the categorical variable, were dropped from the model during the backwards elimination process. The final model also did not contain any of the spatial variables. According to solution, the following equation can be written:

$$\text{Number of Hours Spent Outdoors} = \beta_0 + \beta_1 (\text{Instrumental Activities of Daily Living Score}) + \beta_2 (\text{Willingness to Attend Social Events Score}) + \beta_3 (\text{Friendliness with other Residents})$$

Table 45: Solution for Fixed Effects of Regression Model III (Dependent variable: Number of Hours of Spent Outdoors)

Solution for Fixed Effects					
Effect	Estimate	Standard Error	DF	t Value	Pr > t
Intercept	-0.3536	1.1381	76	-0.31	0.7569
iadlscore	-0.3702	0.09465	76	-3.91	0.0002
socwillscore	1.6144	0.3920	76	4.12	<.0001
friendlyscore	1.7453	0.5589	76	3.12	0.0025

iadlscore: instrumental activities of daily living score;
socwillscore: willingness to participate in social events score;
friendlyscore: friendliness with other residents score.

By using the multiple regression prediction equation, the following interpretations can be made:

- (a) If the instrumental activities of daily living increases by 1, the number of hours spent outdoors will decrease 0.37 hours per week.
- (b) If the willingness to attend social events score increases by 1, the number of hours spent outdoors will increase 1.61 hours per week.
- (c) If the friendliness with other residents score increases by 1, the number of hours spent outdoors will increase 1.74 hours per week,

When closely considered, a logical link between IADLs and outdoor use appears. Four of five instrumental activities of daily living are associated with indoor activities, which are using the telephone, light/heavy housework, meal preparation, and managing money.

Shopping, which is the remaining activity, requires leaving the grounds of the facility. Thus, being able to perform any of these activities alone or with assistance may increase the indoor time. The relation between the other explanatory variables and the outdoor use is clearer. An increase in the willingness to attend social events and friendliness with other residents scores are indicators of a resident being a positive and active member of the community, which can also increase outdoor use.

Being independent from the plan type, this regression model was developed based on only three variables. Yet, the lack of spatial variables and plan type as the categorical variable can be misleading. When the earlier analyses were considered:

(1) In terms of the difference between least square mean of hours spent outdoors only two plan types (plan type 2 and 3) were significantly different from each other;

(2) In terms of the difference between least square mean of frequency of outdoor use, none of the plan types were significantly different from each other; and

(3) In terms of the difference between least square mean of walking distances between bedrooms and outdoors, none of the plan types were significantly different from each other;

(4) In terms of the difference of depth values from outdoors to bedrooms, only plan type was significantly different from the other three.

Thus, it can be concluded that the variability in the spatial variables of the outdoors of the selected plan types were not enough to create a difference in the regression model.

CHAPTER 7: FINDINGS OF OBSERVATIONS

This chapter presents the findings of systematic observations that were made by using a behavior mapping technique. Behavior maps provided the spatial distribution of residents per observation and were employed as an objective measurement of the use of spaces. In addition to space use, lively conversations between the household residents were noted as an indicator of social interaction and noted on the maps.

In this chapter, a descriptive analysis of the use of spaces in the different plan types and social interaction observed at each plan type will first be reported. Second, observations from different plan types will be compared with each other to define the individual spaces of plan types that attract more use and social interaction. Third, the mean number of residents per each observation at each plan type will be compared to define plan types that are significantly different from others. Finally, the environmental features that might create differences in the use of spaces and the social interaction of residents will be discussed.

7.1. The Use of Spaces of Plan Types

The criteria that were used to define the unbiased observation time and the criteria that were used to count a conversation as an indicator of social interaction were discussed extensively in Chapter 4. In summary, the times that were not scheduled for any other activity, such as meals and prearranged events, were defined as appropriate for observations. The conversations that lasted during the observation cycle (5-10 minutes) and were sustained by participant's postures (e.g., facing each other and maintaining eye contact) and gestures (e.g., laugh, smile, etc.) were defined as lively conversations.

Three hundred and eight (308) observations were performed at four different sites that contained nine different cases that are representative of the four plan types. Each observation corresponded to a behavior map, which in total resulted in the same amount of behavior maps to be analyzed. Fourteen (14) observations (4.6%) were ineligible to be included since the data was collected during meals. This happened as a result of a few of the observations

starting before the meal time in one building and continuing in the next building(s) on the same site. The remaining 294 observations were included in the final analyses (Table 1).

Table 1: The Summary of the Observations Included in the Final Analysis

	# Cases	# Obs.	# Ineligible Observations	# Remaining Observations	Average # Obs. Per Case
Plan Type 1	3	108	10	98	≈33
Plan Type 2	2	72	2	70	35
Plan Type 3	2	64	0	64	32
Plan Type 4	2	64	2	62	31
Σ	9	308	14	294	

The descriptive analysis relies on the total number of residents during each observation cycle and the distribution of the observed residents in the common spaces. It was not possible to observe the residents' locations in their bedrooms all the time since the residents kept their doors closed during some hours of the day. Additionally, some residents kept their doors closed all the time. Therefore, if a resident was not observed in any of the common areas, including the outdoors, but the resident was known to be in the house, then he/she was noted to be in his/her bedroom. The total number of residents was provided by the caregiver at the time of each observation to ensure that there weren't any overestimates of the number of residents in the bedrooms.

Additionally, residents using the bathrooms were not counted in the observations. If a resident was seen walking out or into the bathroom/restroom then he/she was noted to be in the bathroom. Yet, in some observations residents who were using the restrooms might be counted to be in the bedrooms. Three of the plan types contained shared bathrooms, which somewhat neutralized the possible overestimated use of the bedrooms. Plan type 2, which contained private bathrooms for each resident, naturally had the same overestimation effect that was a result of assigning bedrooms as the location for unobservable residents. Thus, the bias that may cause the overestimated use of bedrooms was controlled to a reasonable extent in the four plan types.

Since plan types 2 and 4 contained alternative spaces for the same activities, first a descriptive analyses of each plan type will be provided. A total number of residents who use the dining room and the dayroom was also calculated separately for plan types 2 and 4 by combining the use of spaces with the same functions. An overall comparison of the use of space will be done by incorporating the combined results from plan type 2, plan type 4 and the results from plan types 1 and 3.

The data that was used in the descriptive and statistical analyses was obtained by counting the number of residents in each space of the plan type. The descriptive analysis was based on calculating the percentages of the total number residents based on the behavior maps. Since observations were repeated in cycles, the “observed residents” referred to the combined number of residents observed in each cycle.

The observations covered the time that residents had free choice to select their activities. The residents’ use of space was not recorded during the prearranged activities and meals since the reason for the use of a space was determined by other factors. The distribution of residents to each space measures the use of overall spaces of the plan types. A larger percentage of use of the same space was associated with a greater number of observations that located the residents in that same space. Hence, the percentage of use of different spaces also measures the number of residents who have a selection of spaces in which to spend their time.

In the following text, “observed resident” and “use of space” were used interchangeably. The phrase “residents spent most of the time” was used if the space under consideration had a high number (or percentage) of “observed residents” or use. The references that were made to the percentage of the residents were made to the total number of residents counted by adding up all the observations.

The photos that were used in this chapter show a slight warping due to the panoramic image processing of the actual images by using Panaroma ComposerTM software.

7.1.1. Plan Type 1: The Use of Space

The data that was used to explain the use of space in plan type 1 was based on a total of 98 observations in 3 identical buildings. Twenty one (21) residents were observed slightly more than 30 times during the times that equaled two regular weekdays and one day in the weekend.

The distribution of the use of spaces in plan type 1 is presented in Table 2. Most of the time, residents (73% of the total number of the observed residents) were in their bedrooms during the observations. The dayroom was the first choice of residents if they left from their room (Figure 1). Yet, only 14% of the residents were observed in the dayroom. The activities that were generally associated with the dayroom were: watching TV; playing cards; talking on the phone; and sitting with others, including visitors.

Table 2: Use of Spaces in Plan Type 1

P.T. 1 Obs.	Dining Room	Kitchen	Dayroom	Bedroom	Corridor	Outdoor	Laundry	Bathroom	Total
# Res.	13	19	88	472	39	4	0	12	647
% Res.	0.02	0.03	0.14	0.73	0.06	0.01	0.00	0.02	1.00

% Res.: percentage of observed residents where 1.00 = 100%; # Res.: number of observed residents



Figure 1: The dayroom of plan type 1

The linear corridors of plan type 1 were often quiet. Six percent (6%) of the residents were mostly observed in the corridors walking to go to bathroom or to any of the common spaces. Some residents preferred to have their medication at the medication counter, which was situated in the corridor. The linear corridor was also observed to serve as a walking path to a few of the residents (Figure 2).

Considering all the residents observed, 3% of the residents were seen in the kitchen and 2% of the residents were observed in the dining room. The activity usually associated with the use of the kitchen and the dining room, outside meal hours, was generally helping out the caregiver with some housework after the meals (Figure 3 and 4).

Among all the observations, 2% of the residents were observed walking out or walking into the bathrooms, which were located at the opposite side of the bedrooms. Only 1% of the total number of observed residents was seen outdoors. The patio that was accessible from the kitchen and walkways passing in front of the building were the only places that some residents were observed at a few times.



Figure 2: The corridor of plan type 1 and the medication counter located at the corridor

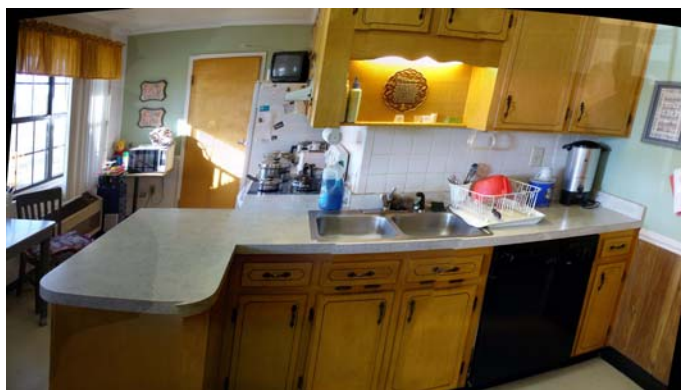


Figure 3: The Kitchen of Plan Type 1



Figure 4: The Dining Room of Plan Type 1

In general, it was observed that residents of plan type 1 left their bedrooms mostly for meals. Yet, there was some use of the dayroom by the residents who watched soap operas as a group and teamed up to play cards

7.1.2. Plan Type 2: The Use of Space

The data that was used to explain the use of space in plan type 2 was based on a total of 70 observations in 2 identical buildings. Thirteen (13) residents were observed slightly more than 40 times during the times that equaled two regular weekdays and one day in the weekend. The distribution of the use of spaces in plan type 2 is displayed in Table 3.

Most of the residents preferred to spend the majority of their time in their private bedrooms, which also contained a private bathroom for each resident. On average, 80% of the observed residents were in their bedrooms.

Table 3: Use of Spaces in Plan Type 2

P.T. 2 70 Obs.	Dining Room	Welcoming Alcove	Kitchen	Garden Dining	Dayroom	Parlor	Bedroom	Sitting Room	Corridor	Tub Room	Outdoor	Laundry	Total
# Res.	12	9	11	6	6	35	440	16	9	1	1	3	549
% Res.	0.02	0.02	0.02	0.01	0.01	0.06	0.80	0.03	0.02	0.00	0.00	0.01	1.00

% Res.: percentage of observed residents where 1.00 = 100%; # Res.: number of observed resident

Among the plan types selected to be studied, plan type 2 had alternative spaces that shared the same functions with the dining room and the dayroom. The parlor, which was one of the alternatives to the dayroom with its size and similar furnishings, attracted six times more residents than the dayroom (Figure 5). The presence of the TV set in the parlor played a role in increased use. Another factor might be the location of the parlor, which was more public, compared to the dayroom that was surrounded by bedrooms. The sitting room, which was a lot smaller and located between the bedrooms, attracted 3% of use, especially for functions such as playing cards and solving puzzles. The dayroom was less preferred and got only 1% of the use. Yet, being close to the bedrooms, it served as a spot for residents to leave their scooters to recharge (Figure 6)



Figure 5: Parlor as an alternative to the dayroom in Plan Type 2



Figure 6: The dayroom in Plan Type 2

The welcoming alcove was designed to be an extension of the entrance and it was used for activities such as checking the mailbox and the activity calendar. Sometimes the residents who had bedrooms closer to the entrance walked to the welcoming alcove and sat in chairs that were placed there. Some residents also used the welcoming alcove to park their scooters (Figures 7 and 8).



Figure 7: Kitchen and Welcoming Alcove of Plan Type 2



Figure 8: Sitting room and immediate outdoor environment in Plan Type 2

The dining space, which was located in front of the open plan kitchen, was used by 2% of the observed residents for activities such as sitting and having conversations. The garden dining area had round tables as an alternative to the long linear dining tables in the dining room; the garden dining area attracted 1% of the total number of observed residents (Figure 9). The activity room was never seen to be used by any of the residents. Additionally, a few of the total number of the residents (3%), preferred to do their own laundry. Two percent (2%) of the total number of residents were seen walking in the corridor.



Figure 9: Main Dining and the Garden Dining in Plan Type 2

In general, it was observed that residents in plan type 2 left their rooms mostly for meals and sometimes for prearranged events. The residents spent most of the time inside their private bedrooms, which were described by the caregiver as their “apartments”.

7.1.3. Plan Type 3: The Use of Space

The data that was used to explain the use of space in plan type 3 was based on a total of 64 observations in 2 identical buildings. Twenty three (23) residents were observed slightly more than 28 times during the times that equaled two regular weekdays and one day in the weekend. The distribution of the use of spaces in plan type 3 is displayed in Table 4.

Slightly more than half (53%) of the total number of observed residents were in their rooms during the observations. The dayroom got 26% of the use among all other spaces. The dayroom was generally used for watching TV, sitting, and having conversation with visitors and other residents. The H shaped corridors of plan type 3 got 6% of the total use, which was mainly residents who were walking to the dayroom and other common spaces. Shared bathrooms located in the corridors got 3% of the total use.

Table 4: Use of Spaces in Plan Type 3

P.T. 3 64 Obs.	Dining Room	Kitchen	Dayroom	Bedroom	Corridor	Outdoor	Laundry	Bathroom	Total
# Res.	29	3	173	347	42	38	0	22	654
% Res.	0.04	0.00	0.26	0.53	0.06	0.06	0.00	0.03	1.00

% Res: percentage of observed residents where 1.00 = 100%; **# Res:** number of observed residents

In plan type 3, the facility administration discouraged the use of the kitchen by residents due to liability issues. Therefore, no significant activity of residents was observed in the kitchen. The dining space had 4% of the total use during the hours between meals. Residents generally used the dining room when they want to make calls, sit alone, or have small group conversations. The porch and the outdoor area had 6% of the use with a few of residents going out on sunny days.

In general, the residents of plan type 3 spent half of their time in their bedrooms. The decreased use of the bedrooms might be related to the semi-private rooms. Yet, residents chose to spend a quarter of the day in the dayroom with other residents, indicating that they

leave their room to be with more people. The spaces of the plan type 3 can be followed from Figures 10, 11 and 12.



Figure 10: Dayroom in Plan Type 3



Figure 11: Dining Room in Plan Type 3



Figure 12: Kitchen and Corridors in Plan Type 3

7.1.4. Plan Type 4: The Use of Space

The data that was used to explain the use of space in plan type 4 was based on a total of 62 observations in 2 identical buildings. Twenty three (23) residents were observed nearly 30 times during the times that equaled two regular weekdays and one day in the weekend. The distribution of the use of spaces in plan type 4 is displayed in Table 5.

