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How residential density relates to social interactions? Similarities and differences of moderated mediation models in gated and non-gated communities

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ABSTRACT

Density and community enclosure are the most widely applied policy tools for residential environments. The effectiveness of these policies is often assessed by the social impacts imposed on local communities. A serious gap in the relationship between density and social outcomes is that present literature deals with internal and external density separately and ignores the role of community enclosure in social procedures. Recent studies have declared that to achieve the desired environmental quality, individuals' perceptions of density should be considered. They have also highlighted that high perceived density predicts low social interactions and territoriality is a well-established mediator of this association. The present paper investigates the similarities and differences of the causal effect between perceived density and social interactions in gated and non-gated communities. A survey was distributed to a sample of 522 habitants residing in six neighborhoods. Presented moderated mediation models suggest that in both types of communities, territoriality mediates the effect of perceived density on social interactions. In non-gated communities residents who perceive a high level of interior crowding may experience the strengthened negative effects of high perceived density on social outcomes. Instead, in gated communities, when perceived interior crowding is high, a higher level of correlation exists between territoriality and social interactions. This finding supports the idea that the residents' incapability to achieve the desired level of privacy encourages boundary-control behavior in shared spaces.

1. Introduction

Although some scholars have indicated the importance of social interactions which occur in residential environments (Abdul Aziz and Sani Ahmad, 2012; Abu-Ghazzeh, 1999), decision-makers use a wide variety of indicators, such as compactness, centrality, quantitative density, complexity, and land-use mix to examine and describe the correlations between urban form and environmental sustainability (Säynäjoki et al., 2014). On the one hand, different density measurement criteria have been utilized for explaining the association between the built environment and social aspects of housing (Boyko and Cooper, 2011). On the other hand, there are conflicting arguments regarding the drawbacks and social benefits of higher densities (Tang et al., 2019), especially in the context of developing countries. Several studies have highlighted the importance of housing layout and physical attributes of the residential environment in explaining social outcomes (e.g., Abu-Ghazzeh, 1999). Nevertheless, the subjective judgment regarding these attributes may affect one's behaviors and attitudes more extensively than physical features (Thornock et al., 2019).

According to social psychological theory, physical density is only one factor affecting residents' feelings of crowdedness; a more critical factor is how a particular level of density is evaluated (Altman, 1975). This is an emphasis not only on the effects of high density but on the individual and situational determinants of crowding perceptions (Gramann, 1982). Hence, some findings emphasize individual experiences and perceptions in exploring relations between density and social interactions (e.g., Dave, 2011; Raman, 2010; Mousavinia et al., 2019).

To understand the multi-dimensional nature of high-density environments, the internal and external densities must be distinguished. Particularly, distance (from others within the communal spaces) and crowding (feeling too close to others in a dwelling unit) are two environmental elements that could be interpreted differently based on the perceptions of people (Thornock et al., 2019). A severe gap with the argument about density is that the present literature deals with density in a separate spatial unit (like a room and a dwelling unit) irrelevant to its external setting. Also, in these studies, it is assumed that there is no

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difference between gated and non-gated neighborhoods in terms of crowding models. According to social context differences, it is entirely possible that gated communities do not have the same kind of function than they have in non-gated communities. In Iran with a historical legacy of at least enclosed residential areas and relatively large households, gated communities are likely to operate differently than in a country like Canada or Australia with legacies of wide-open landscapes and large lots. Issues such as crowding within the dwelling unit are less likely to be a challenge in gated communities in western nations where the gated enclaves are often high-end and occupied by very small households. Based on this gap in the literature, the current work evaluates the direct and indirect links between perceived density, perceived interior crowding, and social interactions in gated and non-gated communities and discusses the similarities and differences in structural models.

