

Article

How Does the Residential Complex Regulate Residents' Behaviour? An Empirical Study to Identify Influential Components of Human Territoriality on Social Interaction

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Abstract: Although urbanisation and urban land limitations are prevalent, residential complexes are seldom discussed as a means of compartmentalising social interactions and contributing to residents' social interactions. Due to the spatial orientation of social interactions, semi-public spaces in these buildings are unable to host residents' interactions due to a lack of appropriate arrangements/establishment of tangible and visible objects. The influential components, however, have rarely been identified in residential complexes. To fill this gap, using the theory of human territoriality, the current study explores the influential physical components of human territorialities in semi-public spaces in four residential complexes and investigates whether a significant relationship exists between human territorialities' physical components and social interactions. This study collected data from 264 residents of four residential complexes with different spatial configuration layouts. Pearson correlation and Spearman's rank correlation are used to evaluate linear and monotonic relationships between study variables. The correlation between spatial configurations of physical components and residents' interactions confirms that spatial configurations influence residents' use of semi-public spaces. Social interaction can, therefore, be improved through green space, brightness, accessibility, and furniture in common areas. The findings prove that residential complexes with clustered arrangements have not performed well in creating social interaction due to the lack of defined spaces and territories for people, but multi-core, mixed, and linear complexes that define several open and semi-open spaces have been more successful in the amount of social interaction of residents. This study is one of the first to identify the influential components using the integration of residents' perceptions and spatial configuration.

Keywords: human territoriality; social interaction; semi-public space; green space; spatial configuration; accessibility



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1. Introduction

Due to urban land limitations and rapid urbanisation in developing countries in recent decades, housing support practices have failed, and housing shortages have intensified from five decades ago because of this trend. Housing authorities promoted residential complex construction in the 90s. It supported housing demand for a few years, but the initiative lost its efficiency due to an imbalance between housing supply and demand in Iran. Nevertheless, living in complexes has become increasingly common, especially in Iran's major cities. Like past experiences in other cities, a problem associated with life in complexes is the poor quality of social interactions [1,2], which deprives an individual of well-being [3] and results in depression, stress, and distress [4]. At the same time, the superiority of economic and population considerations over other human needs reduces the

quality of such residential areas [5]. A housing project, particularly a residential complex, should be able to provide security, health, and stability, as well as meet the initial needs of all ages and social groups, thereby satisfying their initial needs, such as comfort, privacy, peace, and dignity [6]. Hence, private and semi-private territories, as a part of privacy, should also be clearly and accurately defined in designing residential areas to avoid unwanted societal conflicts between residents' and users' space [5].

There are three types of territorial spaces based on privacy levels: primary, secondary, and public territory [7]. Madanipour [8] describes territorial behaviour as marking, controlling, and defending. Territorial behaviour is perceived as a mechanism based on enhancing human–environment interactions for regulating social interaction and ensuring stability in social organisations [9–12]. Through signage and personalising a place, users express nonverbal communication to communicate ownership and occupancy of areas and possessions [13]. However, based on the literature, several components contribute to territoriality, including (1) social [14–16], (2) cultural [14,17], (3) psychological–cognitive [14], (4) physical [14,17–22], (5) functional [14], (6) environmental [14,17], (7) temporal–spatial [14,23], (8) economic [14], and (9) individual [23,24] components.

Research has revealed that creating territoriality can improve users' sense of identity, privacy, and security [25]. In addition, territoriality regulates users' routine activities in spaces where routine activities also influence guardianship patterns and monitoring of their surroundings [26]. As a result, creating different spaces to respond to residents' needs must be accomplished by changing users' routine activities, improving welfare, and increasing social interactions [26,27]. Shared and semi-public areas in housing complexes should be designed to reinforce community encounters [26,28] and strengthen bonds between neighbours [29]. A large body of literature demonstrates how the place affects users' interaction patterns in the space and users' satisfaction [10,29–37].

In metropolises in Iran and many other countries, users' territoriality in residential complexes is not currently preserved according to residential block geometrical shapes [35]. Adhering to building codes and building layout regulations resulted in independent parking lots, standard-dimension stairs, and appropriate fire extinguishing facilities in the latest generation of complexes, but semi-public areas decorated with green space emerged without hierarchy [37]. These were created to be a place for users' interactions, engagement, and social network development. However, the current levels of residents' interactions reveal that the spaces failed to fulfil their mission in many residential complexes. It is, therefore, rare to find places where residents can gather to encourage fun and interaction. As a result, residential complexes and housing projects become a series of volumes with vacant shared spaces among them. In general, communication is an initial human need because engaging with neighbours can enhance community inclusion and a sense of belonging, especially in complexes in Iranian cities. A literature review indicates that users' territoriality improves their engagements [30,34,35]. Due to the lack of territoriality in many residential complexes, neighbours cannot look out for their well-being and communicate together to improve living conditions and situations, particularly between different age groups and social classes. Subsequently, a trend of social exclusion has emerged, which grows in centres with high-density buildings and crowded populations, unlike past patterns in Iran [35].

Taking into account the layouts of residential blocks, this study concentrates on the impact of human territoriality in the semi-public spaces of four residential complexes. Despite various studies that have pointed out residents' behaviours, building configuration, connectivity, infrastructure, and quality of place at neighbourhood levels, mass buildings, or both, few studies have paid much attention to the impact of residents' informal territoriality on residents' behaviours in semi-public spaces of mass residential complexes. Accordingly, the present study investigates whether a significant relationship exists between the physical components of human territoriality and social interactions. Second, it identifies the most influential physical components of territoriality on residents' interactions. In the following, as a third point, the authors will illustrate the proposed design for influential physical

elements of territoriality in residential complexes according to the research findings. The present study consists of four subsequent sections: the Section 2 reviews the literature on territoriality and social interaction. The Section 3 reveals the methods and instruments employed to satisfy the research objectives and introduces the case study. The Section 4 focuses on analysis and results. The Section 5 elaborates on the findings and concludes research findings beyond case studies. Future research recommendations will be highlighted in this section.

2. Literature Review

2.1. Social Interactions in Built Environments

Three types of activities occur in the outdoors: necessary, optional, and sociable [38]. Social interaction is the result of people in the same spaces and positive interpersonal interactions [35]. Many recent environmental psychology studies focus on the interactions between the built environment and social factors. The physical aspect of a built environment facilitates interpersonal communications and provides privacy in a non-private space. It entails the establishment of appropriate dimensions, spatial arrangement, and permeability in the built environment. Finally, the human-made environment grants symbolic and aesthetic perceptions, experiences, and feelings, which affect users' perceptions of place qualities [39,40]. Desired privacy and spatial relations are created through appropriate spatial arrangement and the establishment of required physical elements in a place [17,41].