Table 5: Use of Spaces in Plan Type 4

P.T. 4 62 Obs.	Dining Room	Sunroom	Kitchen	Dayroom	Bedroom	Corridor	Entrance	Outdoor	Laundry	Bathroom	Total
# Res.	35	26	3	141	380	38	31	25	0	5	684
% Res.	0.05	0.04	0.00	0.21	0.56	0.06	0.05	0.04	0.00	0.01	1.00

% Res.: percentage of observed residents where 1.00 = 100%; **# Res.:** number of observed residents

The bedrooms were the most dominantly used spaces by containing 56% of the observed residents. The dayroom was the second in the rank of use with 21% of the total use. The main activities that were observed in the dayroom were watching TV, sitting, and having conversations with visitors and other residents. The entrance, which was connected to the dayroom, had 5% of the use. Residents enjoyed sitting and looking around from two comfortable chairs that were placed at the entrance. Residents who did not want to watch TV or be in a group preferred to sit in the entrance (Figure 13). The sunroom, which was another alternative for the dayroom, was another place for residents who preferred quieter time. The comfortable chairs, telephone, exit to the outdoors, and view of the backyard made this place a favorite for a few of the residents (Figure 14).



Figure 13: Entrance and Dayroom in Plan Type 4

The dining room was adjacent to the sunroom and got 5% of the use. Residents who preferred to sit on higher chairs and needed a table for any kind of activity came to the dining room. The administration is the same as in plan type 3, therefore, the kitchen use by residents was discouraged in plan type 4 due to the liability issues. Therefore, no significant activity of residents was observed in the kitchen (Figure 15).

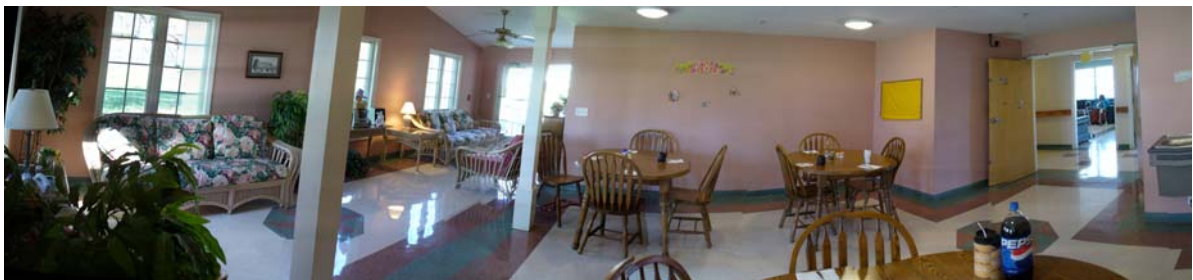


Figure 14: Sunroom and Dining Room in Plan Type 4

The H shaped corridors of plan type 4 got 6% of the total use mostly as a result of residents walking to the dayroom and other common spaces (Figure 15). One percent (1%) of the total number of the observed residents were seen when they were walking into or out of the bathrooms.



Figure 15: Corridor and Kitchen Room in Plan Type 4

The small outdoor area that was accessible from the sunroom and the corridor at the right side of the plan layout, attracted users of both spaces. The porch in front of the house also attracted residents on a few sunny days in the winter. Four percent (4%) of the total use was observed outdoors.

7.1.5. Overall Comparison of the Use of Spaces in Four Plan Types

Two of the studied plan types contained spaces that could serve as an alternative to the dining room and the dayroom. In order to make overall comparisons, the uses of spaces with the same functions were combined in plan types 2 and 4. The distribution of the use of spaces in all plan types is displayed in Table 6. The behavior maps collected from cases that were representative of the same plan type were first overlapped and then weighted to have the same number of residents that correspond to the different number of residents for each plan type. The value that corresponded to each observed resident can be seen in the legends of each map (Figure 16).

The bedrooms had the majority of use in all plan types. Residents of plan type 2 spent the most time in their bedrooms with 80% of the total use. Plan type 1 followed with 73% of the observed residents in their bedrooms during the observations. There was a dramatic decrease in the time that was spent in bedrooms by residents of plan types 3 and 4. The use of bedrooms in plan type 4 was 56% of the total use of all spaces. This was followed by a small decrease to 53% of the use of all spaces for bedrooms in plan type 3. When looking at these

numbers, it is possible to conclude that residents of plan type 1 and plan type 2 were quite similar in terms of the amount of time they spent in their bedrooms. When compared to each other, residents of plan type 3 and plan type 4 spent nearly the same amount of time in their bedrooms but less time in their bedrooms when compared to the residents of plan types 1 and 2.

Table 6: Overall Comparison of the Use of Spaces in Four Plan Types

Res.	Dining		Kitchen		Dayr.		Bedr.		Corr.		Outd.		Laundry		Bathr.		Total	
	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
P.t. 1	0.02	13	0.03	19	0.14	88	0.73	472	0.06	39	0.01	4	0.00	0	0.02	12	1.00	647
P.t. 2	0.03	18	0.02	11	0.12	66	0.80	440	0.02	9	0.00	0	0.01	3	0.00	1	1.00	548
P.t. 3	0.04	29	0.00	3	0.26	173	0.53	347	0.06	42	0.06	38	0.00	0	0.03	22	1.00	654
P.t. 4	0.05	35	0.00	3	0.29	198	0.56	380	0.06	38	0.04	25	0.00	0	0.01	5	1.00	684

#: percentage of observed residents where 1.00 = 100%; #: number of observed residents

The use of the dayrooms in all facilities had the second percentage of use among all other spaces. Although the use of the parlor, welcoming alcove, and sitting room was added to the use of the dayroom, plan type 2 still had the lowest use in dayroom space with only 12% of the total use. Yet, two plan types (1 and 3), which contained only one dayroom, had more use (14% for plan type 1 and 26% for plan type 3). When considered alone, the use of the dayroom in plan type 4 was 21% of the use of all spaces. However, the combined use of the dayroom in plan type 4 was 29%, which included the use of entrance hall and the sunroom. Thus, it can be concluded that the dayroom of the plan type 4 had the highest use. Yet, the differences between the use of the dayroom were small when plan type 3 was compared to plan type 4 and plan type 1 was compared to plan type 2.

The use of dining spaces in all plan types was fairly low. The dining space of plan type 1 had the lowest use by having only 2% of the activity observed around the house. The use of the dining room in plan type 2 was a combined use of the dining area and garden dining. Despite of the open plan solution and providing an alternative space for dining, only 3% of the total use was observed in the dining space. The dining space of plan type 3 had 4% of the total use

of the space. Although located adjacent to the sunroom, 5% of the total use was observed in the dining space of plan type 3. In general, there was not much going on in the dining spaces during the times between and after meals.

Since residents were not encouraged to use the kitchens in plan type 3 and 4, it is only possible to make a comparison between plan type 1 and 2. The kitchen of plan type 1 had 3% of the total use, whereas the kitchen in plan type 2 had only 2% of the total use. Residents of plan type 1 generally were observed helping the caregiver in the kitchen. Yet, the residents of plan type 2 only used the kitchen when they needed to take something from the refrigerator.

When the residents' use of corridors in the four cases were compared, it was interesting to notice that the three plan types (1, 3, and 4) that offered shared bathrooms for residents, had the same use (6%) of the corridors. Plan type 2, which contained private bathrooms in bedrooms, had slightly less use of the corridors at 2% of the total use of space.

The uses of the shared bathrooms in the three plan types (1, 3, and 4) were fairly close by ranging between 1% (in plan type 4) to 3% (in plan type 3). The laundry space was rarely used (1%) by a few of the residents of plan type 2.



Figure 16: Weighted Behavior Maps of Four Plan Types for Use

In plan type 2 there weren't any outdoor activities observed and the outdoors of plan type 1 only had 1% of that use observed in all spaces. Plan types 3 and 4 had 6% and 4% of the total use of the outdoors, respectively. When all plan types were considered, plan types 3 and 4 were somewhat similar in terms of having some outdoor activity. Plan types 1 and 2 can define another group for very low or no observed outdoor activity. However, this difference in groups (plan types 1 and 2 vs. plan types 3 and 4) might be related to the data collection time. For plan types 1, the data collection started during the last week of December 2005 and ended in January 2006. Plan type 2 was studied during the month of February. The rest of the data (plan types 3 and 4) was collected simultaneously from two locations during the following month. Thus, a comparison of outdoor use between plan type 3 and 4 can be done by controlling the effect of weather.

Two buildings that were representative of plan type 3 were located facing each other and defined a cozy outdoor space in between the buildings. There was a transition from the hard concrete surface of the parking lot to the grass covered ground when approaching the outdoor area between the buildings. A gazebo, which was in this outdoor area, was preferred by residents of both buildings and accessible with a very short walkway. A small porch located at the entrance of the buildings also defined a more private outdoor area for the residents of the building. Both outdoor areas provide a view of front and back of the site. A small patio, which was at the back of the building, was generally preferred by caregivers during the breaks and a couple of residents who were smoking (Figure 17).



Figure 17: Gazebo and Patio in Plan Type 3

Two buildings that were representative of plan type 4 were located in neighboring perpendicular sides of a rectangle site. The hard concrete surface of the parking lot was immediately connected to the building, leaving a thin band of green ground. There was no well-defined common outdoor area for the residents of two buildings. The long porch located at the front entrance of the building was used by residents of the same building. The small patio at the corner of the backside of the building was a favorite spot for residents and caregivers looking for a more private outdoor environment to be alone, to smoke, or to have conversations (Figure 18).

Overall, the residents of plan types 3 and 4 spent less time in their bedroom and can be regarded as more active users of the environment than residents of plan types 1 and 2.



Figure 18: Porch and Patio in Plan Type 4

7.2. Overall Comparison of the Social Interaction in the Four Plan Types

In the conceptual framework of this study, social interaction was defined as a behavior that may lead to a better well-being. The location, number, and type (resident, caregiver, and visitor) of people involved in lively conversations were noted on the behavior maps during the observations. Then these numbers were counted and entered into the data table by the corresponding observations.

Table 7 displays the summary of the number and types of people involved in conversation groups in the four plan types. Conversation groups were formed between any combination of the three different types of people (residents, caregivers, or visitors). The reported percentages were calculated to describe the distribution of these different types of people in conversation groups.

The highest involvement of residents in conversation groups was at plan type 3 where 78.1% of the participants in conversation groups were residents. Plan types 1 and 4 were quite close with 64.3% and 68.6% of the participants in conversation groups being residents. Whereas, in plan type 2 less than half (44.4%) of the people who preferred to interact with others were residents.

Table 7: Overall Comparison of Participants of Conversation Groups

	Residents in Conv. Gr.		Caregivers in Conv. Gr.		Visitors in Conv. Gr.		People in Conv. Gr.	
	a / a+b+c	a	b / a+b+c	b	c / a+b+c	c	a + b + c	
	%	#	%	#	%	#	%	#
P.T. 1	64.3%	137	16.0%	34	19.7%	42	100.0%	213
P.T. 2	44.4%	44	39.4%	39	16.2%	16	100.0%	99
P.T. 3	78.1%	153	9.7%	19	12.2%	24	100.0%	196
P.T. 4	68.6%	96	15.0%	21	16.4%	23	100.0%	140

%: Percentage of Residents; #: Number of Residents

The ratio of residents in conversation groups provided the level of involvement of residents in social interactions. These conversation groups also contained caregivers and visitors who

might initiate the conversations. In Chapter 4, the criteria that was established for a conversation to be counted as an indicator of social interaction was discussed. According to that discussion, only the conversation groups that were formed by residents were eligible for consideration. Thus, assumptions based on overall involvement of residents in conversation groups might be misleading. For example in plan type 2, 39.4% of the total number of participants in conversation groups was caregivers. If caregivers in plan type 2 had been talking to the residents all the time, this would have automatically reduced the number of conversation groups that were formed by residents. The same was true for plan type 1, in which nearly 20% of the people who were observed having conversations were visitors.

Table 8 presents the summary of descriptive statistics of the conversation groups and “resident only” conversation groups, which were formed only by residents. In plan type 3, the “resident only” conversation groups made up 57.0% of all conversation groups. Half of all conversation groups were formed only by residents in plan type 4. There was a dramatic decrease in plan type 1, which had 35.2% of conversation groups that contained only residents. Plan type 2 had the lowest (23.7%) percentage of “resident only” conversation groups among all the studied plan types.

Table 8: Overall Comparison of Conversation Groups formed only by Residents

	Conv. Gr.		"Res. only" Conv. Gr.		Residents in "Res. only" Conv. Gr.	
	d		e / d	e	f / a	f
	%	#	%	#	%	#
P.T. 1	100.0%	91	35.2%	32	51.8%	71
P.T. 2	100.0%	38	23.7%	9	50.0%	22
P.T. 3	100.0%	86	57.0%	49	71.9%	110
P.T. 4	100.0%	58	50.0%	29	67.7%	65

a: Total number of residents in "Resident only" conversation groups; %: Percentage of Residents; #: Number of Res.

Now that the type of social interaction, which was observed as an indicator of well-being, has been introduced and the overall summary of the observed conversations in the plan types has been provided, the results of each plan type can be reported separately.

7.2.1. Observed Social Interaction of Residents in Plan Type 1

Table 9 displays the distribution of residents observed in conversation groups formed only by residents between the spaces of plan type 1. Most of the conversation groups (53.1%) were observed in the bedrooms. The dayroom had 37.5% of the “resident only” conversation groups and was in second ranking after the bedrooms. The dining spaces and corridors had the same percentage (4.7%) of conversation groups that were formed by residents.

As mentioned earlier in Chapter 4, plan type 1 had 15 residents in private rooms and 6 residents in shared rooms. All the conversations observed in bedrooms were not only between roommates but also between residents who were visiting each other. Located at the end of the corridor, the dayroom was less preferred by residents who were at the opposite end of the building. Residents who had closer rooms to the dayroom, as well as residents who liked to watch the same TV shows and play cards together were observed to be frequent users of the dayroom. Since residents knew the time for the TV shows and arranged the time when they would meet to play cards, the conversations observed in the dayroom were the result of organized activities.

Table 9: Distribution of Conversation Groups formed by Residents of Plan Type 1

Plan Type 1 21 Res. & 98 Obs.	Distribution of			
	Residents observed in "Resident only" Conversation Groups		"Resident only" Conversation Groups	
Spaces of Social Interaction	#	%	#	%
Dining Space*	4	5.6%	1.5	4.7%
Bedrooms	35	49.3%	17	53.1%
Dayroom	29	40.8%	12	37.5%
Corridor*	3	4.2%	1.5	4.7%
	71	100.0%	32	100.0%

* indicates that there was a common conversation group which was shared between spaces.

Yet, the conversations in the bedrooms were more impromptu conversations. Residents who went out of their room for any reason came to another room and sat down to talk in the room. Residents generally kept their doors open to see what went on in the house and sometimes started conversations with other residents who passed by. Residents who were in adjacent rooms were observed to visit their “neighbors”.

There was no social interaction in the kitchen or the outdoors. Yet, the general uses of these spaces were rather small. Based on the behavior map, it can be concluded that (1) the dayroom had the greatest number of conversation groups, (2) the number of conversation groups formed in bedrooms was not equal, and (3) the number of conversation groups observed in bedrooms decreased as the distance of bedroom got closer to the dayroom (Figure 19).

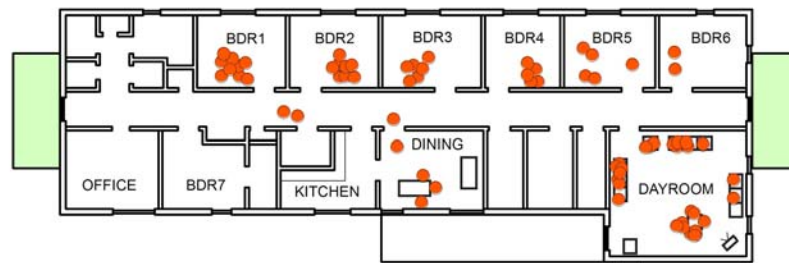


Figure 19: Observed Social Interactions in Plan Type 1

7.2.2. Observed Social Interaction of Residents in Plan Type 2

Table 10 displays the distribution of residents observed in conversation groups formed only by residents between the spaces of plan type 2. Most of the conversation groups (44.4%) were observed in the main dining space. These conversation groups were formed between residents who were either having conversations after (or before) the meal time or came from outside.