First, considering social interactions as a considerable outcome related to the concept of the gated communities, this study focuses on the physical attributes of the residential environment influencing the perceived density and social outcomes through mediating role of territoriality. The second objective of this research is to understand social processes in gated and non-gated communities based on perceptual aspects due to housing layout and semi-public spaces (through perceived density) as well as the perceived characteristics of the home environment (through perceived interior crowding). Few studies have focused on perceived interior crowding to moderate the associations between perceived density and social interactions. This paper intends to investigate the relations between variables using structural equation modeling (SEM-PLS).

2. Background

2.1. Housing policies, gated, and non-gated communities in Iran

While European and North American countries maintain or increase residential densities, many rapidly growing cities in developing countries have high densities already (Raman, 2010). The urban geography of Iranian cities is rooted in various historical and cultural trends with rapid urbanization and population migration from rural to urban areas (Kalantari et al., 2017). The emergence of high-density developments has been accompanied by the heterogeneity of urban residents who demand diverse living spaces due to their varied social-cultural structures, but not much attention has been paid to the differences in their spatial needs in housing design and policies.

It is believed that housing codes and regulations affect the urban form in residential areas. In the Iranian largest cities, in the case of non-gated communities, the regulation of construction exactly in the northern 60 % of plot with the feasibility of advancing for 2 m considering beveled corners (45 degree for preventing neighbors' overshadowing) is one of the codes legislated for the common housing. Therefore, row housing type (apartments with three to six stories height) is a default residential building pattern which frequently illustrates conditions of overcrowding, lack of day lighting, and architectural monotony. The most important attribute of this housing type is that more families can be accommodated on the same amount of land (with shared entrance from street, shared staircase and yard) and municipal services can be more economically provided (Mohajer Milani and Einifar, 2017).

Urban gated communities have become increasingly common housing policy over recent decades (Zhang and Zheng, 2019). The modern gated communities first appeared in Iran following the enforcement of the third (1963–1967) and fourth (1968–1972) Reconstruction Plans of the country during which housing provision by the private sector burgeoned. Encouraging the construction of apartment buildings in the form of enclave communities for specific groups (public servants) was the main policy adopted in the fourth Reconstruction Plan. In addition, due to the economic and political changes, the target profile of gated communities was initially an emerging social class being formed (Einifar et al., 2019) and the affluent residents welcomed this housing type. Gated communities gradually became a marketing opportunity for private housing developers concerning the middle-income group. Recently, the planners and policymakers encourage community enclosure as a symbol of modern living to achieve higher residential densities. Resembling other countries, also in Iran, many residents choose the gated community because it can serve as a means of strengthening safety and a sense of neighborhood identity, too.

Kalantari et al. (2017) have presented four categories of gated communities in Iran: a) Utopian gated communities which can be defined as leisure-oriented communities or the second house located at different places within or outside the city, and most frequently in the north of Iran, b) Security gated communities which provide security in a level beyond the rest of the city, c) The governmental gated communities generally located in suburban areas and low-price districts of cities, d) Special gated communities including military communities, industries, and a wide range of different activities.

One of the issues related to residential density and community enclosure that distinguishes housing policies in Iran from other contexts is the average home size. The General Census of Population and Housing in 2016 showed that about 65.6 % of residential dwelling units have an area of 100 square meters or less. A comparison of this number with the average home size in developed countries (e.g., Canada and Australia) shows a significant difference. At the same time, various statistical data indicate that between 60 % and 70 % of vacant dwelling units (estimated at 2–3 million in gated and non-gated communities) have an area of more than 100 square meters (Statistical center of Iran, 2016), simply demonstrating a clear pattern: dwelling units with more than 100 square meters have fewer functions because the ability of citizens to buy these houses is very low. Although decision makers decide for residential environments using quantitative density and scholars often write about the benefits of higher urban densities in terms of land use efficiency, there is a need to understand the human dimensions of density—perceptions, behaviors and needs—as well as the quality and context of immediate and surrounding environments.