In this regard, neighbourliness consists of two aspects: manifest and latent. Although communicating and chit-chatting are two common types of manifest neighbourliness, mutuality and trust among neighbours are consequences of latent neighbourliness [35,42,43]. Hence, Table 1 categorises the physical elements of the built environment influencing social interactions revealed in past studies. According to the findings, most scholars have identified components, such as furniture, light and brightness, accessibility, and green space.

Table 1. Physical factors influencing social interactions.

Researcher	Physical Factors
[44–50]	Furniture
[45,47,51,52]	Pedestrian, path, network
[44–48]	Light and brightness
[35,40,44,49,50,53–60]	Accessibility
[61,62]	Size of space (human scale)
[55,61,62]	Placing and arranging of activities and equipment (floor, body, landscape components in space)
[61,62]	Visual comfort (harmony of the facade in terms of form, colour, materials, skyline, and desired space brightness)
[55,56,63]	Space arrangement and organisation
[30,37]	Readability of public spaces
[54]	Diversity (mixed land uses)
[53,64]	Confinement
[53,64]	Desired landscape

Table 1. *Cont.*

Researcher	Physical Factors
[47,61,62]	Feeling of peace
[50,56]	Parking
[40,65]	Place identity
[47,56]	Visual pleasure
[54–58]	Visual and spatial proportions
[65,66]	Symbolic mechanisms
[26,66]	Boundaries and hierarchies defined from private to public areas
[47,63]	Urban fabric
[47,54,63]	Readability in form and function
[45,47]	Safety
[67]	Components of contemplation and pause
[67]	Informative art, architectural, and advertising signs
[48,56]	Facilities for people with disabilities
[48–50,57,58,68]	Green space and vegetation
[48,50,57]	Sculptures and fountains
[49,68]	Shades
[50,65]	Floor covers

2.2. Territoriality and Social Interactions in Residential Complexes

Residences create a territory that matches the house's legal boundaries [5]. Spatial territoriality is formed based on permeability and accessibility [30,37]. Hence, segmenting of an area results in a better perception of territorialities [69]. Physical territoriality control involves using signs and marks to claim and protect the area. Generally, each type of activity requires certain physical settings to facilitate their occurrence in space, such as playing with others, greeting others, and talking [70]. Passive communication is a social activity, such as eye contact, watching events, and listening to others. Common areas between houses in neighbourhoods facilitate residents' attendance and contribution to various activities [69].

Territories in a residential building include the arrangement of courtyards, towers, landscaping, and flooring of different areas, such as pedestrian and riding paths, along with the arrangement of sites for multipurpose activities, such as playgrounds, sports, retail, and car parking [71]. Currently, residential complexes, which have the potential for semi-private and semi-public spaces, can play the role of local mediators (in-between spaces) to improve social interaction [30,72–74]. Users perceive defined semi-public spaces as having a significant positive effect on social interactions compared with undefined semi-public spaces [75,76]. If different levels of territory are not defined well, individuals will have to fight the environment to achieve appropriate levels of territoriality to enhance social interaction [77]. In a residential complex, residents prefer spaces that provide interaction opportunities [78], along with privacy, which is necessary [35,79]. This concept indicates the importance of territoriality in improving social interactions in living places [80]. Furthermore, previous research findings have demonstrated that opportunities for community activities and the strengthening of the social bond of residents will be increased by preparing green space in residential environments [30,37,81] or an atrium in cold climate areas [82].

Huang [83] believed that water features with complex and distinct forms encourage observers' social interactions. Configuring a proper public facility enhances informal communication and chitchat [30,65,75,84,85]. For instance, Huang [29] found that the concave seating arrangement near plants, closeness to the activity zone, and features of water or works of art can be among the factors that provide users with facilities, such as shade, events, and aesthetic quality, and can encourage interpersonal interaction.

According to theoretical discussion, territoriality and the segmentation of areas are two components of residential complexes that provide better insight into different territories and their control. Reynald and Moir [86] revealed the significance of the physical and social aspects of environments in both providing and promoting opportunities for monitoring and controlling the surroundings by residents. Territories aim to satisfy the various needs of several age groups, resulting in more confidence and privacy for residents and enhancing social interactions between residents. Studies have shown that the development of green spaces through appropriate patterns, the establishment of interesting facilities and activities, and appropriate outdoor furniture arrangements enhance interaction between residents. In this regard, landscape components in open public spaces encourage informal contact and interaction.

2.3. Conceptual Framework

According to the theory of human territoriality, human behaviour depends on providing appropriate spaces for its activities [87], which have a sufficient level of effect, influence, or control over access, actions, and interactions [88]. Thus, behaviours are influenced by different interactive multilevel factors from individual to public policy levels [89]. As a result, a significant relationship occurs among users and their interactions and social–environmental components [90]. As mentioned, a large body of literature revealed that residents' interaction in neighbourhood areas is affected by some physical elements, including the quality of the neighbourhood, housing layouts, communal facilities, seating area and seat arrangements, open space and green area, lighting, accessibility, and pathways [10,30,35,43,91]. In this respect, the physical aspect of the built environment contributes to the creation of territoriality at the level of users, where users act according to their self-perceived territoriality in a public space, such as a neighbourhood or semi-public residential complex [92]. Territoriality, therefore, results from the combination of individual attitudes and physical characteristics of the built environment, which develop social behaviour, such as social interaction [93].

The research framework was designed based on the theory of human territoriality. It involves understanding and applying the principles and concepts associated with territorial behaviour in humans. Hence, Figure 1 shows the proposed conceptual framework, in which individual behaviours are affected by perceived territoriality and built environment components. Through this approach, users' interactions in semi-public spaces of complexes are modified directly and indirectly by the built environment.

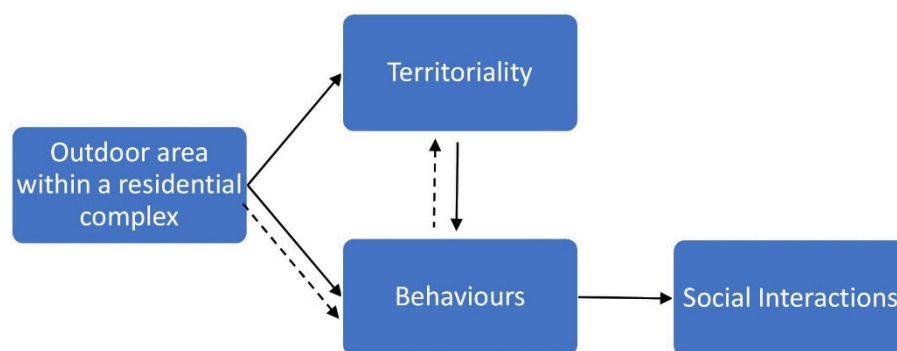


Figure 1. Research conceptual framework.