Table 10: Distribution of Conversation Groups formed by Residents of Plan Type 2

Plan Type 2 13 Res. & 70 Obs.	Distribution of			
	Residents observed in "Resident only" Conversation Groups		"Resident only" Conversation Groups	
Spaces of Social Interaction	#	%	#	%
Dining Space	9	40.9%	4	44.4%
Welcoming Alcove*	3	13.6%	1.5	16.7%
Sitting Room	4	18.2%	2	22.2%
Parlor	5	22.7%	1	11.1%
Corridor*	1	4.5%	0.5	5.6%
	22	100.0%	9	100.0%

* indicates that there was a common conversation group which was shared between spaces.

The sitting room had 22.2% of the “resident only” conversation groups and was in second ranking after the dining space. It was interesting to observe that the sitting room had more conversation groups than the parlor, which only had 11.1% of the conversation groups. Yet, the size of the conversation group formed in the parlor was the largest group among all observed with five residents. With its cozy atmosphere, the sitting room was preferred for small conversation groups formed by residents.

The welcoming alcove served as a place for impromptu conversation. Residents who entered the building spent some time in the welcoming alcove to check their mail and (or) the activity calendar. Some residents liked to sit in the chairs in the welcoming alcove after entering the house or walking from their room to the welcoming alcove.

There was no social interaction between residents in the kitchen, dayroom, or garden dining areas. Based on the behavior map, it can be concluded that in plan type 2, residents interacted with each other in informal places (the welcoming alcove and sitting room) or places that were centrally located (the parlor and main dining space) (Figure 20).



Figure 20: Observed Social Interactions in Plan Type 2

7.2.3. Observed Social Interaction of Residents in Plan Type 3

Table 11 displays the distribution of residents observed in conversation groups formed only by residents between the spaces of plan type 3. Most of the conversation groups (38.8%) were observed in the dayroom. Located in the center and facing the alley between two buildings, the dayroom was generally enjoyed by many of the residents. With the increased use of the dayroom, the conversations between residents increased.

The bedrooms were in second ranking with 30.6% of the percentage of conversation groups observed. All six of the bedrooms of plan type 2 were semi-private. Generally, the conversations observed in bedrooms were between roommates. The bedrooms were clustered in two groups at the opposite sides of the building. A few of the observations noted conversation groups formed by residents of the same bedroom cluster visiting each other.

Table 11: Distribution of Conversation Groups formed by Residents of Plan Type 3

Plan Type 3 23 Res. & 64 Obs.	Distribution of			
	Residents observed in "Resident only" Conversation Groups		"Resident only" Conversation Groups	
Spaces of Social Interaction	#	%	#	%
Dining Space	10	9.1%	5	10.2%
Bedrooms	30	27.3%	15	30.6%
Dayroom	44	40.0%	19	38.8%
Corridor	4	3.6%	2	4.1%
Outdoor	22	20.0%	8	16.3%
	110	100.0%	49	100.0%

It was observed that 16.8% of the conversation groups were taking place outdoors. All of these conversation groups were observed at the front porch or gazebo between the two buildings that were representative of plan type 3. The patio in the backyard was used by the caregivers and a few of the residents who were smokers, yet conversations between the caregivers and residents were not included in the scope of this paper.

The dining space had 10.2% of the conversation groups formed only by residents. The presence of a sofa, which could seat two people, made the dining room an alternative spot for residents looking for a less crowded space for conversations. Generally residents, who came to call their families from the phone located by the sofa, preferred to sit after their call was over. Residents passing by the dining room came in to talk to the resident who was sitting alone.

A few of the conversation groups (4.1%) were formed in corridors by residents who came across each other while they walked out of their room to go to one of the other rooms or the bathroom.

There was no social interaction between residents in the kitchen. Based on the behavior map, it can be concluded that in plan type 3, residents interacted with each other mostly in the dayroom and dining room, both of which were centrally located. The gazebo, which was also

located in the center of the two buildings, became a space for conversation groups formed by residents of two cases representative of plan type 3 (Figure 21).



Figure 21: Observed Social Interactions in Plan Type 3

7.2.4. Observed Social Interaction of Residents in Plan Type 4

Table 12 displays the distribution of residents observed in conversation groups formed only by residents between the spaces of plan type 4. Most of the conversation groups (32.8%) were observed in the dayroom. The centralized location and its visual connection with the entrance, dining room, and front porch initiated the daily use of the dayroom. Effective use also played a role in the increasing number of conversation groups. The activities associated with conversations were sitting and (or) watching TV.

Table 12: Distribution of Conversation Groups formed by Residents of Plan Type 4

Plan Type 4 23 Res. & 62 Obs.	Distribution of			
	Residents observed in "Resident only" Conversation Groups		"Resident only" Conversation Groups	
Spaces of Social Interaction	#	%	#	%
Dining Space	11	16.9%	5	17.2%
Bedrooms	9	13.8%	4	13.8%
Dayroom*	26	40.0%	9.5	32.8%
Sunroom	3	4.6%	1	3.4%
Corridor	6	9.2%	3	10.3%
Outdoor*	10	15.4%	6.5	22.4%
	65	100.0%	29	100.0%

* indicates that there was a common conversation group which was shared between spaces.

The outdoors areas were ranked second with 22.4% of the conversation groups formed only by residents. There were two main outdoor spaces in plan type 3. The first one was the front porch, which contained 40% of the outdoor conversation groups. The second one was the small patio, which was accessible through the sunroom and the corridor in one of the bedroom clusters, and had 60% of the outdoor conversations.

The dining space had 17.2% of the conversation groups and had the third rank when the number of conversation groups was considered. In fact, when the number of residents observed in conversation groups formed only by residents was considered, the dining room had second ranking. Generally conversation groups contained residents who stayed after or came early for meals. The dining chairs and tables were used by residents who leave their rooms to get a snack or water from the fountain in the dining room. Conversations were observed when they came across another resident(s) who was (were) already in the dining room.

All six bedrooms of the plan type 4 were semi-private and a few of the conversations groups (13.8%) were formed in bedrooms between roommates. The sunroom, which was designed

as an alternative to the dayroom, was a place for only 3.4% of the conversation groups. The sunroom was generally used to access the patio where most of the conversations were observed. The linear layout of the furniture also made this place more like an extension of the dining room, which was more preferred for conversations.

There was no social interaction between residents in the kitchen. Based on the behavior map, it can be concluded that in plan type 4, residents interacted with each other mostly in the dayroom and dining room, both of which were centrally located. Two outdoor areas (porch and patio), one of which (porch) was also located in the center of the building, were spaces for conversation groups formed by residents (Figure 22).

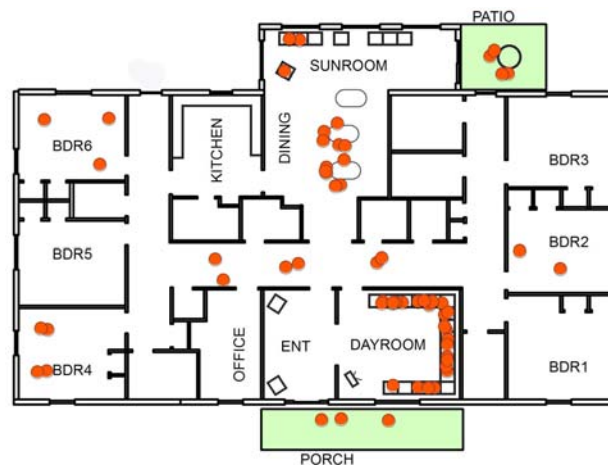


Figure 22: Observed Social Interactions in Plan Type 4

7.2.5. Comparison of Observed Social Interactions as a Use of Space in the Four Plan Types

Conversations, which were observed between residents, were noted as a special use of space that might enhance well-being. The percentages of the number of residents who were observed in conversation groups by considering all the residents in all cycles of observations were calculated for all plan types in Table 13. For both categories of conversation groups (formed only by residents and formed by the household), plan type 3 had the highest percentage of the use of space for social interaction with 23.4% and 16.8% respectively. Whereas, plan type 2 had the lowest percentage of the use of space by residents for social interaction with only 8.0% as calculated by including the number of residents in general

conversation groups. When plan types were ordered by considering the use of space for social interaction for both conversation group categories, the order was (from highest to lowest): Plan type 3 > Plan type 1 > Plan type 4 > Plan type 2.

Table 13: Comparison of Observed Social Interactions as a Use of Space in the Four Plan Types

	Observed Residents		Residents in Conv. Gr.		Residents in "Res. only" Conv. Gr.	
	%	#	%	#	%	#
P.T. 1	100.0%	647	21.2%	137	11.0%	71
P.T. 2	100.0%	549	8.0%	44	4.0%	22
P.T. 3	100.0%	654	23.4%	153	16.8%	110
P.T. 4	100.0%	684	14.0%	96	9.5%	65

?: Percentage of Residents; #: Number of Residents

The spaces of each plan type that were used for social interaction were considered in terms of percentages of their contribution to the total observed social interaction. Table 14 displays the summary of the top three (first one with the highest) spaces used for social interaction in the four plan types. The spaces were selected based on the number of residents observed in each space. The total percentages of the contribution of these three spaces were calculated by considering only the number of residents observed to be in conversation groups formed only by residents and the number of these conversation groups.

Table 14: Comparison of Spaces of Social Interaction in Four Plan Types

		P.T. 1	P.T. 2	P.T. 3	P.T. 4
Spaces of Social Interaction (SoCI)		Bedrooms Dayroom Dining Space	Dining Space Parlor Sitting Room	Dayroom Bedrooms Outdoor	Dayroom Dining Space Outdoor
Observed at SoCI	% Residents in "Res only" Conv. Gr.	95.8%	81.8%	87.3%	72.3%
	% "Res. only" Conv. Gr.	95.8%	77.8%	85.7%	72.4%

The findings, based on the summary table are as follows:

- (1) Plan type 2 and plan type 4 had alternative common areas in different locations of the plan layout for the same functions; this can be described as a decentralized distribution of common areas. These two plan types had fewer percentages of residents in their three most used spaces for social interaction when compared to plan type 3 and plan type 1.
- (2) In plan types 2, 3, and 4 the spaces where most of the social interaction between residents was observed were located in the center of the plan layout.
- (3) In plan type 1 and plan type 3, which did not have any alternative common areas, bedrooms were preferred as an alternative to the dayroom for conversations.
- (4) Outdoor spaces were observed as an alternative to indoor spaces for social interactions in plan types 3 and 4 which had more appropriate weather conditions at the time of the data collection.
- (5) The dining space was observed to be among one of the most preferred spaces. Yet, in plan type 1, the observed number of conversations between residents was very low (4.7%). It was observed that the presence of alternative places around the dining area in both plan types 2 and 4 increased the social interactions observed in the dining space. In both plans, the dining area was centrally located and was located at the intersection of various paths. However, in plan types 1 and 3, although the dining spaces were located at the center of the plan layout, they were not adjacent to alternative spaces.
- (6) No social interactions were observed in the kitchens of the four plan types. The rules of the facilities, which were articulated for plan types 3 and 4, preferred that residents ask for assistance when they needed something from the kitchen. Yet, in the absence of this kind of rule there still was no observed conversation between residents in the kitchens of plan types 1 and 2.
- (7) In terms of the locations of conversation groups, it was noted that seats generally located close to the door, the chairs located at the intersections of the walking paths, and a seat with a height that allowed rising up to be easier were preferred to seats

distant to the door, seats detached from the walking paths, and seats that were low in height.

- (8) The corridors of all four plan types did not make the list of the top three spaces for social interaction since the number of conversation between residents observed in the corridors were very low. Yet, the corridors were used as much as some of the other spaces where an important percentage of the social interaction was observed. This indicates that the corridors had some unused potential for social interaction that can be linked to their institution-like design.

7.3. Results of the Physical and Architectural Checklist (PAF)

The systematic observations provided the objective information related to the use of space and how it served for social interactions between the residents. The spaces with increased use and social interaction were identified using the observed spatial data. Yet, in general, this kind of extensive data collection is not possible for a complex array of reasons that limit the researchers who wanted to assess the environment with the use of checklists.

A physical and architectural checklist, which was explained in detail in Chapter 4, was used to assess the physical environment of the studied plan type cases. Since the cases with the same plan type were identical, only the result of one of these cases was reported. However, all representative buildings (3 for plan type 1, 2 for the other plan types) were considered for the questions that applied to the whole facility, the site planning, and the location.

As a part of the Multiphastic Environmental Procedure (MEAP, Moos and Lemke, 1996), PAF contains 153 scored items and 8 sections to measure 4 different aspects of space. For this study, six of these sections, which covered three different aspects of space, were selected for their relevance. Spaces for resident and staff functions were not included since the sizes of the spaces were considered earlier (Chapter 6) and there was a very limited number of staff. The scores in six of the sections for the studied plan types are presented in Figure 23 and Table, 15.

In the “Community Accessibility” section, the facilities representing plan type 1 and plan type 4 had the same score of 18.8%. Both locations were close to a church but there weren't many activities occurring in local community outside the facility. Located on a main street, the facility that contained representative cases for plan type 3 had a slightly higher score of 25.0%. Yet, none of the three facilities even came close to the facility that contained representative cases of plan type 2, which was a retirement community. In addition to this advantage, the location of the two of the cases representative of plan type 2 were opposite of the health center and close to the main building, which contained various activities. Thus, many of the features (health center, senior center, pharmacy, etc.) asked about in this section were within a walking distance of ¼ miles for plan type 2.

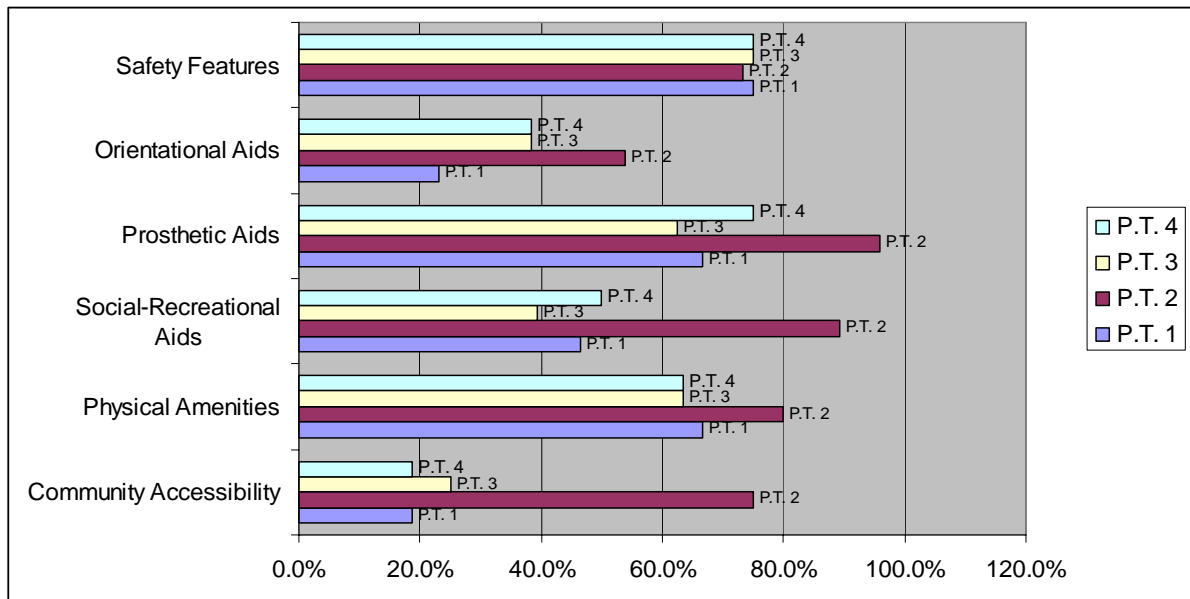


Figure 23: Graph of the Percentage Scores for Each Plan Type for the Selected PAF Sections

Table 15: The Summary of Score Percentages of Plan Types in PAF Sections Selected

What's Measured?	No	Sections	Score Percentages for Plan Types			
			P.T. 1	P.T. 2	P.T. 3	P.T. 4
Degree of Physical Integration	1	Community Accessibility	18.8%	75.0%	25.0%	18.8%
Physical features for comfort and involvement	2	Physical Amenities	66.7%	80.0%	63.3%	63.3%
	3	Social-Recreational Aids	46.4%	89.3%	39.3%	50.0%
Supportive physical features	4	Prosthetic Aids	66.7%	95.8%	62.5%	75.0%
	5	Orientational Aids	23.1%	53.8%	38.5%	38.5%
	6	Safety Features	75.0%	73.3%	75.0%	75.0%
Mean of Score = \sum Section Sc. / 6			49.4%	78.6%	50.6%	53.4%

In the “Physical Amenities” section, plan types 3 and 4 had the same percentage score of 63.3% and plan type 1 had a very close score of 66.6%. With alternative places for different activities plan type 2 had the highest score (80.0%) among all the plan types. In the “Social and Recreational Aids” section, plan type 2 had nearly twice the score of the other facilities by providing various on site amenities that were expected to increase the social life of the residents. Plan types 1, 3, and 4 had small differences in their scores due to their similar coverage of physical amenities. In the “Prosthetic Aids” section, three plan types (plan types 1, 3 and 4) scored relatively close to each other. This was due to a number of matching rules that describe the standards. Yet, by providing some extra prosthetic aids, plan type 2 had nearly a full score.