2.2. Density and social outcomes

From psychological and social perspectives, high-density living leads to different problems such as loss of control, overcrowding (Proshansky et al., 1970), cognitive overload (Altman, 1975), perceptions of no privacy, social withdrawal (McCarthy and Saegert, 1978), and violations of personal space (Baum and Paulus, 1987). For defenders of high-density environments, in a highly populated region, a safer urban area is more probable, and more significant social interaction would take place (Newman and Hogan, 1981). For instant, according to Jacobs (1961), density can keep the diversity of cities contributing to the attractive and dynamic urban environment (Caprotti and Gong, 2017). The relationship between density and social interactions is not linear throughout all quantitative densities. High density per se does not lead to social disorders and social withdrawals but poor planning does (Tang et al., 2019). Also, the acceptability of high-density living may vary in different social and cultural contexts (Breheny, 1997).

Density is an essential factor simultaneously affecting the spatial requirements of families in private and public spaces. Various definitions of density have been provided on different scales, ranging from rooms to buildings and neighborhoods to cities. Three concepts are used to address the issue of density and how density affects people's lives: density, perceived density, and crowding (Alexander, 1993). Within the planning field, the word "density" refers to cities and neighborhoods (indeed the number of individuals or dwelling units per acre), while "crowding" denotes the density of interior spaces (Forsyth, 2003). Crowding has been defined by social psychologists as a negative affective reaction to density (Gramann, 1982). Two important explanations for crowding are the "stimulus overload" and "social interference"

models (Stokols, 1976).

2.2.1. Crowding as stimulus overload, mediation role of territoriality

The fundamental assumption of the stimulus overload model of crowding is that the size, density, and heterogeneity of urban populations cause individuals to be exposed to excessive levels of psychic stress (Gramann, 1982). According to Churchman (1999), it is easier for planners to affect perceived density than to affect the subjective experience of crowding. Based on the definition given by Rapoport (1975), perceived density implies that in any environment, cues are offered to allow people to judge the number of people and the nature of an environment, as well as the appropriate activities and performances. It is assumed that some physical variables are associated with perceived density. These variables influence the sensual stimuli in an environment which specifies the actual or possible presence of people (Churchman, 1999). In the literature, these physical variables include neighborhood size, general layout and configuration of units (building type and design, building height-to-space ratio, division into small clusters, and number of dwelling units that use the same building entrance), configuration of open spaces (space between buildings, visual and functional accessibility from a dwelling unit to open spaces, and landscaping), respect for privacy, diverse elevation designs, noise infiltration, mix of use, location of community services, and inclusion of natural or green elements (Mousavinia et al., 2019).

Some studies have confirmed the importance of physical environment and housing layout as integral components of perceived density and emphasize the negative relation between perceived density and some aspects, including sense of safety, social interaction, and quantity of living space (Dave, 2011; Raman, 2010). Architects and planners decide on the housing layout to create a frame to organize hard surfaces, open spaces, vegetation, and the functions provided by these surfaces (Tahvonen and Airaksinen, 2018), influencing perceived density.

According to stimulus overload model, crowding perceptions are most incredible when the individual is unable to reduce that stimulation through adaptive strategies and the level of social stimulation exceeds that desired (Gramann, 1982). It is hypothesized that high-density environment causes further unpredictability and creates situations for inhabitants with less or no control (Evans and Lepore, 1992; Altman, 1975). As shown in previous studies, territoriality mediates the effect of perceived density on social outcomes (Mousavinia et al., 2019). Territoriality as a central property of defensible space is by definition a "person's behavioral expression of her/his feelings of ownership toward a physical or social object" (Brown and Zhu, 2016, p.55). Territoriality is also specified as "the capability of the physical environment to provide perceived zones of territorial influences" (Newman, 1972). According to Brown and Zhu (2016), our claims are marked off and protected only through interactions with other people. Territorial behaviors express ownership over an object and focus on establishing, communicating and maintaining an individual's relationship with that object relative to others in the social environment.