3. Methodology

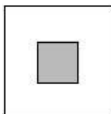
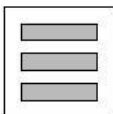
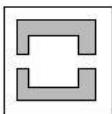
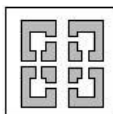
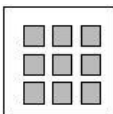
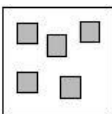
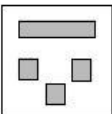
This study employed a mixed-methods approach to satisfy the research objectives, including (A) a closed-ended questionnaire to assess users' characteristics and the experience and perception of interaction with neighbours within residential complexes and (B) the physical characteristics of residential complexes objectively observed by the authors. This study used quantitative analysis methods, such as correlational and descriptive methods, to analyse the collected data. It is a descriptive correlational study that examines the relationship between research variables. Using SPSS 24, the study evaluated monotonic and linear relationships between study variables by Pearson correlation and Spearman's rank correlation.

3.1. Study Area

Four residential complexes in Shiraz, one of the four largest cities in southwest Iran, were selected for the study. The city has a population of more than 2 million people across 152 neighbourhoods and 11 districts, based on available data from Shiraz Municipality. Due to its proximity to less developed provinces, many migrations have made Shiraz a metropolitan city with a heterogeneous population. Hence, privacy, safety, and territoriality are among the main concerns of residents, for whom the potential risk of crime is high [94]. Considering the rapid urbanisation and high demand for housing, irregular and uncontrolled construction has led to housing issues becoming a crisis.

These four case studies were selected based on the following inclusion and exclusion criteria: (1) the spatial configuration unit must be included as one of four types of residential housing complex typology in Shiraz, and (2) the residential complex must have open semi-public space, including sports facilities, playgrounds, seating areas, and landscapes in open space. Furthermore, we excluded employer-provided housing complexes. For this reason, as shown in Table 2, spatial building block layouts in residential complexes of Shiraz have been studied recently. They were categorised into five patterns: (1) individual, (2) linear, (3) centralised (single and multicore), (4) clustered (regular and irregular), and (5) mixed [95].

Table 2. Typology of residential complexes in Shiraz, source: [95].

Pattern	Individual	Linear	Centralised		Clustered		Mixed
			Single	Multi-Core	Regular	Irregular	
Building Block Layout							

Referring to the different patterns, residential complexes were selected in terms of the four patterns from the five typologies listed in Table 2. In this regard, the current study drew site plans of selected residential complexes with a focus on the location of the block(s), unused spaces, green space, and main entrance, as shown in Table 3.

Table 3. Description the case studies, source: authors.

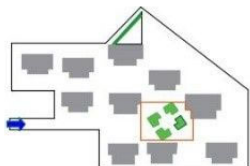


Typology	The Complex Name	Plan	Images	
Clustered arrangement	Nastaran Complex			

Table 3. Cont.

Typology	The Complex Name	Plan	Images
Features: This complex is comprised of seven 5-story blocks with three dwelling units on each story.			
mixed arrangement	Jannat Complex		
Features: This complex is comprised of 23 blocks including seven 3-story blocks and sixteen 4-story blocks. Four blocks have 3 dwelling units on each floor, three blocks have 5 dwelling units on each floor, and sixteen blocks have 4 dwelling units on each floor.			
Centralised arrangement	Tose'e-va-Omran Complex		
Features: This complex is comprised of fifteen 4-story blocks, with 268 one-bedroom, 258 two-bedroom, and 74 three-bedroom dwelling units.			
Linear arrangement	Mohandesin Complex		
Features: This complex is comprised of eight 10-story blocks with two dwelling units on each floor.			

3.2. Observation

Although previous studies [29,30,35] investigated social interactions at the neighbourhood level, this study focuses on residential complexes and semi-public spaces within the blocks. Hence, a field observation was conducted to observe and record the physical characteristics and spatial layout of building blocks in the selected complexes. In this regard, the current study investigated site plans of selected residential complexes, focusing on the location of the block(s), forms of semi-public areas, green spaces, light and brightness, accessibility, and shared facilities (as shown in Table 4).

Table 4. Availability of physical components in selected residential complexes.

Component	Index	Nastaran Complex	Mohandesin Complex	Jannat Complex	Se'e-va-Omran Complex
Typology		clustered	linear	mixed	centralised
Placing and arranging	Diversity of spaces specific to different age groups	-	-	-	-
	Distance from playground and residential area	-	-	-	-
	Separation of spaces	-	✓	✓	-
	Allocation of parking lots	-	✓	-	-
Green space	Diverse green space	-	-	-	✓
	Separating spaces with green spaces	-	-	-	-
Light and brightness	Effect of light on the readability of turning points and pathways	-	✓	-	-
	Quality of light at night	-	✓	-	-
Accessibility	Separating pedestrian and vehicles	-	✓	-	-
	Hierarchical access	-	✓	✓	-
	Using turning points, intersection, and main pathways for important spaces	-	✓	-	-
	Appropriate access from different areas to public spaces	-	✓	-	-
Furniture	Group furniture	✓	-	✓	-
	Table tennis facilities	-	✓	✓	-
	Playground equipment	-	-	-	✓
	Sport facilities	-	-	-	✓
	Signs	✓	-	-	-
	Sculptures and fountain	✓	✓	✓	✓

3.3. Questionnaire

In the quantitative part, the study prompts residents of residential complexes to fill out a self-administered questionnaire. Hence, a walk-in questionnaire survey was conducted in November 2020. Regarding the available residential population data in the Shiraz Municipality, the total resident population for these complexes is 3174 people (as of October 2020). The stratified sampling method was applied for this study. Of 500 residents who received the questionnaire at their self-units' doors, 303 returned the questionnaire, with a response rate of 60.6%. For most of the other 197 residents, the reason for not contributing to the survey was lack of time. The main inclusion criterion was that respondents had lived on the current property for at least one year. After data cleaning, 39 respondents' questionnaires were excluded due to incomplete and/or inadequate responses or not meeting the inclusion criteria. Therefore, the total number of respondents was reduced to 264. Participants were asked to provide demographic characteristics in the first section of the questionnaire. They were also invited to respond to 23 statements that reflect their experiences regarding the availability of shared amenities, green spaces, lighting and

daylighting, accessibility, and social interactions in semi-public areas in their complexes. Table 5 shows the study variables with their respective indicators.

Table 5. Study variables with respective indicators.