The “Orientational Aids” section was the second section in which all plan types scored poorly. This was due to the fact that many of the items that were asked in this section were designed by considering larger facilities, such as the presence of color coding in corridors, residents’ ability to find their way around a facility, and the presence of a reception desk.

In the “Safety Features” section, three of the plan types (plan types 1, 3 and 4) had the same score of 75.0%. This was the only section in which plan type 2, which had score of 73.6%, scored less than other plan types. Plan type 2 lost only a few points since the entrance and part of the outdoor area could not be seen from the main living area.

When the mean of the scores was calculated by adding up the results of each section and dividing the result by 6, it was found that three of the plan types (1, 3, and 4) had very close score percentages. Yet, plan type 2 had approximately 1.5 times higher score than the other plan types. When the plan types were ranked from high to low in terms of scores, their order was as follows: Plan type 2 > Plan type 4 > Plan type 3 > Plan type 1.

Considering the results of the PAF and observations, it is obvious that PAF scores were not in parallel with the findings of observations indicating that the presence of a large array of spatial features does not necessarily mean that they were actively used by the residents. Three plan types scored relatively close to each other, yet there were also differences in the use of spaces in these plan types. Thus, evaluations based only on checklists provide only limited information that is independent from the other spatial factors that may play a role in the use of space, such as distances between spaces and the configuration of the space.

7.4. Comparison of the Observations in All Plan Types

The descriptive analysis of the use of spaces in the plan types provided the distribution of use of those spaces in the different plan types. The use of descriptive statistics in the cross comparison of the common spaces of the different plan types provided the order of use of the same type of common space in the different plan types. The use was reported in percentages of residents observed while using those spaces in the plan type and was based on the total number of residents observed during the entire observation. Yet, making an assumption based only on this information will be misleading due to two factors:

- (1) The descriptive comparison was made by considering the summary of all of the observation cycles. However, the difference between each observation cycle, which could be a more accurate indicator of the residents' choice of spending their time, was ignored.
- (2) The descriptive statistics did not indicate whether the differences between the uses of different spaces in the selected plan types were statistically significant.

The observation data (294 behavior maps) and corresponding variables (the number of residents per each space per observation) can be used to run two types of statistical tests for comparison based on how the variables were defined. The number of residents observed in a certain space is a discrete quantitative variable where all the possible values for the number of people increase or decrease one by one. In this study, the number of residents ranges between 6 (the minimum number of resident required to be eligible for this study) and 12 (the maximum number of residents that a facility can be licensed to run). However, if we consider the percentage of the residents observed in a given space, then we assume that the “number of residents” is a continuous variable.

Representative cases of the plan types contained a different number of residents; this required using percentages of residents per space per observation. Yet, using percentages had a disadvantage of overestimating the variable in favor of cases that had fewer residents. For example, if 3 people were observed in one dayroom in one of the plan types that contained 6 residents in total, then this would be 50% of residents using the dayroom. If the same number of residents were observed in the dayroom in another plan type that contained 12 residents, then this would be 25% of the residents.

Using just the number of residents rectifies this bias by comparing the actual number of people observed in the same type of space (e.g., 5 residents in the dayroom of plan type 1 vs. 3 people in the dayroom of plan type 2). However, using the actual numbers of residents for comparison of plan types creates other sorts of problems due to the inequalities of the total number of residents per each representative case. Opposite of the bias resulting from using the percentage of residents, using actual numbers of residents underestimates the use in cases with fewer residents. For example, if two plan types with 6 and 10 residents are to be compared, there is a higher chance that the plan type with more residents will have more residents in considered spaces.

Since, these biases were unavoidable, two methods were considered. The first statistical method, which was used to compare the number of residents per each same space of the four plan types, per observation, is called the Cochran-Mantel-Hansel (CMH) Chi-Square method. The second method was a one way ANOVA, which is the same test that was used to compare survey variables of the four plan types in Chapter 6. Both methods question whether there were at least two plan types that have significant differences between the Y variable tested (Agresti 2002; Agresti and Finlay 1999). SASTM software was used to perform CMH Chi-Square tests and JumpTM software was used to perform ANOVA tests.

(1) Cochran-Mantel-Hansel (CMH) Chi-Square Test: CMH Chi-Square test first categorized the observation data of a particular space of the four plan types according to the frequency of residents. For example, for the dining space, the frequency of residents were calculated in 6 columns indicating that there were 6 categories (0 if no residents were observed, 1 if 1 resident was observed, 2 if 2 residents were observed...5 if 5 residents were observed) (Table 16). Then, a significance test was performed to test whether mean scores for at least two rows were unequal (Agresti, 2002).

Table 16: The Frequency Procedure for the Number of Residents Observed In Dining Spaces

Table of Plan Type by # Residents in Dining							
Plan Type	Number of Residents in Dining						Total
(1) Frequency (2) Percent (3) Row Pct (4) Col Pct	0	1	2	3	4	5	
1	89	6	2	1	0	0	98
	30.27	2.04	0.68	0.34	0.00	0.00	33.33
	90.82	6.12	2.04	1.02	0.00	0.00	
	37.87	16.67	14.29	16.67	0.00	0.00	
2	59	6	3	2	0	0	70
	20.07	2.04	1.02	0.68	0.00	0.00	23.81
	84.29	8.57	4.29	2.86	0.00	0.00	
	25.11	16.67	21.43	33.33	0.00	0.00	
3	45	13	4	1	0	1	64
	15.31	4.42	1.36	0.34	0.00	0.34	21.77
	70.31	20.31	6.25	1.56	0.00	1.56	
	19.15	36.11	28.57	16.67	0.00	100.00	
4	42	11	5	2	2	0	62
	14.29	3.74	1.70	0.68	0.68	0.00	21.09
	67.74	17.74	8.06	3.23	3.23	0.00	
	17.87	30.56	35.71	33.33	100.00	0.00	
Total	235	36	14	6	2	1	294
	79.93	12.24	4.76	2.04	0.68	0.34	100.00

(1) First value in each cell is called **Frequency**: number of occurrence;
(2) Second value in each cell is called **Percent**: frequency / total number of observations;
(3) Third value (if available) in each cell is called **Row Pct**: Frequency / total number of observations for the plan type considered;
(4) Fourth value (if available) in each cell is called **Col Percentage**: Frequency / total number of occurrence in all plan types.

When the CMH Chi-Square test was performed for each of the spaces considered, there were at least two plan types with a significantly different mean of observations for the number of residents observed in the same type of space in different plan types ($p < 0.05$) (Table 17).

Table 17: Summary of Significance Test for the Use of Spaces

	Observation of Residents in__	p value
Use	Dining Spaces	0.0022*
	Kitchen	0.0282*
	Dayroom Spaces	<.0001*
	Bedrooms	<.0001*
	Corridors	<.0001*
	Outdoors	<.0001*

(1) * indicates statistical significance;
 (2) Cochran-Mantel-Haenszel Chi-Square statistical test was performed; (3) The p value was calculated by using Row Mean Score Differences.

Observing significant differences across the uses of plan types with different spatial configurations is parallel to the initial hypothesis of this study. Yet, it will be insufficient to give a decision just based on the CMH-Chi Square test. As mentioned earlier, the difference in the total number of the residents of different plan types was expected to cause a significant difference between the uses of same spaces. If no significant differences were observed between uses of the same space of any of the plan types, then it would have been an unexpected result that might have led to a discussion. Since the result was as expected and might be related to another factor, further analysis will be performed to test the hypothesis of difference in uses of adult care home.

(2) One Way ANOVA: As explained in Chapter 6, the ANOVA test is used for testing the alternative hypothesis that there are at least two plan types that contain residents with a significant difference in means of the variables studied. The mean that was considered in the ANOVA test is called the sample adjusted mean, which is also called the least square mean in SASTM and JumpTM. The sample adjusted mean of Y for a particular group is the prediction equation for that group evaluated at the overall mean of the X values for all the groups (Agresti and Finlay 1999). If a significant difference between the least square means of percentages of residents, who were observed at same type of space, will be found between any of the plan types, then the Tukey-Kramer comparison will be used to define which plan

types have a significant difference. In the following presentation of ANOVA results of each common space; “least square means”, “least square means of percentages”, and “least square percentage of number of residents observed in particular space” were used interchangeably. When least square means of percentages were reported, both (number)% and 0.(number) formats were used (e.g., 85 % can be also noted as 0.85).

7.4.1. Comparison of Percentage of Use of Dining Spaces in the Four Plan Types

The order of the least square means of the percentages of residents observed using the dining space(s) can be seen in Figure 24. The residents of plan type 4 had the highest least square mean percentages of residents in the dining space (0.05, std error: 0.01). Whereas, compared to the other plan types, residents of plan type 1 had the lowest least square mean percentages of residents in the dining space (0.02, std error: 0.0085).

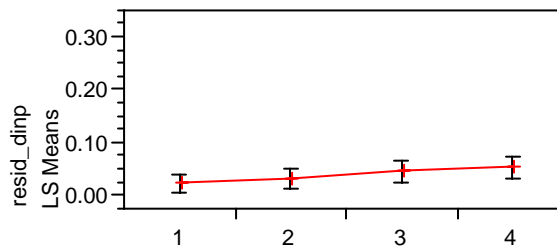


Figure 24: Least Square Means Plot of Percentages of Residents Observed in Dining Spaces

When a significance test was performed (RMSE: 0.084076) by using data from 294 observations performed in the dining spaces of the four different plan types, it was found that the difference in least square means of percentages of dining space uses was insignificant ($p = 0.1049$). Since there weren't any two pairs that had significantly different means, no further comparisons were performed as a follow-up by using the Tukey-Kramer method.

7.4.2. Comparison of Percentage of Use of Kitchens in the Four Plan Types

The order of the least square means of percentages of residents observed using the kitchen can be seen in Figure 25. The residents of plan type 1 had the highest least square mean percentages of residents in the kitchen (0.03, std error: 0.005). Whereas, compared to the

other plan types, residents of plan type 4 had the lowest least square mean percentages of residents in the kitchen (0.004, std error: 0.006).

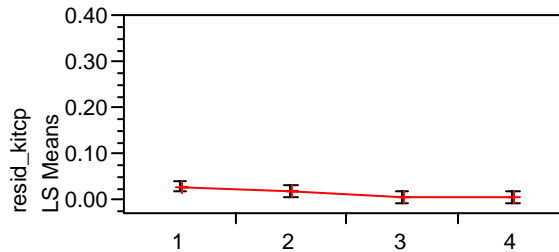


Figure 25: Least Square Means Plot of Percentages of Residents Observed in Kitchens

When a significance test was performed (RMSE: 0.050919) by using data from 294 observations performed in the kitchen of the four different plan types, it was found that there were at least two kitchens with a significantly different least square mean of percentage of residents, per observation ($p = 0.0032$).

The Tukey-Kramer method was used for comparisons of all the pairs of means of percentages of residents observed in the kitchens of the four different plan types. The results showed that the use of the kitchen in plan type 1 (percentage of residents per observation) was significantly different from the use of the kitchens in plan types 3 and 4 (Table 18). Yet, comparisons between pairs that included the least square mean of the percentage of residents observed in the kitchen in plan type 2 and other plan types were insignificant.

Table 18: Least Square Means Differences of Percentages of Residents Observed in Kitchens

Level	Least Sq Mean
1 A	0.02985909
2 A B	0.01870748
3 B	0.00445865
4 B	0.00415445

Levels not connected by same letter are significantly different.

7.4.3. Comparison of Percentage of Use of Dayroom in Four Plan Types

The order of the least square means of the percentages of residents observed using the dayroom can be seen in Figure 26. The dayroom of plan type 4 had the highest use with a least square mean of 29.2% of residents per each observation (std error: 0.02747). Whereas, the dayroom in plan type 1 had the lowest use with a least square mean of only 13.1% of residents per observation (std error: 0.02185).

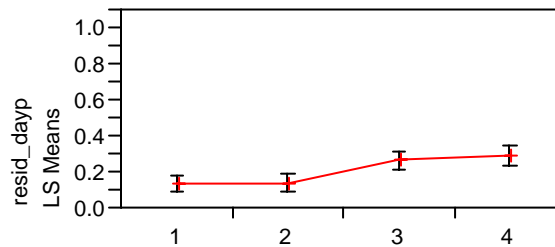


Figure 26: Least Square Means Plot of Percentages of Residents Observed in Dayroom Areas

When a significance test was performed (RMSE: 0.216282) by using data from 294 observations performed in dayroom spaces of the four different plan types, it was found that there were at least two plan types with a significantly different least square mean of percentage of residents in dayrooms, per observation ($p < .0001$).

The Tukey-Kramer method was used for comparisons of all the pairs of means of percentages of residents observed in the dayrooms of the four different plan types (Table 19). The results showed that the differences between the least square means of percentages of residents were insignificant when plan type 3 was compared to plan type 4 and when plan type 2 was compared to plan type 1. Yet, other comparisons between the least square means of plan types from different pairs had significant differences.

Table 19: Least Square Means Differences of Percentages of Residents Observed in Dayroom Areas

Level		Least Sq Mean
4	A	0.29244053
3	A	0.26303267
2	B	0.13694444
1	B	0.13114674

Levels not connected by same letter are significantly different.

7.4.4. Comparison of Percentage of Use of Bedrooms in Four Plan Types

The order of the least square means of percentages of residents observed (or assumed to be) in the bedrooms can be seen in Figure 27. The bedrooms of plan type 2 had the highest use with a least square mean of 79.1% of residents per each observation (std error: 0.02). Whereas, the dayroom of plan type 3 had the lowest use with a least square mean of only 54.1% of residents per observation (std error: 0.03).

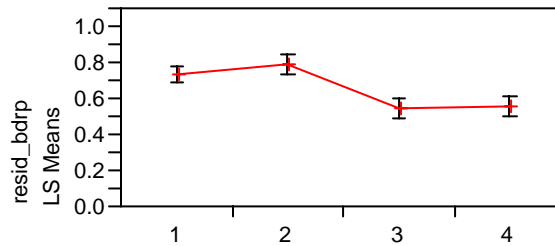


Figure 27: Least Square Means Plot of Percentages of Residents Observed in Bedrooms

When a significance test was performed (RMSE: 0.230566) by using data from 294 observations performed in the bedroom of the four different plan types, it was found that there were at least two plan types with a significantly different least square mean of percentage of residents in bedrooms, per observation ($p < .0001$).