2.2.2. Crowding as social interference, moderation role of perceived interior crowding

The principal assumption of the social interference model as the second primary theoretical model in the crowding literature is that much of people's behavior consciously or subconsciously motivated by the desire to achieve a variety of psychological states, such as solitude, stress release, or social interaction. This model emphasizes density-related interference with various psychological "goals" motivating a behavior (Evans and Lepore, 1992; Proshansky et al., 1970; Gramann, 1982). There is a robust relation between perceived interior crowding and behavioral outcomes (Nagar and Paulus, 1997; Baum and Paulus, 1987). Homes with higher interior densities may make it more difficult for individuals to be away from others when desired; hence, they perceive high density-related crowding.

2.3. Gated and non-gated communities

The gated communities that emerged over suburbanization procedures in the USA in the early 1980s (Blakely and Snyder, 1997) are determined as physical spaces separated from their surroundings by fences or walls (Zhao and Zou, 2017; Low, 2008). They consist of a number of housing units with their own private access but shared spaces and facilities with other units (Lai, 2016, p.379). Based on the first group of research, gated communities increase place attachment (Lu et al., 2018) and the sense of community due to the increased commonalities and group territory (El-Ekhteyar and Furlan, 2016; Serife, 2007). In contrast, the second group noticed the negative impact of gated communities on social cohesion (e.g., Pow, 2015; Atkinson and Smith, 2012) and reductions in neighborliness regarding privacy concerns among homeowners. Some studies have argued that gated communities separate 'good' people inside and the 'bad' remaining outside (Low, 2003). The community enclosure leads to urban segregation on the macro scale and physical/social fragmentation of urban areas. Consequently, enclave areas produce a highly unequal society and unhealthy neighborhoods (Elhadary and Ali, 2017, p.52).

According to Lai (2016, p.380), a community can be gated, but gating in itself does not produce a community in the true sense of the word. Numerous researches deal with various aspects of community enclosure compared to other residential environments. For instance, Zhang and Zheng (2019) demonstrated that urban gated communities differentiate from gated villages and the consequences of the gated village are in general positive. Focusing on the co-evolution of private and public neighborhoods, Woo and Webster (2014) declared that this is too simple a characterization, to consider gated communities as steps towards the privatization of the public realm. The social impact that enclosure has on a community has been under-researched to date. Some studies have compared different variables such as fear of crime (Breetzke and Cohn, 2013; Vilalta, 2011) and sense of community (Blandy and Lister, 2003; Serife, 2007) in gated and non-gated communities, and the majority of these works have demonstrated a significant difference between the two types of communities (Roitman, 2010). Thus, it can be assumed that gated and non-gated communities are different in inherent social processes.

3. Research design and methodology

3.1. Research model and hypotheses

Some findings emphasized the effect of control in relation between density and social outcomes (Evans and Lepore, 1997, p.269; Gormley and Aiello, 1982; Altman, 1975) and in particular highlighted the mediational role of territoriality in relation between perceived density and social interactions in gated communities (Mousavinia et al., 2019). Although it is essential to understand how perceived density-induced from design and housing layout- may influence social outcomes for specific individuals, a better understanding of how high interior density through perceived interior crowding might affect this process is needed.

The relation between two variables is explained by the mediator as a third variable. The term moderated mediation is used to convey instances when the mechanism through which independent variable affects dependent variable is moderated by a fourth variable, such that the indirect effect is different at different values of moderator (Edwards and Konold, 2020). In summary, the present study constructed a moderated mediation model (Fig. 1) to examine the mediating effect of territoriality on the link between perceived density and social interactions of residents in gated and non-gated communities with the moderating role of perceived interior crowding. This model could provide further implications for reducing the negative impacts of density based on residents' subjective evaluation and from the view of environmental psychology.