Construct	Item	Description
Placing and arranging activities—Items were adapted based on the work of [55,61,62]. (1 = strongly disagree, 5 = strongly agree)		
	Q1	Furniture around facilities and activities
	Q2	Talking in cozy and comfortable corners
	Q3	Walking in pathways through a green space
	Q4	The placement of communal spaces in the focal points
	Q5	Placing the playgrounds in a full natural surveillance
	Q6	Using different forms for collective spaces motivate me
Green spaces—Items were adapted based on the work of [48–50,57,58,68]. (1 = very rarely/little, 5 = very frequently/ very much)		
	Q7	Using the green space of the complex
	Q8	Monitoring green spaces from the dwelling unit or block
	Q9	Reading books and newspapers, playing music and movies in green spaces
	Q10	Extending your attendance due to creative green spaces
Lighting and daylighting—Items were adapted based on the work of [45–48]. (1 = strongly disagree, 5 = strongly agree)		
	Q11	The quality of lighting and your fear of crime in complex
	Q12	Proper lighting extending my public spaces use
	Q13	Proper lighting increases residents’ safety and security in public spaces use
	Q14	Proper lighting extends the visibility of activities and open spaces
Accessibility—Items were adapted based on the work of [40,49,50,54–58]. (1 = strongly disagree, 5 = strongly agree)		
	Q15	Proper access motivates me to attend to the communal space
	Q16	Communal spaces with high accessibility motivated users to attend.
	Q17	A full separation of pedestrians and vehicles
	Q18	A high effect between the placement of communal spaces, accessibility, user attendance
Shared furniture—Items were adapted based on the work of [45–50]. (1 = very rarely/little, 5 = very frequently/ very much)		
	Q19	Sufficient outdoor chairs and furniture
	Q20	Using sign boards helps visitors find way easier
	Q21	The quality of sports equipment and furniture boosts residents’ attendance and activities
	Q22	Using the proper sculptures and memorials enhance my motivation to attend to space
	Q23	The existence of a proper gazebo, shed, or pergola encourages residents to talk together

In total, 264 respondents participated in the survey, and 51.13% and 48.86% of respondents were male and female, respectively. Additionally, the percentage of respondents by complex residential pattern includes 8% of the residential complex of the linear pattern, 13% of the residential complex of the clustered pattern, 25% of the residential complex of the mixed pattern, and 54% of the residential complex of the centralised pattern. The respondents' residence length includes 2% over 15 years old, 8% between 10 and 15 years old, 35% between 5 and 10 years old, and 55% under 5 years old.

4. Results

This study was conducted based on the environmental meaning model to explain the role of physical components of territory and social interactions in the presence of social groups of residents and to analyse the effective components. The collected data through questionnaires were analysed through SPSS 24 using the Pearson correlation coefficient to illustrate potential relationships between two normally distributed quantitative variables. In this regard, an index coefficient between 1.0 and 1.0 indicates ideal positive and negative relationships, respectively. A two-tailed significance level of 5% was applied to determine if any difference exists between the components we are comparing. Consequently, the analysis of the questionnaire yielded the results detailed below.

4.1. Placing and Arranging Activities

The components mentioned in the first part, related to placing and arranging the activities in residential complexes, are positively and significantly correlated (Figure 2). As a result, the layout patterns of activities and functions in semi-public areas have a positive effect on each other. An alpha value of less than 0.05 confirms this finding (Table 6). Consequently, the use of concave furniture around the playground or the fountains encourages social interaction among residents. The application of quiet and shaded corners, linear passages beside green spaces, the construction of playgrounds and sports fields in central areas of the courtyard, and the use of different forms (e.g., children's parks, space for elderly individuals), as public spaces, result in more effective user relationships. Notably, although allocating a specific space to children or the elderly is a constructive and effective act, statistics show that it does not have such effects on social interactions. This is because the components have no significant correlation.

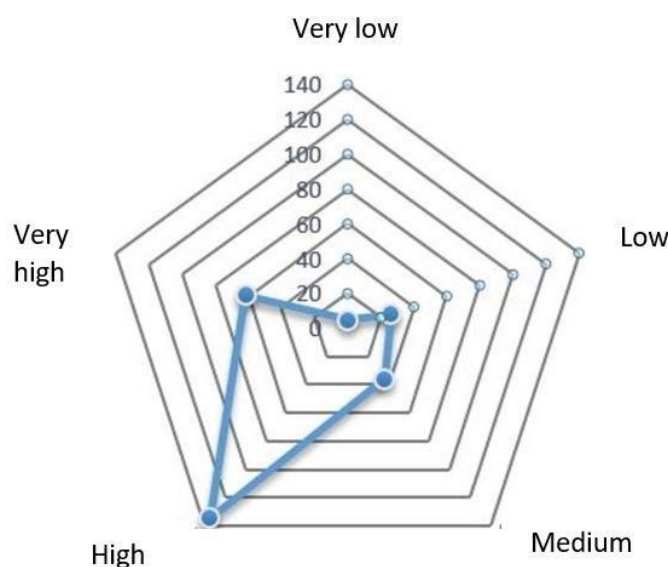


Figure 2. Mean effect of components of placing and arranging on social interactions.

Table 6. Correlation for the placing and arranging components.

		Components of Item 1	Components of Item 2	Components of Item 3	Components of Item 4	Components of Item 5	Components of Item 6
Components of Item 1	Pearson correlation	1	0.283	0.197	0.175	0.202	0.213
	Sig. (2-tailed)		0.000	0.001	0.004	0.001	0.000
Components of Item 2	Pearson correlation	0.283	1	0.339	0.240	0.202	0.070
	Sig. (2-tailed)	0.000		0.000	0.000	0.001	0.256
Components of Item 3	Pearson correlation	0.197	0.339	1	0.259	0.212	0.052
	Sig. (2-tailed)	0.001	0.000		0.000	0.001	0.403
Components of Item 4	Pearson correlation	0.175	0.240	0.259	1	0.299	0.038
	Sig. (2-tailed)	0.004	0.000	0.000		0.000	0.539
Components of Item 5	Pearson correlation	0.202	0.202	0.212	0.299	1	0.221
	Sig. (2-tailed)	0.001	0.001	0.001	0.000		0.000
Components of Item 6	Pearson correlation	0.213	0.070	0.052	0.038	0.221	1
	Sig. (2-tailed)	0.000	0.256	0.403	0.539	0.000	

4.2. Green Space

According to respondents' responses, all components of green space were significantly and positively correlated. As a result, their implementation has a positive effect on each other, which is confirmed by the estimated Cronbach's alpha < 0.05. Only components in Items 8 and 10 are not significantly correlated and do not affect each other (Table 7). Considering the statistical analysis, the components of green space improve social interaction (Figure 3).