The Tukey-Kramer method was used for comparisons of all the pairs of means of percentages of residents observed (or assumed to be) in the bedrooms of the four different plan types. The results showed that the differences between the least square means of percentages of residents were insignificant when plan type 3 was compared to plan type 4

and when plan type 2 was compared to plan type 1. Yet, other comparisons between the least square means of plan types from different pairs had significant differences (Table 20).

Table 20: Least Square Means Differences of Percentages of Residents Observed in Bedrooms

Level		Least Sq Mean
2	A	0.79091837
1	A	0.73023567
4	B	0.55290811
3	B	0.54248737

Levels not connected by same letter are significantly different.

7.4.5. Comparison of Percentage of Use of Corridors in Four Plan Types

The order of the least square means of percentages of residents observed in corridors can be seen in Figure 28. The corridors of plan type 3 had the highest use with a least square mean of 6.2% of residents per each observation (std error: 0.009). Whereas, the corridors of plan type 2 had the lowest use with a least square mean of only 1.6% of residents per observation (std error: 0.009).

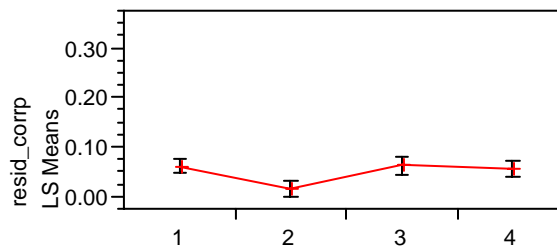


Figure 28: Least Square Means Plot of Percentages of Residents Observed in Corridors

When a significance test was performed (RMSE: 0.070876) by using data from 294 observations performed in the bedrooms of the four different plan types, it was found that there were at least two plan types with a significantly different least square mean of percentage of residents in corridors, per observation (p=0.0002).

The Tukey-Kramer method was used for comparisons of all the pairs of means of percentages of residents observed in the corridors of the four different plan types (Table 21).

The results showed that there were no significant differences between plan types 1, 3, and 4. However, the use of corridors in plan types 2 (least square mean of percentage of residents per observation) was different from the other three plan types.

Table 21: Least Square Means Differences of Percentages of Residents Observed in Corridors

Level	Least Sq Mean
3 A	0.06191209
1 A	0.06016764
4 A	0.05535191
2 B	0.01612812

Levels not connected by same letter are significantly different.

7.4.6. Comparison of Percentage of Use of Outdoors in Four Plan Types

The order of the least square means of percentages of residents observed to be outdoors can be seen in Figure 29. The outdoors of plan type 3 had the highest use with a least square mean of 5.1% of residents per each observation (std error: 0.051). Whereas, there was no use (0.0% of residents per observation) of the outdoors in plan type 2 (std error: 0.008).

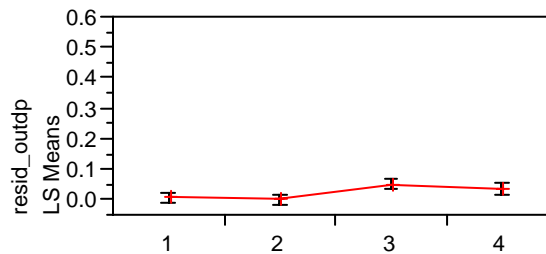


Figure 29: Least Square Means of Plot of Percentages of Residents Observed in Outdoors

When a significance test was performed (RMSE: 0.069462) by using data from 294 observations performed in the outdoors area of the four different plan types, it was found that there were at least two plan types with a significantly different least square mean of percentage of residents in the outdoors area, per observation ($p < .0001$).

The Tukey-Kramer method was used for comparisons of all the pairs of means of percentage of residents observed in outdoors area of the four different plan types (Table 22). The results

showed that there was a significant difference in outdoor use of plan types 3 and 1. There was also a significant difference between plan types 4 and 2 in terms of a least square mean of percentage of residents observed in outdoors areas. Yet, the differences between plan types 3 and 4; plan types 4 and 1; and plan types 1 and 2 were insignificant.

Table 22: Least Square Means Differences of Percentages of Residents Observed in the Outdoor Areas

Level		Least Sq Mean
3	A	0.05105745
4	A B	0.03453079
1	B C	0.00607386
2	C	0.00000000

Levels not connected by same letter are significantly different.

7.4.7. Comparison of Percentage of Residents in Conversation Groups

The order of the least square means of percentages of residents observed to be in conversation groups can be seen in Figure 30. The conversation groups of plan type 3 had the highest participation of residents with a least square mean of 23.2% of residents per each observation (std error: 0.021). Whereas, the conversation groups of plan type 2 had the lowest participation of residents with a least square mean of only 7.05% of residents per observation (std error: 0.020).

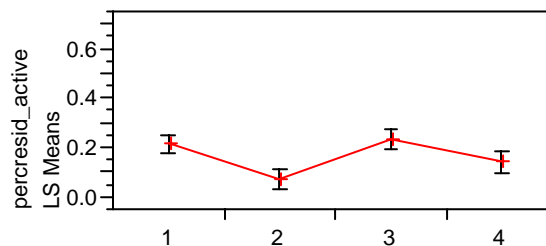


Figure 30: Least Square Means Plot of Percentages of Residents in Conversation Groups

When a significance test was performed (RMSE: 0.169846) by using data from 294 observations of conversation groups in the four different plan types, it was found that there were at least two plan types with a significantly different least square mean of percentage of residents in conversation groups, per observation ($p < .0001$).

The Tukey-Kramer method was used for comparisons of all the pairs of means of percentage of residents observed to be in conversation groups in the four different plan types. The results showed that the differences between the least square means of percentages of residents in conversation groups were insignificant when plan type 3 was compared to plan type 1 and when plan type 2 was compared to plan type 4. Thus, it can be said that plan types 3 and 1; and plan types 4 and 2 can be perceived equally in terms of the percentage of residents observed in conversation groups. However, other comparisons between the least square means of plan types from different pairs had significant differences, indicating that the levels of social interaction of residents of those plan types were different (Table 23).

Table 23: Least Square Means Differences of Percentages of Residents in Conversation Groups

Level		Least Sq Mean
3	A	0.23158539
1	A	0.21386054
4	B	0.14118605
2	B	0.07049320

Levels not connected by same letter are significantly different.

7.4.8. Comparison of Percentage of Residents in Conversation Groups Formed by Residents

The order of the least square means of percentages of residents observed to be in conversation groups that were formed only by residents can be seen in Figure 31. Plan type 3 had the highest percentage of residents in “resident only” conversation groups with a least square mean of 16.6% of residents per each observation (std error: 0.018). Whereas, the conversation groups of plan type 2 had the lowest percentage of residents forming conversation groups with a least square mean of only 3.1% of residents per observation (std error: 0.018).

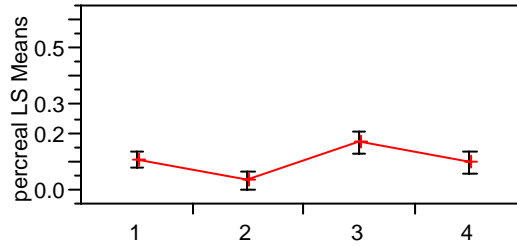


Figure 31: Least Square Means Plot of Percentages of Residents in Conversation Groups Formed by Residents

When a significance test was performed (RMSE: 0.147572) by using data of observed conversation groups during 294 observation cycles in the four different plan types, it was found that there were at least two plan types with a significantly different least square mean of percentage of residents in conversation groups, per observation ($p < .0001$).

The Tukey-Kramer method was used for comparisons of all the pairs of means of percentage of residents observed to be in “resident only” conversation groups in the four different plan types. The results showed that the differences between least square means of percentages of residents in conversation groups were significant when plan type 3 was compared to plan type 4 and when plan type 1 was compared to plan type 2. Yet, other comparisons between the least square means of plan types from different pairs had insignificant differences (Table 24).

Table 24: Least Square Means Differences of Percentages of Residents in Conversation Groups Formed Only by Residents

Level	Least Sq Mean
3 A	0.16604324
1 A B	0.10692420
4 B C	0.09496579
2 C	0.03134921

Levels not connected by same letter are significantly different.

7.4.9. Summary of One Way ANOVA of Percentage of Residents Observed in the Same Type of Spaces of the Four Plan Types

The main hypothesis of this study was that plan types with different spatial configurations lead to differences in use, which may affect well-being outcomes. The difference in spatial

configuration was measured by differences in orders when the common areas of each plan type were ranked according to their integration level. The common areas were defined as the dayroom, kitchen, and dining room. Revisiting the initial hypothesis, observing a statistically significant difference for comparison of at least one of the three common spaces of two plan types will prove the hypothesis. Yet, in order to understand the general use of spaces, the analysis was extended to include the outdoors, corridors, and bedrooms. Extending the number of considered spaces is also helpful to understand how residents of different facilities spent their time during the day.

Conversations were defined as an indicator of social interaction and especially noted as a special use of the space that may influence well-being. The percentage of residents observed in conversation groups formed by the household and formed only by residents was taken as a variable for observed social interaction. The general use of six spaces and the two social interaction types were compared among the four plan types.

Table 25 displays the summary of ANOVA tests done by using the least square means of percentage of residents for each observation. In the CMH-Chi Square test, which was based on the number of residents, at least two of the plan types were found to have different frequencies of use of the dining spaces. Yet, when ANOVA tests were performed as a follow up, there weren't any significant differences between any of the dining spaces of the different plan types.

Table 25: Summary of ANOVA Results of Observations of the Use of Space and Conversations of Residents by Plan Type

	Observation of Residents in__	One Way ANOVA		Order of Least Square Means	Tukey-Kramer			
		p	Root MSE		1	2	3	4
Use	Dining Spaces	0.1049	0.084076	4>3>2>1	A	A	A	A
	Kitchen	0.0032*	0.050919	1>2>3>4	A	AB	B	B
	Dayroom Spaces	<.0001*	0.216282	4>3>2>1	B	B	A	A
	Bedrooms	<.0001*	0.230566	2>1>4>3	A	A	B	B
	Corridors	0.0002*	0.070876	3>1>4>2	A	B	A	A
	Outdoors	<.0001*	0.069462	3>4>1>2	BC	C	A	AB
Social Interaction	Conversation Groups	<.0001*	0.169846	3>1>4>2	A	B	A	B
	Resident Only Conv. Gr.	<.0001*	0.147572	3>1>4>2	AB	C	A	BC

(1) * indicates statistical significance; (2) Root MSE is the estimated standard deviation of Analysis of Variance test; (3) In the Tukey-Kramer summary, each row is independent and the plan types that do not contain any common letters are significantly ($p < 0.05$) different from each other.

Except for the comparison for the dining spaces, all of the comparisons of the least square means of percentage of residents of the same type of spaces resulted in a significant difference ($p < 0.05$). However, the use of all spaces, except the dayroom and bedroom, were low and yet had a significant difference. The plan types that were significantly different from each other in terms of the use of bedrooms and dayrooms were exactly the same. Plan types 3 and 4 had significantly higher uses of the dayrooms and lower uses of the bedrooms. Yet, plan types 1 and 2 had the opposite. Based on this fact, for all plan types, it was more likely for residents to be in the dayroom if they were not in their bedrooms, indicating that the use of other spaces were not preferred.

In a comparison of the social interaction and the number of residents in general conversation groups, there were significant differences between the two groups of plan types (plan types 3 and 1 vs. plan types 4 and 2). When the difference in the least square means of percentages of residents in conversation groups formed only by residents were considered, there were significant differences between three of the six possible pair comparison.

Observing significant differences between the use of five of the six spaces and each of the indicators for social interaction showed that the hypothesis that a difference in spatial configuration leads to a difference in actual use of space and social interaction between residents is accepted at $p < 0.05$ level.

CHAPTER 8: CONCLUSION

The main purpose of this dissertation was to understand the effect of the design of home-like long term care settings on the well-being of its residents. Following the contemporary definition of health, the health and well-being of elderly was conceptualized as their active uses of space and their social interactions with others.

This study tested the hypothesis that the interrelations between spaces (spatial configuration) lead to differences in use and social interaction between people, which may, in turn, affect health and well-being. Nine 12-bed adult care homes were selected as representatives of four plan types. Each plan type was represented by three (for plan type 1) or two (for plan types 2, 3, and 4) buildings with identical plan layouts located at different sites. A configurational analysis was performed by employing Space Syntax theory and application tools to show that the relationships between the common spaces (kitchen, dining room, and dayroom) of each plan type were different.

Based on the main assumptions of the socio-ecological theoretical approach, multiple instruments were employed to deal with the complexity of the studied phenomena. A self administered survey was conducted by caregivers to collect their assessments of the residents with whom they had day to day experience. Systematic observations were performed to objectively collect behavior maps that were used to understand the use of the environment and the social interactions between residents. Spatial distinctions between plan types were extended beyond the initial configurational analysis by including distances that were measured between the residents' bedrooms and common areas (including the outdoors) and syntax values (global, local, and depth) of each resident's bedroom in the analyses.

This chapter will first summarize and discuss the findings; second, build a discussion based on all findings from the surveys and observations; third, include the voices of participants of this study by adding highlights from the interviews; fourth, list the implications to design and

to the theories of care environments; and finally, provide the future prospects for research on home-like care environments.

8.1. The Effect of Walking Distances on Well-being

In this study, walking distance was defined as the actual length of the shortest path between a resident's bedroom and any of the common spaces (including the entrance and the outdoor area). Walking distances were viewed as actual length of the route when all residents of the four plan types were considered. Whereas, perceived walking distances were also added to the variability by assigning a rank to each bedroom according to its proximity to different common areas. Following are the main findings and discussions about actual walking distances:

(1) The observed numbers of conversation groups that were formed only by residents were significantly higher in plan types with significantly shorter walking distances between bedrooms to any or all of the three indoor common areas (dining room, kitchen, and dayroom). (Compare rows 6, 7, 8 to row 23 of Table 1)

(2) The observed numbers of general conversation groups that included residents, caregivers, and visitors were significantly higher in plan types with significantly shorter walking distances between the bedrooms to any or all of the three indoor common areas (dining room, kitchen, and dayroom). (Compare rows 6, 7, 8 to row 22 of Table 1)

(3) The residents' numbers of hours of absences from social events were significantly higher in plan types that had significantly longer walking distances between the entrance of the building and residents' bedrooms. (Compare row 1 to 5 of Table 1)

(4) The residents' numbers of hours of absences from social events were significantly higher in plan types that had significantly longer walking distances between the residents' bedrooms and the dayroom (and/or dining room). (Compare rows 1 to rows 6 and 7 of Table 1, considering the Tukey-Kramer results)

(5) At the scale of a 12-bed home, the differences in use of the common areas can not be explained by the actual distance between the common area and the bedroom. (See differences by comparing rows 5 to 8 with rows 16 to 20 of Table 1)

Table 1: The relationships between the studied variables

row	Data SourceQ	Similarity of Orders				Variables	Importance	p	Order of Least Sq Means	Tukey-Kramer				# Sig. Diff. Gr.		
		1	2	3	4											
1	Survey	Outcomes	S	Q		# Hours of Abs. in Soc. Ev.	✓✓	*	2>4>3>1	C	A	B	AB	3		
2			Q	Q	Q	Social Willingness Sc.	✓✓	*	1>3>2>4	A	B	B	B	2		
3			S			Depression Score	n.f.e.	*	3>4>1>2	B	B	A	A	2		
4			S			# Hours of Outdoor Use	✓	*	3>4>1>2	AB	B	A	AB	2		
5	from Plan Layout	Dist.	S	Q	Q	S	Bedr.-Entrance	✓	*	2>4>3>1	C	A	BC	B	3	
6			Q	S		Bedr.-Dining	✓✓	*	2>4>1>3	C	A	C	B	3		
7			Q	S	Q	Bedr.- Dayroom	✓✓	*	2>4>1>3	B	A	B	A	2		
8			Q	Q	S	Q	Bedr.- Kitchen	✓✓	*	2>4>1>3	B	A	B	B	2	
9		Intg	S	Q		local int	✓✓	*	1>3>4>2	A	D	B	C	4		
10			S	Q		local int. (with ext.)	✓✓	*	1>3>4>2	A	C	B	B	4		
11		Depth	S			Bedr.-Dayroom	✓✓	*	2>4>3>1	D	A	C	B	4		
12			S			Bedr.-Entrance	✓✓	*	2>4>3>1	D	A	C	B	4		
13						Bedr.-Dining	✓	*	2>(3=4)>1	C	A	B	B	3		
14			Q			Bedr.-Outdoors	✓	*	2>(3=4)>1	B	A	B	B	3		
15			Q			Bedr.-Kitchen	✓	*	2>3>4>1	B	A	B	B	2		
16		Observations	Use				S	Dining Spaces	*		4>3>2>1	A	A	A	A	0
17							S	Kitchen	✓	*	1>2>3>4	A	AB	B	B	2
18				S	S		S	Dayroom Spaces	✓✓	*	4>3>2>1	B	B	A	A	2
19					S			Bedrooms	✓✓	*	2>1>4>3	A	A	B	B	2
20					S	Q	Corridors	✓	*	3>1>4>2	A	B	A	A	3	
21				S		Q	Outdoors	✓	*	3>4>1>2	BC	C	A	AB	3	
22	Soc Int.			Q		S	Q	Conversation Groups	✓✓	*	3>1>4>2	A	B	A	B	2
23		Q		S	Q	Resident Only Conv. Gr.	✓✓	*	3>1>4>2	AB	C	A	BC	3		

S: Same order (as is or as in reverse); Q: Quite similar order; ✓✓: Very Important; ✓: Important; *: Not statistically valid; n.f.e.: needs further evidence

(1) * indicates statistical significance; (2) In the Tukey-Kramer summary, each row is independent and the plan types that do not contain any common letter are significantly (p<0.05) different from each other.