First two assumptions of this study are associated with the relationships between perceived density, territoriality, and social

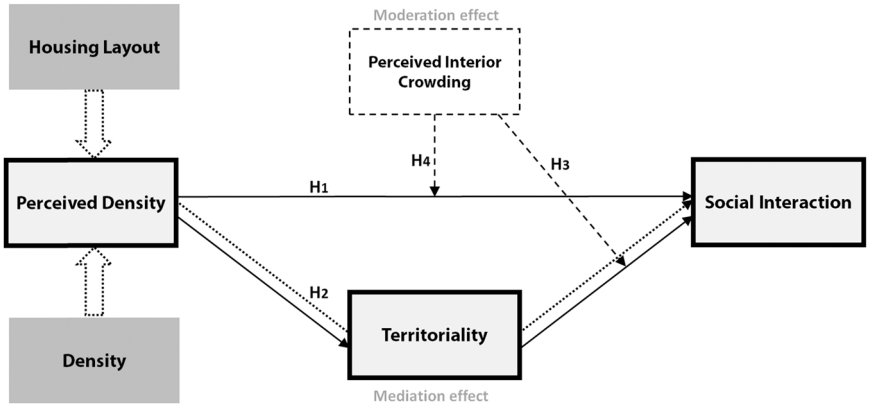


Fig. 1. Research model and hypotheses diagram.

interactions as follows:

H1: There is a negative relationship between perceived density and social interactions.

H2: The relationship between perceived density and social interactions will be mediated by territoriality in both groups of gated and non-gated communities.

Tests of moderation can be particularly useful for evaluating whether relationships hold across situations, settings, and people (Edwards and Konold, 2020). This study has hypothesized the following:

H3: The impact of territoriality on social interactions is moderated by perceived interior crowding in high-density residential environments.

H4: In high-density residential environments, perceived interior crowding moderates the impact of perceived density on social interactions.

3.2. Study areas and neighborhoods features

In the second largest city of Iran, Mashhad, gated communities have become the dominant housing form with middle-class occupants. They are primarily residential and few have any commercial or institutional uses within them. Prior studies have suggested that perceptions and social impacts in residential environments are associated with commercial land use (Sohn, 2016), location of the community, the number of destinations, the adequacy of the facilities (Jones et al., 2017, p.4), socio-economic status (SES) of residents (Wood et al., 2008), and the residential density of neighborhoods (Raman, 2010). The following criteria were considered in selecting the study areas. First, the neighborhoods were selected as closely as possible with comparable area-based status. Accordingly, control included the proportionate averages of the median housing rate and household income score. Second, the distance between neighborhoods and commercial centers and year of construction (between 15 and 20 years) were considered. Ultimately, density impacts were considered using net residential density as a simple density measure (dwelling units per hectare). Three gated and non-gated neighborhoods, depicted in Table 1, possess comparable net residential densities, same housing types (mid-rise apartments), and various housing layouts.

3.3. Sample size and participants

The levels of social impact and perception of habitats will depend significantly upon the socio-economic context of the residential environment and several demographic factors (Jones et al., 2017, p.4). It has been indicated that gender is an important variable affecting crowding (Xiao and Hong, 2018). There is also a strong relationship between the residents' quantity of social contacts at the neighborhood level and socio-demographic variables such as homeownership and length of residence (Wilson-Doenges, 2000). Consequently, a questionnaire was distributed among women with the same homeownership (being the owner) and at least five years of residence in the area.

Monte Carlo power analyses are the best practices for determining power and sample size in mediation models. Using the continuously varying sample size approach to Monte Carlo power analysis (Schoemann, 2017), approximately 250 questionnaires (for each group) was required to ensure statistical power is at least 90 % for detecting the hypothesized indirect effect (see Appendix A for more details). Data were collected from March to April 2018, before the state of emergency due to COVID-19 was declared. From 538 returned questionnaires, 16 of them were excluded for incomplete answers, leaving a final sample of 522 participants. The distribution of the participants based on the socio-demographic features is summarized in Table 2.

Table 1
Study areas.