Table 7. Correlation for green space components concerning social interaction.

		Components of Item 7	Components of Item 8	Components of Item 9	Components of Item 10
Components of Item 7	Pearson correlation	1	0.176	0.975	0.207
	Sig. (2-tailed)		0.004	0.000	0.001
Components of Item 8	Pearson correlation	0.176	1	0.167	0.070
	Sig. (2-tailed)	0.004		0.007	0.260
Components of Item 9	Pearson correlation	0.975	0.167	1	0.212
	Sig. (2-tailed)	0.000	0.007		0.001
Components of Item 10	Pearson correlation	0.207	0.070	0.212	1
	Sig. (2-tailed)	0.001	0.260	0.001	

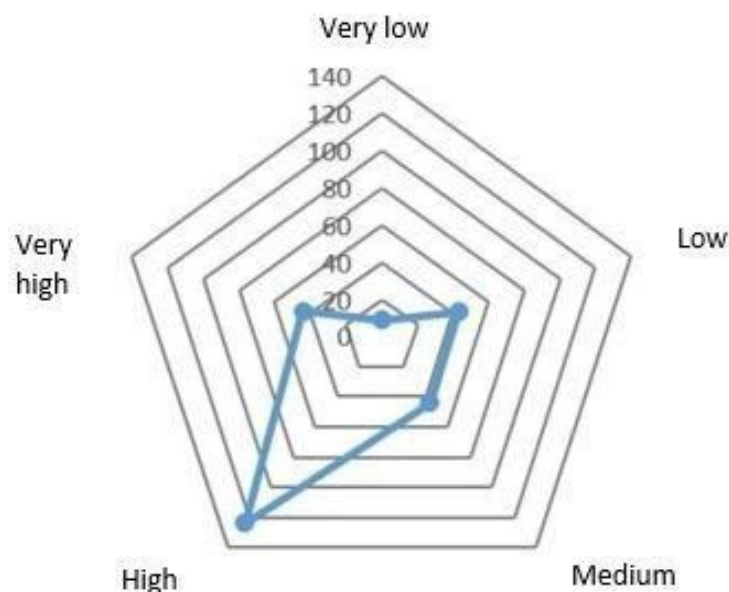


Figure 3. Mean effect of green space components on social interactions.

4.3. Light and Brightness

According to the statistical analysis, spatial light quality had no significant relationships with the other components of items (Table 8 and Figure 4). Other components, such as environmental aesthetic improvement, proper lighting for safety, and legibility of turning points and signs, also affect social interactions and community relationships. An increased level of each component enhances other components and improves social interactions. For instance, augmenting space beauty through light leads to a heightened sense of security, which, in turn, boosts social interaction.

Table 8. Correlation of light and brightness components concerning social interaction.

		Components of Item 11	Components of Item 12	Components of Item 13	Components of Item 14
Components of Item 11	Pearson correlation	1	0.067	−0.075	0.038
	Sig. (2-tailed)		0.276	0.227	0.538
Components of Item 12	Pearson correlation	0.067	1	0.345	0.245
	Sig. (2-tailed)	0.276		0.000	0.000
Components of Item 13	Pearson correlation	−0.075	0.345	1	0.233
	Sig. (2-tailed)	0.227	0.000		0.000
Components of Item 14	Pearson correlation	0.038	0.245	0.233	1
	Sig. (2-tailed)	0.535	0.000	0.000	

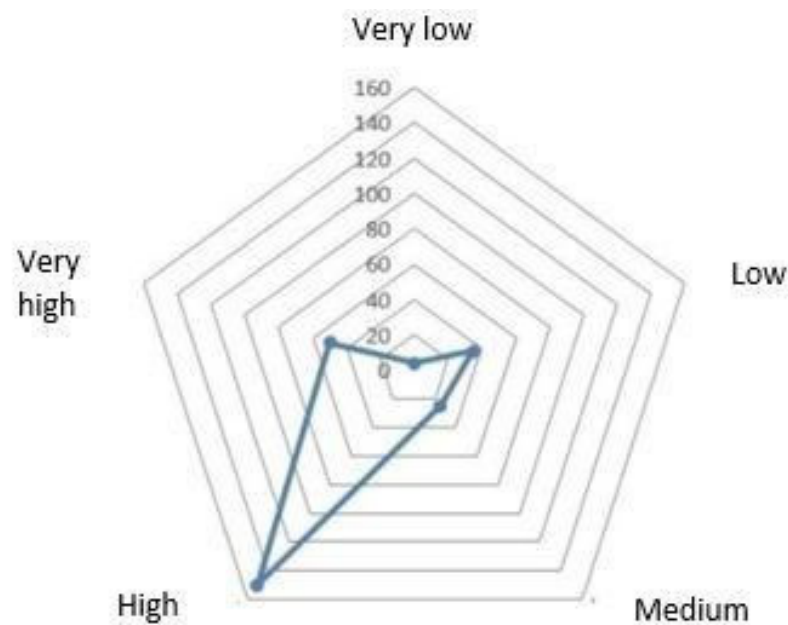


Figure 4. Mean effect of light and brightness components on social interactions.

4.4. Accessibility

The analysis shows a significant relationship between the components (Table 9 and Figure 5), but no significant relationship exists between the separation of pedestrian and riding paths and the hierarchical component of accessibility to public space or between the location of public space and appropriate access to different sites (Table 9). Therefore, these components do not affect each other. Pushing aside, decreasing and/or increasing the level of each component did not affect their effectiveness. These factors are independent and have unique effects.

Table 9. Correlation for accessibility components concerning social interaction.

		Components of Item 15	Components of Item 16	Components of Item 17	Components of Item 18
Components of Item 15	Pearson correlation	1	0.010	0.314	0.278
	Sig. (2-tailed)		0.873	0.000	0.000
Components of Item 16	Pearson correlation	0.010	1	0.158	−0.010
	Sig. (2-tailed)	0.873		0.010	0.866
Components of Item 17	Pearson correlation	0.314	0.158	1	0.543
	Sig. (2-tailed)	0.000	0.010		0.000
Components of Item 18	Pearson correlation	0.278	−0.010	0.543	1
	Sig. (2-tailed)	0.000	0.866	0.000	



Figure 5. Mean effect of accessibility on social interactions.

4.5. Furniture

Table 10 shows all components are significantly correlated, except for furniture, which has no impact on other components. Figure 6 also indicates signs, tables, and memorial sculptures significantly affected social interactions. Moreover, an increase in each component strengthens other components, which, in turn, enhance social interactions.

Table 10. Correlation for furniture components concerning social interaction.