The first four main findings highlighted the importance of the walking distances between the bedrooms and the common areas at the scale of 12-bed homes. In fact, there were only a few studies that considered walking distances between common areas and residents' bedrooms at

a nursing home scale in a similar manner. Pinet (1999) observed 960 residents from 5 nursing homes (97% were 65 and older) to determine which spaces were most used. Interviews were conducted with 50 residents and focused on their social space preference. Similar to this study, Pinet (1999) conceptualized social interaction as an indicator of well-being and use of social spaces were assumed to be correlated with the amount of social interaction. The main finding was that residents of nursing homes use social spaces that were closer, primarily because it required less energy to getting to them.

Yet, the findings of this study showed that at the scale of 12-bed homes, walking distances were less determinant of use of space but still played an important role in social interaction. What creates increased social interaction in facilities with shorter walking distances was the amount of increased physical activity. In parallel to this, the order of uses of the corridors of the four facilities was the same as the order of conversation groups observed between household members (both including and excluding residents) of the four plan types.

In the literature, there is enough evidence that residents of larger long term care facilities socialize in corridors (Moos et al. 1984) and encounters between residents due to their movement in the circulation area increase their social interaction (Peatross 1997). However, in the context of this study, this result should be evaluated as an increase in activity of residents around the facility.

The results showed that conversation groups were mostly formed in dayrooms and bedrooms. In plan types 1 and 3, which have shorter walking distances, residents were observed many times walking to the dayroom to check whether anyone was there. Whereas, in other plan types with significantly longer walking distances, residents had fewer numbers of trips between their bedrooms and the dayroom (and other common spaces). More simply, compared to larger facilities that were the setting of the studies mentioned, residents observed in the small scale setting of this study went out of their room more often; this resulted in more encounters in different spaces.

This study also included the possibility of differences in social interaction and use due to the bedroom order or proximity (closest to the..., second closest to the..., most distant from the...) to common areas for each plan type. Yet, this variable was not correlated with any of the outcomes in linear or multiple regression models. This finding is important since it indicated that at this scale, being closest or most distant to one of the common areas did not cause significant differences among the residents of the same plan type or between the residents of different plan types. As a metric variable like distance, the areas of the bedrooms were also not found to be correlated with any other variables that can be evaluated in parallel.

In the universe of the considered spatial and outcomes variables, the distance between bedrooms and the dining room and the kitchen were found to impact residents' absences from social events. According to the regression model, an increase in distance between bedrooms and the dining room lead to an increase in absence from social event. Whereas, an increase in distance between bedrooms and the kitchen decreases absences from social events. In three of the plan types, the dining rooms were the only places that can be used for activities (such as arts and crafts) that required residents to sit around a table. Thus, it was meaningful to observe the dining room in the fitted model. Yet, observing distances between bedrooms and the kitchen in the fitted model was unusual. However, it is also possible that a combined result of the two variables of distance may result in another variable of distance (for example: distance between dayroom and a set of coordinates where residents were most likely to be). Thus, it is inherently important to include spatial statistics in further studies.

8.2. Effect of Non-Metric Variables on Well-Being

The studied non-metric variables were the global integration of plan layouts, global and local integration of bedrooms (including and excluding the effect of the outdoors), and depth values of bedrooms from common areas (including the entrance and the outdoors).

8.2.1. Effect of Configurational Distinctiveness on Well-Being

The difference in configuration of common areas in the four plan types led to significant differences in outcomes (observed frequencies of use and social interaction, reported values of absence from social events, willingness to attend social events, and number of hours of outdoor use). The main hypothesis of this research was accepted at the $p < 0.05$ level indicating that the global integration values of the common areas were the correct choice for a configurational comparison. Yet, it is important here to underline that it was not the value that made a difference but the distinctive spatial configuration of common areas that appear when the common areas were arranged according to their integration level.

When the order of the global integration values of a whole plan type and the common spaces of the plan types were compared to any of the order or least square means, no similarity was observed. This may have two reasons: (1) the number of compared plan types was not enough (only four plan types with 2 to 3 representative cases) and (2) the complexity of the relationships between the variables is beyond the explanation of spatial configuration. However, the result was compatible with a recent study that incorporates syntax variables while measuring the quality of life at different scales of 38 long-term care settings (Hanson and Zako 2005).

8.2.2. Effect of Local Integration and Global Integration Values of Bedrooms

In an effort to include variables of individual differences, bedrooms were defined as a single spatial attribute that may lead to differences not only based on locations, but also with the integration level to the whole system of (convex) spaces. The main findings of the analyses are as follows:

(1) Global integration of the bedrooms was not found to be related to any of the variables, indicating that the differences between the integration levels of bedrooms in the whole system did not play a role in any of the outcomes.

(2) Residents of plan types with locally segregated bedrooms tend to have less absence from social events. (Compare row 1 to row 9 and 10 of Table 1, note that the higher

numerical values for local integration indicates segregation, whereas a smaller value indicates integration)

(3) Residents of plan types with locally segregated bedrooms tend to have more willingness to attend social events. (Compare row 2 to row 9 and 10 of Table 1)

(4) There is also some evidence that local segregation in bedrooms may lead to an increase in social interaction. (Compare rows 1 and 2 to rows 22 and 23 of Table 1)

Local integration was calculated by including the neighboring spaces that surround the bedrooms. Thus, observing relationships between different outcome variables and local integration highlights the importance of the relationship between bedrooms and their neighbors. The results indicated that the segregation of bedrooms, in fact, created more social interaction. In other words, residents of bedrooms that were less integrated with their immediate neighbors were found to be more socially interactive with others. Although this seems to conflict with the main assumption of Space Syntax theory, as Hiller and Hanson (1984) advised for those who will make systematic interpretation based on syntax results:

...trying to see the settlement as an interface between the two kinds of social relations: those among inhabitants and those between inhabitants and strangers. (p: 123)

From this point of view, bedrooms were private areas which, to an extent, should be segregated from the system. This can be perceived as giving the resident a choice to interact with others when he/she wants and to spend time with his/her door open without being bothered by the daily life going on in the facility.

The use of common areas and social interaction may be reduced if bedrooms are segregated from the common areas in larger care facilities. Yet, at the scale considered, the use was found to be independent from the integration level of the bedrooms.

8.2.3. Effect of Depth of Bedroom from Common Areas

In Chapter 6 it was reported that the depth levels of the bedrooms from common areas were associated with absence from social events and a willingness to attend social events. The residents with bedrooms deeper from the common areas were found to have a greater number of hours of absence and in most of the cases, less willingness to attend social events. (Compare rows 11-15 to rows 1-2 of Table 1)

Yet, there was no similarity between residents' uses of spaces of different plans types and the depth values of bedrooms from common areas. This finding is also parallel to the findings of distance, indicating that in this studied scale of long-term care facilities, the depth level was found to be independent from the use.

The contribution of this study to Space Syntax literature is that it shows the syntactic variables of the resident's bedroom as an indicator of well-being. Global and local integration variables were found to be significant indicators of the difference in outcomes in building level by Hanson and Zako (2005). Yet, the importance of local integration of bedrooms in small scale settings was introduced in this study.

8.3. Effect of Alternative Spaces on Use and Social Interaction

Two of the plan types (plan types 2 and 4) contained alternative spaces for the same functions. Plan type 2 had alternative spaces for the dining room and dayroom, whereas plan type 4 only had alternative spaces for the dayroom. Based on the findings:

(1) The presence of alternative spaces significantly increased the walking distances between bedrooms and other common areas. (Compare rows 6, 7, 8 of Table 1)

(2) Increased walking distances in plan types with alternative spaces led to a decrease in the number of observed conversations between residents by decreasing the number of encounters (and other members of the household). (Compare rows 6, 7, 8 to rows 22 and 23 of Table 1)

(3) The presence of alternative spaces reduced the use of the main areas, increased the use of other common areas, or became more dominant than the main space. For example, the use of the dining room in plan type 4 was found to be increased by the presence of the sunroom. In plan type 2, the sitting room attracted residents more frequently than the parlor (second alternative to the dayroom) or the dayroom itself.

In the literature, plan types that offer social spaces (common areas) at the central location of the plan layout are described as a *centralized plan layout*, plan types that offer social spaces in different locations are described as *decentralized plan layouts*. Although there weren't any studies in the context of this study, there's some evidence that centrally located social areas were found to draw more residents (Lawton, et al. 1984). The dayrooms of plan types 3 and 4 were centrally located. Yet, plan types 1 and 2 had dayrooms in different locations than the other common spaces and had less use. The results between the two groups (plan types 3 and 4 vs. plan types 1 and 2) were significant at $p < 0.05$ level.

The definition of decentralization of social spaces was not clear for plan type 1 and plan type 4. However, in the context of the study, the presence of alternative locations for social spaces (centralized vs. decentralized) were found to increase environmental variability by providing different choices of sitting arrangements, furniture, and lighting.

8.4. Revisiting Outcome Variables: A Word of Caution

In this study, the outcome variables were gathered both by employing objective and subjective instruments. In order to check the consistency of responses given in each plan type, each outcome was questioned by at least two variables that, by evidence in the literature or logic, were known to be correlated. Among all the variables, the results related to depression were weak and sometimes contrary to the evidence in the literature. For example, the plan types housing residents with high depression scores were also found to be the plan types where residents had high levels of social interaction (Compare row 3 to row 22, 23 of Table 1). The reasons for this inconsistency were discussed earlier (e.g., the design of the instrument and possible bias due to responses of caregivers, etc.)

The results for the rest of the variables were consistent with each other and the context of the study, indicating a word of caution in the selection of “outcomes” to be tested. Even if the depression scores of residents were observed to be consistent with the other findings, this word of caution on using “pathogenic” indicators of health would have been necessary.

There have been a number of studies in healthcare environments that highlighted the effect of single elements on healing. Even two-well known studies (Ulrich, 1984; and Miller et al. 1995) were subject to criticism (Weber, 1996). Yet, as discussed extensively in the theoretical framework, the relations between the environment and health are complex (Stokols, 1992). Thus, showing a link between one objective variable and health (recovery from surgery in Ulrich, 1984 and weight gain of premature babies in Miller et al.) can also be perceived as an oversimplification of the healing phenomena.

The theoretical discussion built on this finding is beyond the scope of this research. Yet, three proposals were given for those who will study the effect of space on health and well-being that: (1) the complexity of the relationships between the environment and humans should be captured as much as possible; (2) the variables that are selected to be studied should be selected from the objective indicators of a dynamic interaction between the environment and a respondent group; and (3) there should be more than one variable to measure the “same effect of space” to check for consistency.

8.5. Including the Voices of Residents

Interviews with willing residents were the final part of the data collection procedure, which was added to include the residents’ thoughts on their environment. A selection from diverse but mostly shared comments will be presented here to highlight some issues that should be taken into consideration in the design of home-like long-term care settings.

(a) A number of residents mentioned their desire for individual outdoors spaces accessible through their bedroom.

(b) Residents mentioned that it would be better if they have an indoor garden that they can take care of.

(c) Residents with mobility problems and current users of assistive devices, such as walkers and scooters, wanted enough space to leave these items in the house and in outdoor spaces without blocking others.

(d) Most of the residents complained about the lack of storage, yet a few of them mentioned that this is a problem of residents who “did bring too much of their stuff and did not want to scale down.”

(e) In a facility where all of the residents were women, some residents mentioned that they would not be able to leave a shared bathroom in a bathrobe if there were male residents, indicating the need for privacy in the form of extra dry space for dressing in bathrooms.

(f) Some residents indicated that the size of the dayroom (length and width) was too big, the furniture was comfortable to sit in and rise from, and that there weren’t any tables.

(g) Married couples who were living in the same facility had different opinions about sharing their room with their spouses. One couple, who shared the same bedroom, thought that it was necessary to connect two rooms adjacent to each other so that they could have a “living room and bedroom”. Yet, the other couple thought that due to differences in health conditions, it was best if they had shared rooms. These two different views underline the need for bringing flexibility in design to deal with similar situations after the completion of design.

(h) Residents who were in shared bedrooms brought up the issue of their need for a larger space.

(i) Residents of facilities without alternative spaces indicated that they needed spaces where they could be alone. However, some residents of facilities with alternative spaces indicated that they were not using most of the designed space.

As it can be seen, some of the residents’ comments conflict with issues of control, such as direct access to the outdoors from bedrooms. Yet, some of them were really a matter of including the needs of elderly people in the design. In either case, the design process that

integrates planning, programming, and design can serve to resolve conflicts and create better solutions.

8.6. Implications of this Study to Design of Home-like Long Term Care Settings

Designing a home-like long term care setting is a challenging task, yet often perceived as simpler. Easily moveable and replaceable elements in architecture are called non-fixed features of spaces, which designers rely on to create a home-like atmosphere (see Hall 1961, and Rapoport 1984 for further review). It is generally taken for granted that a preference of material, such as lighting fixtures and furniture with warm character, would create a home-like environment.

However, this study showed that, in fact, the home-likeness of a facility is related to:

- (1) The distances between residents' bedrooms and common spaces, including the outdoors;
- (2) The interrelations between the common spaces and bedrooms (spatial configuration); and
- (3) The number and location of common areas.

These factors are called semi-fixed features of space and are related to primary design decisions. It requires a much greater effort to change and, in some cases, some of these decisions are reversible only by large amounts of construction work.

What is expected from a home-like facility are residents with increased activity and social interaction. This study found that even at the scale of 12 bed facilities, the semi-fixed features of space make a difference in the daily lives of the elderly. This, in turn, may affect their well-being. Thus, it is less likely for similar outcomes to be observed by only the presence of home-like interior design elements, which are generally non-fixed features of space.

The following items should be considered in the design of small scale home-like long-term care settings:

(1) Reducing the distance between the bedrooms and common spaces is always important, regardless of the size of the facility.

(2) Locating common areas centrally, preferably with equal distances to all residents.

(3) Considering isolation (a problem at larger scales), which reverses in small scale long-term care settings. In this study, segregation from neighboring spaces was found to be a factor that increased the residents' level of social interaction. Thus, locating bedrooms to provide segregation from the adjacent neighbors is essential to minimize the outer discomforts due to the level of activity at the small scale.

(4) Promoting diversity in use by offering alternative areas without increasing the distance. Promoting diversity in design shouldn't be perceived as increasing the number of spaces by providing dedicated spaces for the same function but rather, giving residents diverse choices in a small numbers of common areas.

In general, the design of the long-term care facilities can be followed by applying the scale of macro, mezzo, and micro scales of ecology to build the environment and provide meaningful transitions between these three.

For example, if the building (including the outdoors) is perceived at the macro scale, then a group of spaces with similar functions (bedrooms and common areas) can be perceived as the mezzo scale and each individual space falls in the micro scale. If a particular group of spaces (bedrooms or common area) is perceived at the macro scale, then the micro scale gets down to the level of furniture arrangements. It is also possible to consider each room as a macro scale and get down to the scale of each individual component of the room (furniture, light fixtures, etc.).

What is important is to have a consistency in applying the basic principle in each step, regardless of the determined macro scale. Consistency is important so that a shift between scales does not cause the design decisions to conflict with each other in terms of neutralizing the positive outcomes of one another. There will always be trade-offs in design decision

making but identifying the priorities before the decision making occurs is what will make the difference in outcomes.

8.7. Future Prospects

The findings of this study are limited to the range of the included variables and the studied context. Yet, a recent study proposed the future development of 12-bed units for various reasons (Rabig et al. 2006), which underlines the fact that results of this study may provide insights for the future concepts innovated from The Green House Project as well as the traditional examples.

As discussed earlier, home-likeness of a long term care environment is limited by primary design decisions, such as scale and spatial configuration. As scale increases and the number of relationships between spaces increases in complexity, the home-like qualities of the space will start to fade. Yet, it is important to define the reduction in well-being outcomes as the scale increases. There has been a comparison between nursing homes and assisted living facilities of the same scale. Thus, following the effect of the spatial factors that were outlined in this research in smaller or larger facilities will help to build research-based criteria to assess facilities of different scales, in terms of their contribution to residents' well-being. In this study, the effect of interior design elements was found to have less of an impact when compared to spatial configuration. Yet, it is also important to investigate the outcomes of different options of home-like design features on the building and place attachment in residents by controlling the other spatial variables.

There are three main inter-connected major challenges that await future studies with a similar research agenda in the longer run:

First, there is a need for hard data to effectively lead the market trends from “what sells” to “what is good”. This requires adoption of analytic theories and objective data collection instruments.

Second, there is a need for collaborating with other fields for design researchers to deal with the complexity of studying the effect of space on health and well-being of a particular group. There is a whole new field of ubiquitous computing technology –*ubicomp*, which is defined as a method for enhancing computer use by making many computers available though the physical environment, while making them effectively invisible to the user (Weiser and Brown, 1996). Such environments will be aware of the activities performed within it and will be capable of supporting these activities without increasing the cognitive load on the users of the space (Essa, 1999). Also there is a growing body of research on defining people with cognitive impairments as beneficiaries of this technology (Mynatt, et al. 2002; Morris, et al. 2003). The use of this technology and collaborating with computer science will provide the hard data that is hard to obtain via traditional methods.

Third and last, there is a need for advocacy for design research. Architecture, as a profession, traditionally spends no time on understanding the results of the design decisions. In the case of home-like long term care environments, it's a shared responsibility of the community of design researchers and designers to provide a better quality of life for the elderly in their golden years.

REFERENCES

- Agresti, A. and Finlay, B. 1999. *Statistical Methods for Social Sciences*. New Jersey: Prentice Hall.
- Agresti, A. 2002. *Categorical Data Analysis*, 2nd ed. New York: Wiley.
- Altman, I. 1975. *The Environment and Social Behavior*. Monterey: Brooks/Cole Publishing Company.
- Altman, I., Lawton, M. P., and Wohwill, J. F. 1986. *Elderly people and the environment*. New York: Plenum Press
- Altman, I. and Werner, C. M. 1986. *Home environments*. New York: Plenum Press.
- American Association of Retired Persons Public Policy Institute. 2004. "Assisted Living in the United States" by Bernadette Wright. <www.aarp.org/ppi> (March 2006).
- American Psychological Association. 1994. *Diagnostic and statistical manual of mental disorders*, 4th ed. Washington: American Psychiatric Press.
- Antonovsky, A. 1979. *Health, Stress, and Coping*. San Francisco: Jossey-Bass Publishers.
- Antonovsky, A. 1987. *Unraveling the Revealing the Mystery of Health*. San Francisco: Jossey-Bass Publishers.
- Antonovsky, A. 1990. "Studying health vs. studying disease." Lecture presented at the Congress for Clinical Psychology and Psychotherapy. Berlin, Germany, February 19, 1990. <www.angelfire.com/ok/soc/aberlim.html> (August 2005).
- Antonovsky, A. 1996. A salutogenic model as a theory to guide health promotion. *Health Promotion International* 11 (1): 11-18.
- Antonovsky, A. 1998. "Salutogenic approach to aging." Lecture presented at University of California at Berkley. Berkley, U.S., January 21, 1993. Salutogenesis: The Sense of Coherence Newsletter 07 March 1998. <www.ensp.unl.pt//sosabogac/default.asp?send=a_comunica/a_berkeley.html> (August 2005).
- Barker, R. G. 1968. *Ecological Psychology: Concepts and Methods for Studying the Environment of Human Behavior*. Stanford: Stanford University Press.

- Barnes, S., McKee, K., Morgan, K., Parker, C., Torrington, J., and Tregenza, P. R. 2002. The design of caring environments and the quality of life of older people. *Ageing and Society* 22: 775-789.
- Bayo, M. V., Garcia, A. M., and Garcia, A. 1995. Noise levels in an urban hospital and workers' subjective responses. *Archives of Environmental Health* 50: 247-251.
- Beck, A. T. and Steer, R. A. 1987. *Manual for the revised Beck depression inventory*. San Antonio: Psychological Corporation.
- Benya, J. 1989. Lighting for healing. *Journal of Healthcare Interior Design* 1: 55-58.
- Bruck, L. 1997. Welcome to Eden. *Nursing Homes* 46 (1): 28.
- Canter, D. and Canter, S. 1979. *Designing for Therapeutic Environments: A review of Research*. New York: John Wiley & Sons.
- Carp, F. M. and Carp, A. 1984. "A complementary/congruence model of well-being or mental health for the community elderly." In *Human Behavior and the Environment: The elderly and the physical environment*, edited by I. Altman, M. P. Lawton, and J. Wohwill, 279-336. New York: Plenum Press.
- Carpman, R. J. and Grant, M. A. 1993. *Design that cares: Planning health facilities for patients and visitors*. Chicago: American Hospital Publishing.
- Centers for Medicare & Medicaid Services. 2002. "Medicare Current Beneficiary Survey." <www.cms.hhs.gov/apps/mcbs/PubCNP02.asp> (February 2004).
- Christ, P. 1999. Does quality of life vary different types of housing among other persons? A pilot Study. In *Aging in Place*, edited by E. D. Taira and J. L. Carison, 101-116. New York: Haworth Press.
- Cohen, S., Evans, G. W., Stokols, D., and Krantz, D. S. 1986. *Behavior, health and environmental stress*. New York: Plenum Press.
- Cohen, U. and Weissman, G. D. 1991. *Holding to home: Designing environments for people with dementia*. Baltimore: John Hopkins University Press.
- Cutchin, M. P., Chang, P. F., and Owen, S. V. 2005. Expanding Our Understanding of the Assisted Living Experience. *Journal of Housing for the Elderly* 19 (1).
- Cvitkovich, Y. and Wister, A. 2001. A comparison of Four Person-Environment Fit Models Applied to Older Adults. *Journal of Housing for the Elderly* 14 (1): 1-25.

- Davidson, A., Teicher, M. H., and Bar-Yam, Y. 1997. The role of environmental complexity in the well-being of elderly. *Complexity and Chaos in Nursing* Summer: 5-12.
- De Syllas, J. 1989. "Aesthetic order and spatial disorder in children's home." Master's thesis, University of London.
- De Syllas, J. "Domestic Asylum: A study of eleven local authority hostels for mentally handicapped people." Paper presented at the Second International Space Syntax Symposium. Brasilia, Brazil, April 1999.
- Devlin, A. S. and Arneil, A. B. 2003. Healthcare environments and patient outcomes: A review of the literature. *Environment and Behavior* Vol. 35 (5): 665-694.
- Dilani, A. 2001. "Psychosocially supportive design: Scandinavian healthcare design." In *Design and Health: The Therapeutic Benefits of Design*, edited by A. Dilani. Stockholm: Swedish Building Council Center.
- Essa, I. 1999. "Ubiquitous Sensing for Smart and Aware Environments: Technologies towards the building of an Aware Home." Position Paper for the DARPA/NSF/NIST Workshop on Smart Environments.
- Federal Interagency Forum on Aging-Related Statistics. 2000. *Older Americans 2000: Key Indicators of Well-Being. Federal Interagency Forum on Aging-Related Statistics*. Washington, DC: U.S. Government Printing Office.
- Firestone, I. J., Lichtman, C. M., and Evans, R. J. 1980. Privacy and solidarity: effects of nursing home accommodation on environmental perception and social preferences. *International Journal of Aging and Human Development* 11 (2): 229-241.
- Friedman, E. P. 1966. Spatial proximity and social interaction in a home for the aged. *Journal of Gerontology* 21 (4): 566-570.
- Golant, S. M. 1998. "Changing an older person's shelter and care setting: A model to explain personal and environmental outcomes." In *Environment and aging theory: A focus on housing*, edited by R. J. Scheidt and P. G. Windley, 33-60. Westport: Greenwood Press.
- Gubrium, J. 1975. *Living and Dying at Murray Manor*. New York: St. Martins Press.
- Guralnik, J. M., Yanagishita, M., and Schneider, E. L. 1988. Projecting the older population of the United States: Lessons from the past and prospects for the future. *Milbank Quarterly* 66, 283-308.
- Hall, E. T. 1966. *The Hidden Dimension*. Garden City: Doubleday.

- Hall, E. T. 1969. *Handbook of Proxemic Research*. Washington: Society for the Anthropology of Visual Communication.
- Hanson, J. 1998. *Decoding Homes and Houses*. Cambridge: Cambridge University Press.
- Hanson, J. and Zako, R. "Configuration and Design in Caring Environments: Syntax and quality of life in a sample of residential care homes for older people." Paper presented at the Fifth International Space Syntax Symposium. Delft, Holland, June 2005.
- Hawley, A. H. 1950. *Human Ecology: A Theory of Community Structure*. New York: Ronald Press.
- Helmes, E., Csapo, K.G., Short, J. A. 1987. Standardization and validation of the Multidimensional Observational Scale for the Elderly Subjects (MOSES). *Journal of Gerontology* 42: 395-405.
- Hetzel, L. and Smith, A. 2001. *The 65 years and over population: 2000*. Washington, D.C: U.S. Bureau of the Census. <www.census.gov/prod/2001pubs/c2kbr01-10.pdf>.
- Hill, R. D., Thorn, B. L., Bowling, J., and Morrison, A. 2002. *Geriatric Residential Care*. New Jersey: Lawrence Erlbaum Publishers.
- Hillier, B. and Hanson, J. 1984. *The Social Logic of Space*. Cambridge: Cambridge University Press.
- Hilton, B. A. 1985. Noise in acute patient care areas. *Research in Nursing and Health* 8: 283-291.
- Holahan, C. J. 1972. Seating patterns and patient behavior in an experimental dayroom. *Journal of Abnormal Psychology* 80: 115-124.
- Hollingberry, R. 1993. *Multipurpose Centres for the Elderly people*. London: The Helen Hamlyn Foundation.
- Intel Corporation. 2003. "Ubiquitous Computing for Cognitive Decline: Findings from Intel's Proactive Health Research" by Margaret Morris and Jay Lundell.
- Jones, D.C. 1975. Spatial proximity, interpersonal conflict, and friendship formation in the intermediate care facility. *The Gerontologist* 15 (2): 150-154.
- JUMPTM User Guide 2005. SAS Institute Inc., Cary, NC.

- Kahana, E. 1982. "A congruence model of person-environment interaction." In *Aging and the environment: Theoretical approaches*, edited by M. P. Lawton, P. G. Windley, and T. O. Byerts, 97-121. New York: Springer.
- Kahana, E., Lovegreen, L., Kahana, B., and Kahana, M. 2003. Person, environment, and person-environment fit as influences on residential satisfaction of elders. *Environment and Behavior* 35 (3): 434-453.
- Kane, R. A. 2003. "Studying Green Houses: The predicted benefits and costs of dramatically changed nursing home care." <<http://thegreenhouseproject.com/kane/pdf>> (June 2006).
- Kepez, O. 2005. "Environment and Gerontology: Evaluation of environment and behavior theories in aging and their potential applications for Turkey." Paper presented at the 1st International Gerontology Symposium in Turkey. Antalya, Turkey, May 10-12, 2005.
- Kolanovski, A. M. 1992. The clinical importance of environmental lighting to the elderly. *Journal of Gerontological Nursing* 18: 10-14.
- Koncelik, J. A. 1972. "Considerate design and the aging: Review article with a selected bibliography." In *Index to Council of Planning Librarians Exchange Bibliographies*, edited by M. Vance. Monticello: Illinois.
- Lang, J. 1987. *Creating Architectural Theory*. New York: Van Nostrand Reinhold.
- Lawrence, R. J. 2002. Healthy Residential Environments. In *Handbook of Environmental Psychology*, edited by R. B. Bechtel, A. Churchman, Chapter 26, 394-412. New York: John Wiley & Sons, Inc.
- Lawton, M. P. and Brody, E. M. 1969. Assessment of older people: Self maintaining and instrumental activities of daily living. *Gerontologist* 9: 179-185.
- Lawton, M.P. 1970. Planning environment for older people. *Journal of the American Institute of Planners* 36: 124-129.
- Lawton M. P., Liebowitz B., Charon H., 1970. Physical structure and the behavior of senile patients following ward remodeling. *Aging and Human Development* 1: 231-239.
- Lawton, M. P. and Namehow, L. 1973. "An ecological theory of adaptive behavior and aging." In *The psychology of the adult development and aging*, edited by C. Eisdorfer and M. P. Lawton, 657-667. Washington: American Psychological Association.

- Lawton, M. P. 1979. "Therapeutic Environments for the Aged." In *Designing for Therapeutic Environments*, edited by D. Canter and S. Canter. John Wiley and Sons, New York.
- Lawton, M. P. 1980. Housing the elderly: Residential quality and residential satisfaction among the elderly. *Research on Aging* 2: 309-328.
- Lawton M. P., Fulcomer, M. and Kleban, M. H. 1984. Architecture for the mentally impaired elderly. *Environment and Behavior* 16 (6): 730-757.
- Lawton, M. P. 1987. "Aging and proactivity in the residential environment." Paper presented at the annual meeting of the American Psychological Association. New York, NY, September 1, 1987.
- Lawton, M. P. 1990. Aging and performance of home tasks. *Human Factors* 32 (5): 527-536.
- Lawton M. P., Weisman G. D., Sloane P., and Calkins M. 1997. Assessing environments for older people with chronic illness. *Journal of Mental Health and Aging* 3: 83-100.
- Lawton, M. P. 1998. "Environment and aging: Theory revisited." In *Environment and aging theory: A focus on housing*, edited by R. J. Scheidt and P. G. Windley, 1-31. Westport: Greenwood Press.
- Lawton M. P. 2001. "Designing by degree: Assessing and incorporating individual accessibility needs." In *Universal Design Handbook*, edited by W. F. E. Preiser and E. Ostroff, Chapter 7, 7.1-7.13. New York: McGraw-Hill.
- Leather, P., Beale, D., and Santos, A. 2003. Outcomes of environmental appraisal of different hospital waiting areas. *Environment and Behavior* 35 (6): 842-869.
- Lewin, K. 1951. *Field theory in social science: Selected theoretical papers*. Edited by D. Cartwright. New York: Harper & Brothers.
- Liebovitz, B., Lawton, M. P., and Waldman, A. 1979. Evaluation: Designing for confused elderly people. *American Institute of Architect Journal* February: 59-61.
- Lingaert, L., Rapson, D., Lagman, R. 2002. *Towards development of universal design guidelines for long-term care health facilities*. Winnipeg: Universal Design Institute, University of Manitoba.
- Long-Term Care National Resource Center at UCLA/USC. 1989. *Assisted Living Resource Guide*. Los Angeles: Long Term Care National Resource Center at UCLA/USC.