		Components of Item 19	Components of Item 20	Components of Item 21	Components of Item 22	Components of Item 23
Components of Item 19	Pearson correlation	1	−0.086	−0.030	−0.070	0.045
	Sig. (2-tailed)		0.164	0.631	0.256	0.468
Components of Item 20	Pearson correlation	−0.086	1	0.464	0.246	0.122
	Sig. (2-tailed)	0.164		0.000	0.000	0.047
Components of Item 21	Pearson correlation	−0.030	0.464	1	0.264	0.361
	Sig. (2-tailed)	0.631	0.000		0.000	0.000
Components of Item 22	Pearson correlation	−0.070	0.246	0.246	1	0.183
	Sig. (2-tailed)	0.256	0.000	0.000		0.003
Components of Item 23	Pearson correlation	0.045	0.122	0.361	0.183	1
	Sig. (2-tailed)	0.468	0.047	0.000	0.003	

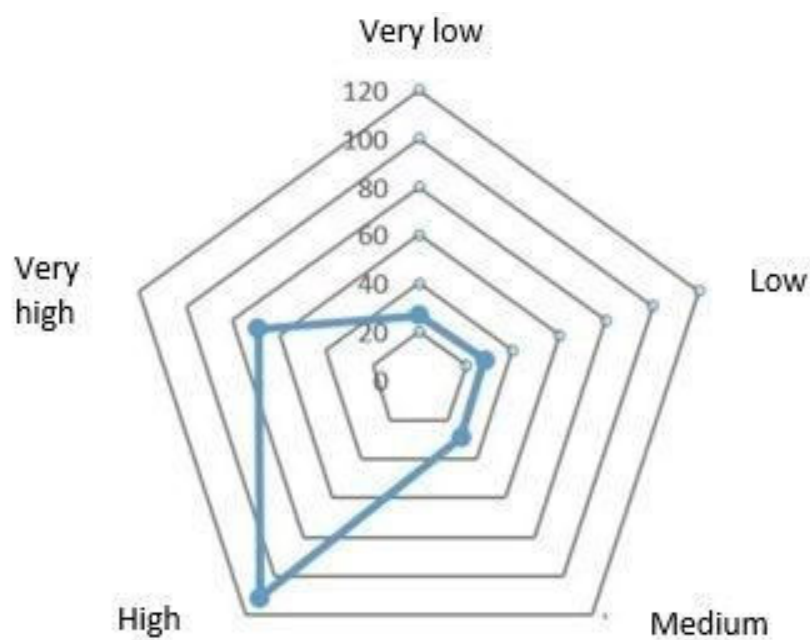


Figure 6. Mean effect of furniture on social interactions.

In general, the placement and arrangement of activities, green space, light and brightness, accessibility, and furniture are significantly correlated. Among these components, accessibility is the least effective variable influencing social interaction (as shown in Figure 7). While conducting the survey, the authors carried out a field observation to identify the existing physical components of territories. They also analysed the weakness of points with the potential to establish social interactions in a field study. Additionally, detailed information was illustrated based on the current layout and arrangement of spaces in Table 11.

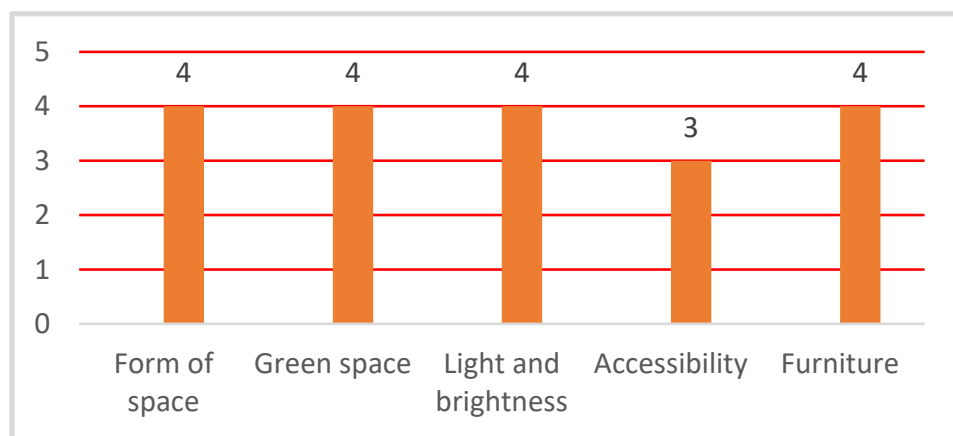
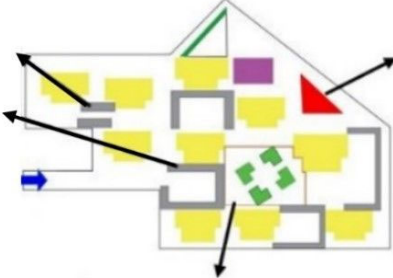
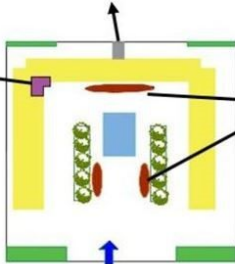
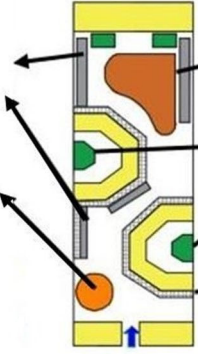
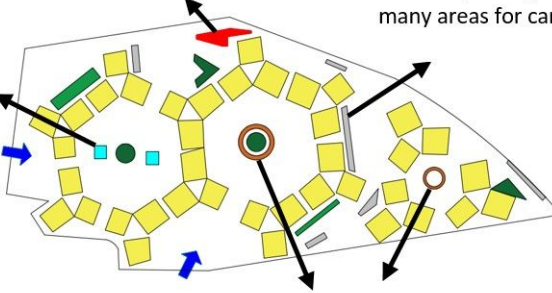


Figure 7. Significance of components from the perspective of respondents.

Table 11. The territories of the studied complexes.

Residential Arrangements	Different Territories
Clustered arrangement	 <p data-bbox="461 450 710 495">Lack of parking area, resulting in the occupation of many areas by</p> <p data-bbox="1134 405 1442 517">Playground, lack of green space near this space, reduced visibility from the dwelling units, and lack of adequate play facilities are among factors that inhibit the presence of children</p> <p data-bbox="799 689 1034 730">The lack of appropriate lighting inhibits social interaction</p> <p data-bbox="1118 629 1220 674"> ■ Dwelling blocks ■ Playground ■ Green space </p>
Linear arrangement	 <p data-bbox="579 891 778 916">Grocery in public space</p> <p data-bbox="1129 869 1331 994">The lack of appropriate seating in public territory to boost interaction near water and green space</p> <p data-bbox="1118 1055 1220 1099"> ■ Dwelling blocks ■ Commercial ■ Green space </p>
Mixed arrangement	 <p data-bbox="493 1160 671 1227">Lack of parking space and occupation of a large area for car park</p> <p data-bbox="493 1317 639 1341">Table tennis space</p> <p data-bbox="1034 1137 1422 1182">Lack of appropriate seating for interaction in this block</p> <p data-bbox="1034 1272 1342 1317">Presence of vegetation and seating for interaction</p> <p data-bbox="1034 1391 1353 1435">Specific walking path around two blocks presented in the form hatch</p> <p data-bbox="922 1496 1024 1541"> ■ Dwelling blocks ■ Walking path ■ Green space </p>
Centralised arrangement	 <p data-bbox="456 1671 571 1695">Sport space</p> <p data-bbox="983 1585 1449 1641">Lack of specific parking space and occupation of many areas for car park</p> <p data-bbox="834 1917 1123 1939">Lack of seating for interaction</p> <p data-bbox="1177 1816 1279 1883"> ■ Dwelling blocks ■ Playground ■ Green space ■ Sport field </p>

5. Discussion

According to the findings, the segregation of spatial territoriality (public, semi-public, semi-private, and private) is among the factors influencing social interactions in residential complexes. The arrangement of things in space is an influential physical component of territoriality in social interaction. The formation, location, and shape of items in semi-public space of residential complexes affect the connectivity and users' use of these spaces. As specified by Huang [29], concave furniture around the playground or fountain can boost interaction between parents and children. Considering the current research results, another way to encourage peace is to create pathways and pedestrian paths around green spaces that are consistent with early findings [37]. The location of public spaces in the focal points of the yard and near residential blocks also affects social interactions. The research results indicate that green space is the second most effective physical component of territoriality in promoting users' interaction in semi-public areas of residential complexes. As another factor of territoriality influencing social interaction, this study examined the role of green spaces in users' motivation for communication with other users in residential complexes. Based on the findings, the decoration of green areas with a higher level of diversity in semi-public areas of residential complexes affects users' territoriality and may boost interactions between them. The findings are in agreement with past studies' findings [30,37]. In this regard, the separation of areas from plants has been considered a beneficial practice in past studies (such as [47]). Hence, a part of the courtyard can be designed with a diverse green space (e.g., a green space confined by boxes) as a place for newspaper reading, or it is possible to separate another part of the courtyard with shade trees and group furniture to make a place for chit-chat and communication. Designing such diverse green areas can encourage people to attend and participate.

Consistent with recent studies that advocate the role of lighting and brightness in encouraging users to interact [45,46], as physical components of territoriality, the impact of lighting and brightness on social interaction was evaluated. The results show that appropriate lighting and brightness can make the place attractive for communication. This is especially true in semi-public areas, such as courtyards. Sufficient lighting and brightness decrease fear of crime because users know that crime rates are higher in dark places. People are not willing to be in places without brightness and lighting. This means that appropriate lighting and brightness encourage users to attend and participate in the space.

This study assessed the impact of accessibility as a physical component of territoriality on changing user interactions in semi-public areas and residential complexes. The arrangement of building blocks, accessibility, and social interactions have a significant impact [60], but the present study suggests that accessibility has the least effect on social interaction change. This result, however, confirms that accessibility impacts user interaction, but its effectiveness is less than that of other components. Thus, the study results are consistent with past studies. In this regard, accessibility can improve social interaction when pathways or boulevards have a suitable width and length [37]. As a result, accessibility's low effectiveness in encouraging users to interact is due to unsorted and unsized pathways or lack of hierarchical access.

In addition, the results show that accessibility factors influence user interaction, which agrees with past studies [30,34,37,38,60]. The present study's findings revealed no significant relationship between the separation of pedestrians and vehicles, with the hierarchical component of accessibility to public space, and the location of public space and appropriate access to different places in residential complexes. This means that these components do not affect each other. Thus, removing, decreasing, and/or increasing the level of each of them did not affect their effectiveness. These factors are independent and have unique effects. Furthermore, the impacts of communal facilities were investigated in the current study. Residential complexes in Iran usually include outdoor seating, table tennis facilities, sports facilities, and gazebos in outdoor and semi-public areas. Facilities encourage users and residents to attend and participate in these areas. Such encouragement was

facilitated by offering facilities for relaxation, meditation, running, fun, and a variety of physical activities.

The location of these facilities is significant because their location and spatial connections contribute to users' safety, fear of crime, peace, territoriality, and interaction with others. In this regard, past studies [40,47,48] have found that playgrounds located near blocks and green areas decrease the fear of crime in children and their parents. It, in turn, improves their motivation, activities, and interactions with other players. Children's outdoor activities can be enhanced when playgrounds are placed within the natural surveillance of dwelling units. Conversely, locating playgrounds without natural surveillance from dwelling units decreases the likelihood of children doing outdoor activities due to fear of crime. As a result, public spaces with convenient accessibility and/or located near central points will enhance residents' attendance and encourage participation.

In addition, the study observation revealed that the physical components of territoriality, such as hierarchical access and green spaces, as well as the way of organising elements and blocks, enhance legibility and a sense of invitation toward social interaction between users. This finding aligned with the literature [29,30,35,38]. According to the results, residential complexes with green spaces, light and brightness, access hierarchies, furniture, and elements create more motivation for social interaction. By contrast, residential complexes with clustered arrangements have not performed well in creating social interaction due to the lack of defined spaces and territories for people. Furthermore, multi-core, mixed, and linear complexes are able to define territoriality in several public and semi-public spaces. Accordingly, the second category can encourage residents to interact more than the clustered arrangement complexes. These findings are consistent with experimental research through a comparative approach using space syntax analysis by [37].

Human territorialities in historic neighbourhoods arguably were generated as a result of the existence of hierarchical spaces (i.e., courtyards and roads), which engendered osmotic borders, in conjunction with medieval socio-cultural activities, including intertwined spatial-political layers, such as power, traditions, gender segregation, ownership patterns, and ideological or blood-related backgrounds. Thus, semi-public courtyard roads functioned as the primary form of in-between spaces in historical Iranian and perhaps Middle Eastern architecture [96]. But urbanisation growth and a housing shortage changed current neighbourhoods' patterns and features. As a result, semi-public areas experienced deterioration when developers and planners excluded them from houses because of an urban land shortage. In this sense, the current study proved that a proper arrangement is needed for building blocks, hierarchical access, activities, and spatial decoration. It is in the courtyards and open spaces of residential complexes. Hence, as shown in Table 12, the following propositions have been provided; such semi-public spaces can potentially enhance residents' territoriality and facilitate their attendance, contribution, and interaction, including improving social cohesion and contributing to safety and satisfaction (Table 12).