- Mace, R. L. Hardie, G. J. and Place, J. P. 1991. "Accessible Environments: Toward Universal Design." In *Innovation by Design*, edited by W. E. Preiser, J. C. Vischer, and E. T. White. New York: Van Nostrand Reinhold.
- Manton, K. G. 2001. *Aging and Health in Old Age. International Encyclopedia of the Social & Behavioral Sciences*. Oxford: Elsevier Science Ltd.
- Marcus, C. C. and Barnes, M. 1999. "Acute care hospitals: case studies and design guideline." In *Healing Gardens: Therapeutic benefits and design recommendations*, edited by C. C. Marcus and M. Barnes, 157-234. New York: John Wiley.
- Martin, D. P., Hunt, J. R., Conrad, D. A. 1990. The planetree model hospital project: An example of the patient as partner. *Hospital and health services administrator* 35: 591-601.
- Marsden, J. P. 1999 Older person's and family members; perceptions of homeyness in assisted living. *Environment and Behavior* 31 (1): 81-104.
- Maslow, A. 1954. *Motivation and Personality*. New York: Harper and Row.
- Miller, C. L., White, R., Whitman, T. L., O'Callagan, M. F., and Maxwell, S. E. 1995. The effects of cycled versus noncycled lighting on growth and development in preterm infants. *Infant Behavior and Development* 18: 87-95.
- Miller, D. B. and Beer, S. 1977. Patterns of friendship among residents in a nursing home setting. *The Gerontologist*. 17 (3): 269-275.
- Mitchell, J. M. and Kemp, B. J. 2000. Quality of life in assisted living homes: A multidimensional analysis. *The Journals of Gerontology Series B* 55, 117-127.
- Moos, R. H. and Lemke, S. 1980. Assessing the physical and architectural features of sheltered care settings. *Journal of Gerontology*. 35 (4): 571-583.
- Moos, R. H., David, T. G., Lemke, S., and Pastle, E. 1984. Coping with and intra-institutional relocation: Changes in resident and staff behavior patterns. *The Gerontologist* 24 (5): 494-502.
- Moos, R.J. and Lemke, S. 1996 *Evaluating residential facilities*. Thousand Oaks: Sage.
- Mynatt, E. D. and Rogers, W. A. 2002. Developing technology to support the functional independence of older adults. *Ageing International* 27: 24-41.
- Namazi, K.; Chafetz, P. K. 2001. *Assisted Living: Current Issues in Management and Residential Care*. London: Auburn House.

- National Center for Assisted Living. 2001. "Facts and Trends: The Assisted Living Sourcebook." <www.ahca.org> (June 2005).
- Nesmith, E. L. 1995. *Health care architecture: Design for the future*. Washington DC: The American Institute of Architects Press.
- North Carolina Department of Health and Human Services. 2005. *Rules 10A NCAC 13F For Adult Care Homes for Seven and More Beds*. North Carolina Department of Health and Human Services Division of Facility Services Adult Care Licensure Section.
- Osmond, H. 1959. "The relationship between Architect and Psychiatrist." In *Psychiatric Architecture*, edited by Charles Goshen. Washington: American Psychiatric Association.
- Park, R. and Burgess, E. (Eds) 1925. *The City*. Chicago: University of Chicago Press.
- Parker, C., Barnes, S., Morgan, K., Parker, C., Torrington, J., and Tregenza, P. R. 2004. Quality of life and building design in residential and nursing homes for older people. *Ageing and Society* 24: 941-962.
- Peatross, F. D. 1994. The Spatial dimensions of control in restricted settings. Ph.D. diss., College of Architecture, Georgia Institute of Technology.
- Peatross, F. D. "The Spatial Dimension of Control in Restrictive Settings." Paper presented at the First International Space Syntax Symposium. London, United Kingdom, April 1997.
- Pinet, C. 1999. Distance and Use of Social Space by Nursing Home Residents. *Journal of Interior Design* 25 (1): 1-15.
- Preiser, W. 2001. "Toward universal design evaluation." In *Universal Design Handbook*, edited by W. Preiser and Ostroff, E. New York: McGraw-Hill
- Porter, M. E. and Teisberg, E. O. 2006. *Redefining Health Care: Creating Value-Based Competition on Results*. Boston: Harvard Business School Press.
- Rabig, J. R., Thomas, W., Kane, R. A., Cutler, L. J., and McAlilly, S. 2006. Radical Redesign of Nursing Homes: Applying the Green House Concept in Tupelo, Mississippi. *The Gerontologist* 46 (4): 533-539.
- Regnier, V. 1994. *Assisted living housing for the elderly*. New York: Van Nostrand Reinhold.

- Retsinas, J. and Garrity, P. 1985. Nursing home friendship. *The Gerontologist* 25 (4): 376-381.
- Robinson, J., Gruman, C., Gaztambide, S., and Blank, K. 2002. Screening for depression in middle-aged and older Puerto-Rican primary care patients. *Journal of Gerontology: Biological Sciences and Medical Science* 57: 308-314.
- Rogers, W. A., Meyer, B., Walker, N., and Fisk, A. D. 1998. Functional limitations to daily living tasks in the aged: A focus group analysis. *Human Factors* 40 (1): 111-125.
- Rosen, G. 1993. *A history of public health*. Baltimore: John Hopkins University.
- Sanoff, H. 1991. *Visual Research Methods in Design*. New York: Van Nostrand Reinhold.
- SAS™ User Guide 2003. SAS Institute Inc., Cary, NC.
- Schwarz, B. and Brent, R. 1999. *Aging, Autonomy, and Architecture*. Baltimore: John Hopkins University Press.
- Schwarz, B and Brent, R. 2001, The Architectural Metamorphosis of Long-Term Care Settings. *Journal of Architectural Planning Research* 18 (3): 225-269.
- Schwarz, B., Chaudhury, H., and Tofle, R. B. 2004. Effect of Design Interventions on a Dementia Care Setting. *American Journal of Alzheimer's Disease and Other Dementia* 19 (3): 172-176.
- Sherwood, S. 1975. "Long term care: Issues, perspectives and directions." In *Long term care: A handbook for Researchers, Planners and Providers*, edited by S. Sherwood. New York: Spectrum Publications.
- Sheikh, J. I. and Yesavage, J. A. 1986. "Geriatric Depression Scale (GDS) recent evidence and development of a shorter version." In *Clinical gerontology: A guide to assessment and intervention*, edited by T.L. Brink, 165-173. New York: Haworth Press.
- Sommer, R. and Ross, H. 1958. Social interaction on a geriatric ward. *International Journal of Social Psychiatry* 4: 128-133.
- Sommer, R. 1969. *Personal Space: The Behavioral Basis of Design*. New Jersey: Prentice-Hall, Inc.
- Sonit, B. 2003. Space Syntax: A Brief Introduction to Its Logic and Analytical Techniques. *Environment and Behavior* 35 (1): 17-29.

- Steinfeld, E. and Danford, S. G. 1999. *Enabling Environments*. New York: Plenum Publishers.
- Sterner, M. 1998. Notes from an Eden Alternative pioneer. *Nursing homes* 47 (1): 5.
- Stokols, D. 1992. Establishing and Maintaining Healthy Environments. *American Psychologist* 47 (1): 6-22.
- Tavormina, C. E. 1999 Embracing the Eden Alternative in long-term care environments. *Geriatric Nursing* 20 (1): 58-161.
- Thomas, W. H. 1996. *Life is worth living: How someone you love can still enjoy life in a nursing home: The Eden Alternative in action*. Boston: VanderWyk & Burnham.
- Ulrich, R. S. 1984. View through a window may influence recovery from surgery. *Science* 224: 420-421.
- Ulrich, R. S. 1991. Effects of interior design on wellness: Theory and recent scientific research. *Journal of Healthcare Interior Design* 3: 97-109.
- Ulrich, R. S. 1999. "Effects of gardens on health outcomes: theory and research." In *Healing Gardens: Therapeutic Benefits and Design Recommendations*, edited by C. C. Marcus and M. Barnes. New York: John Wiley.
- Ulrich, R. S. 2000. "Evidence based environmental design for improving medical outcomes." In proceedings of the conference, Healing by Design: Building for Health Care in the 21st Century. Montréal: McGill University Health Centre.
- Ulrich, R. S. 2001. "Effects of healthcare environmental design on medical outcomes." In *Design and health: The Therapeutic Benefits of Design*, edited by A. Dilani. Stockholm: Swedish Building Council Center.
- Ulrich, R. S., Simons, R. F., Miles, M. A. 2003. Effects of environmental simulations and television on blood donor stress. *Journal of Architectural Planning Research* 20 (1): 38-47.
- Ulrich, R. and Zimring, C. 2004. "The Role of Physical Environment in the Hospital of the 21st century: A Once-In-a-Lifetime Opportunity." <www.rwjf.org/publications/publicationsPdfs/> (October 2004).
- Verderber, S. and Fine, D. J. 2000. *Healthcare architecture in an era of radical transformation*. New Haven: Yale University Press.
- Weber, D. O. 1996. Life-enhancing design. *The Healthcare Forum Journal* 39: 3-11.

- Weiser, M. and Brown, J. S. 1996. Designing Calm Technology. *PowerGrid Journal* 1.01. <<http://powergrid.electriciti.com/1.01>> (July 1996).
- Willis, S. L. 1996 Everyday problem solving. In *Handbook of psychology of aging*, 4th ed. edited by J. E. Birren and K. W. Schaie, 287-301. San Diego: Academic Press.
- Wilson, K. B. 1990. *Assisted Living: The merger of housing and long-term services. Long-term Care Advances*. Durham: Duke University Center for the Study of Aging and Human Development.
- Witzius, F., Gamber, S. and Dustine, E. 1981 Importance of residence placement within a skilled nursing facility. *Journal of the American Geriatrics Society* 29 (3): 418-421.
- Wister, A. W. 2005. The built environment, health and longevity: Multi-level salutogenic and pathogenic pathways. *Journal of Housing for the Elderly* 19 (2): 49-70.
- World Health Organization. 1946. Health Promotion: A discussion document on the concept and principles. *Health Promotion* 1: 73-76.
- Yesavage, J. A. and Brink, T. L. 1983. Development and validation of geriatric depression scale: A preliminary report. *Journal of Psychiatric Research* 17 (1): 37-49.
- Yin, R. 1994. *Case Study Research: Design and Methods*, 2nd ed. Thousand Oak: Sage.
- Zeisel, J. 2001. "Universal Design to Support the Brain and Its Development." In *Universal Design Handbook*, edited by W. F. E. Preiser and E. Ostroff, Chapter 7, 7.1-7.13. New York: McGraw-Hill.
- Zeisel, J. 2003a. Marketing therapeutic environments for Alzheimer's care. *Journal of Architecture and Planning Research* 20 (1): 76-86.
- Zeisel, J., Silverstein, N. M., Hyde, J., Levkoff, ScD., Lawton, M. P., and Holmes, W. 2003b. Environmental Correlates to Behavioral Health Outcomes in Alzheimer's SpecialCare Units. *The Gerontologist* 43 (5): 697-711.

APPENDIX

APPENDIX 1: CAREGIVER SURVEY

WILL BE FILLED BY CAREGIVER FOR EACH RESIDENT PRIOR INTERVIEWING RESIDENT

date: - - 06

Please fill for Room _____ Building No _____

Gender _male _female

Background

1. Year of birth _____
2. Country of Birth if different than USA _____
3. Native language if not English _____
4. Ethnic background _Asian or Asian American
 _White
 _ Black of African American
 _Latino or Hispanic
 _Other
5. Marital Status _Married _Widowed _Separated or divorced _Single
 5.1. If married: Is resident's spouse living in the same facility? _Yes _No
6. How long has the resident lived in this facility? _____

Competence in ADLs & IADLs

7. How much help does this resident need with the following activities?

- | | | | |
|----------------------------------|---|---|---|
| 7.1. Bathing | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.2. Dressing | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.3. Eating | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.4. Getting in/out of chair/bed | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.5. Walking | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.6. Using the toilet | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.7. Using telephone | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.8. Light/heavy housework | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.9. Meal preparation | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.10. Shopping | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |
| 7.11. Managing money | <input type="checkbox"/> NO HELP needed | <input type="checkbox"/> SOME HELP needed | <input type="checkbox"/> CANNOT DO at all |

Caregiver's Evaluation of Resident's Participation of Social Events

From your records please state the following

8. How many social hours did you prepare that this resident didn't attend in the last 6 months? _____
- 8.1. Compared to other residents how do you rate the willingness of this resident to attend social events?
_Very willingly _Willingly _Somewhat willingly _Not willingly
9. What is the total number of events that this resident participated in inside the community? _____

10. What is the total number of events that this resident participated in outside the community? ____

11. What is the resident's level of friendliness with other residents?

_Very Friendly _Friendly _Somewhat Friendly _Not Friendly

Caregiver's Evaluation of Resident's Mood

12. From your observations of this resident for the past 2 months please state the following about this resident.

- | | | | |
|--|----------------------------------|-------------------------------------|---------------------------------|
| 12.1. This resident showed depressive mood most of the day. | <input type="checkbox"/> _Always | <input type="checkbox"/> _Sometimes | <input type="checkbox"/> _Never |
| 12.2. This resident showed diminished interest in everything. | <input type="checkbox"/> _Always | <input type="checkbox"/> _Sometimes | <input type="checkbox"/> _Never |
| 12.3. This resident showed diminished pleasure in everything | <input type="checkbox"/> _Always | <input type="checkbox"/> _Sometimes | <input type="checkbox"/> _Never |
| 12.3. This resident lost or gained a significant amount of weight. | <input type="checkbox"/> _Always | <input type="checkbox"/> _Sometimes | <input type="checkbox"/> _Never |
| 12.4. This resident had problems in sleeping or waking up regularly. | <input type="checkbox"/> _Always | <input type="checkbox"/> _Sometimes | <input type="checkbox"/> _Never |
| 12.5. This resident showed decline in ability to think or concentrate. | <input type="checkbox"/> _Always | <input type="checkbox"/> _Sometimes | <input type="checkbox"/> _Never |
| 12.6. This resident complained from fatigue or loss of energy nearly everyday. | <input type="checkbox"/> _Always | <input type="checkbox"/> _Sometimes | <input type="checkbox"/> _Never |

Caregiver's Evaluation of Resident's Use of Outdoors

13. From your observations of a general day with appropriate weather conditions please state

13.1. How often have you seen this resident outside the house?

_Very _Somewhat _Never

13.2. How many hours in a usual week is he/she spending outdoors on average? ____

Privacy

14. Does this resident have a private or shared bedroom? _Private _Shared

14.1. If shared: how many roommates does this resident have? _One _Two

14.2. Are the roommate(s) relatives or non-relatives of this resident? _Non-relatives _Relatives

15. Is this resident capable of answering interview questions? Please consider residents competence in hearing, understanding and speaking.

_Yes _No

16. Can you show this resident's room in the plan layout? *If the resident is sharing his/her room, put a cross (X) at his/her bed side.*

Plan layout will be here...