Table 12. The proposed physical components for semi-public areas toward enhancing residents' territoriality.

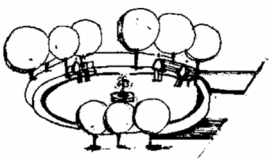
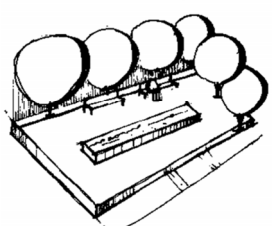
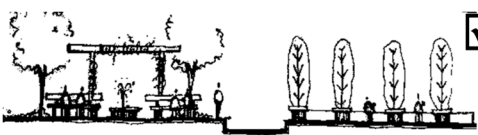



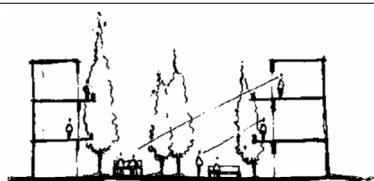
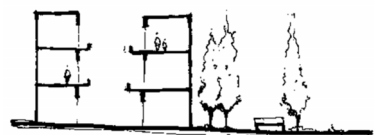
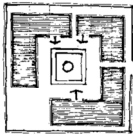
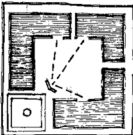

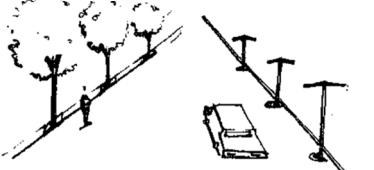
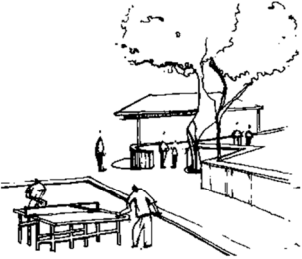
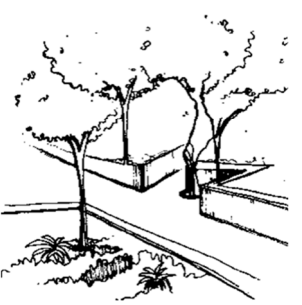
Index Physical	Component	Suggested Criteria	Appropriate and Inappropriate Samples
Form of Space	Form of furniture	Use of concave furniture around the fountain	 <input checked="" type="checkbox"/>
			 <input type="checkbox"/>
Green space	Green space diversity in different areas	Using diverse green spaces and defining different territories, such as spatial territories for study, a space with group furniture, and shade trees	 <input checked="" type="checkbox"/>
			 <input type="checkbox"/>
	Location of green space	The placement of green space in areas near the blocks with a view from the dwelling units enhances the presence of residents and social interaction among them	 <input checked="" type="checkbox"/>
			 <input type="checkbox"/>
Light	Light	Appropriate light in places with the potential for the presence of residents enhances this presence by encouraging the feeling of security	 <input checked="" type="checkbox"/>
			 <input type="checkbox"/>

Table 12. Cont.

Index Physical	Component	Suggested Criteria	Appropriate and Inappropriate Samples	
Accessibility	Location of public spaces	Placement of public spaces in areas with easy accessibility and near the blocks		☑
				☒
	Separation of the pedestrian path from riding path	The separation of the pedestrian path from the riding path clarifies safe areas for making social interaction		☑
				☒
Furniture	Components, such as gazebo and table tennis facilities, and components related to social activities	The use of such components as gazebo and table tennis facilities in the courtyard encourage the presence of the residents		☑
				☒

6. Conclusions

This study aimed to investigate the influential physical components of human territorialities in semi-public spaces in four residential complexes and evaluate whether there is a significant relationship between human territorialities' physical components and social interactions. Based on human territoriality theory, the study was conducted with a mixed method using a questionnaire and direct observation in the four mass residential complexes of Shiraz, the third-largest city in Iran. The initial idea of this study refers to residents needing a place for living in peace, privacy, safety and comfort. Due to continuous migration from rural and small urban areas to major cities in Iran, such as Shiraz, they have suffered from ad hoc planning with confusion in decision-making that has resulted

in turmoil in housing construction, and providing the proper infrastructures and public facilities in major cities.

Accordingly, serious issues have emerged in the physical aspect of cities, particularly neighbourhoods, in the past five decades. Housing, as the main cell of urban tissues, lacks the provision of previous functions for its residents as much as expected roles, such as well-being and interaction among residents of a residential complex. This is a result of the transformation of historic Iranian cities, such as Shiraz, and the result of social-spatial changes caused by the industrialisation of major cities, despite changes in residential neighbourhood fabrics occurring naturally, organically, and technologically in previous decades. The findings indicated that outdoor common areas arguably disclose socio-spatial mechanisms that once formed interactions of residents as members of a community and that once engendered satisfaction and physical activity in residential complexes. Lacking or inappropriate common areas in residential complexes results in isolation and exclusion among residents in residential complexes as relatively small communities. Negative impacts manifest in urban communities and higher levels, resulting in behavioural and communicational changes in the whole community.

Therefore, improving social interaction as a fundamental function is crucial in residential complexes. In other words, the existence and preservation of personalised territory and a sense of safety within that territory are the bases of everyone's social behaviour in the community. By discovering the correlation between human territoriality and physical activity, the association between neighbours' interactions and appropriate open space and shared facilities in the context of residential complexes proved to be crucial. Human territoriality, along with practical studies' findings, proved that current housing construction processes are inefficient in Shiraz and other major Iranian cities, have lagged far behind a deleterious process, have been physical-oriented, and are mostly concentrated on independent interventions, rather than considering the development process of communities. The present study revealed how human territoriality as spatial boundaries of individuals is formed based on the physical components of built areas (such as residential complexes), and the perceived spatial boundaries manage residents' behaviour to attend and contribute to an area or interaction with someone surrounding.

This redress in knowledge, that is, understanding perceived human territoriality and its social and physical implications, must be taken advantage of as a priority measure for the proposition of upgrading the quality of residential complexes in all Iranian cities. Hence, this study builds on previous research providing a useful case study insight that could be replicated in other countries/locations for comparison and influence the design of social housing spaces where human well-being, as part of sustainability objectives, is a priority factor for assessing design success.

Finally, this study discloses an idea for different stakeholders in the decision-making atmosphere to focus on building codes with a new perspective as human-oriented residential buildings that can redress semi-public spaces in residential complexes as an opportunity to increase residents' sense of belonging and to avoid migration and growing segregation.

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