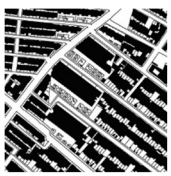
	Gated			Non-Gated		
						
Area(m^2)	51540	25775	21637	60075	57147	50298
Number of dwelling units	612	312	238	640	600	545
Net residential density	118dph	121dph	110dph	106dph	105dph	108dph
Housing layout	Courtyard form	Super block	Linear block	Non-linear	Cul-de-sac	Row houses
Floor area per person (m^2)	29.29	28.46	30.39	25.10	22.60	29.30

Table 2
Participant socio-demographic and descriptive statistics.

variable	Gated			Non-Gated		
	N = 253			N = 269		
	M	SD	Range	M	SD	Range
Age (years)	36.7	9.52	18–75	34.7	10.15	18–68
Person per family	3.66	0.82	2–6	3.69	0.94	2–6
Home area (m^2)	93.3	14.75	60–135	99.6	13.64	50–140
Home area per person (m^2)	**27.02**	**9.02**		**30.32**	**10.00**	

3.4. Measures

To assess the research variables, a questionnaire was designed presenting the items associated with socio-demographic features and questions related to latent constructs. In this scale, a 5-point Likert type response pattern was used with the score range of 1 ("Agree strongly") to 5 ("Disagree strongly").

Independent variables: Six variables of the housing layout affecting perceived density, noted in prior studies (Bonnes et al., 1991; Dave, 2011; Pourdeihimi et al., 2017), were used to measure perceived density including (a) space between buildings, (b) appropriate buildings' height and volume, (c) view from home, (d) visual exposure, (e) existence of green spaces, and (f) presence of cars and organization of parking lots.

Dependent variables: Measuring the social interaction as an outcome variable was included (a) knowing people in the neighborhood, (b) trusting the neighbors, (c) looking out for one another, (d) shared help among neighbors, and (e) frequency of interacting with neighbors (Liu et al., 2017; Zhu and Fu, 2017; Abu-Ghazzeh, 1999; Wilkerson et al., 2012).

Mediator variable: Territorial functioning conveys a nonverbal message of control originated from protecting space, personalization, defense against intrusion, and exterior house maintenance (Abdullah et al., 2015). Measuring territoriality was based on (a) perceived ownership, (b) identity-based marking (personalizing), (c) control-based performances (accountability for the individuals, circumstances and actions), and (d) spatial territory and access to communal space (Brown and Zhu, 2016).

Moderator variable: Perceived interior crowding is explained as the perceptions of a person of spatial restriction (due to too limited space or too many individuals within a space) (Rollings and Evans, 2019). In this study, the used perceived interior crowding scale was modeled on four underlying dimensions, which were labeled by Nagar and Paulus (1997) as (a) space satisfaction, (b) positive relations, (c) negative relations, and (d) uncontrolled disturbance.

3.5. Data analysis

Smart-PLS software was used to estimate research model for each group of gated and non-gated communities. Also, the Bootstrap method which reconstructs the sample by random sampling with replacement of the meta-sample was used to test the significance of the regression coefficients. This study constructs 5000 samples, the standard error and confidence intervals for the parameter estimates were obtained. If the confidence interval does not contain 0, the result is significant.

4. Results

4.1. Descriptive statistics

Table 3 presents factor loading for indicators, Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE) for each variable. While, in gated areas visual exposure and overlooking has high factor loading in perceived density indicators, visual relations to communal open spaces and the presence of greenery are important in non-gated areas.

Table 3
Factor loading, Cronbach's Alpha, Reliability, and Validity.

Construct	Gated					Non-Gated				
	Indicators	Factor loadings	Cronbach's Alpha	CR	AVE	Indicators	Factor loadings	Cronbach's Alpha	CR	AVE
PD			**0.81**	**0.87**	**0.53**			**0.84**	**0.88**	**0.58**
presence of cars and organization of parking lots	D9	0.66				D5	0.81			
presence of green spaces	D8	0.52				D2	0.82			
view from home	D7	0.76				D4	0.89			
visual exposure	D6	0.81				D6	0.75			
space between buildings	D3	0.78				D3	0.80			
suitable volume and height of buildings	D1	0.78				D10	0.38			
PIC			**0.81**	**0.87**	**0.64**			**0.80**	**0.86**	**0.61**
uncontrolled disturbance	P1	0.72				P1	0.84			
space satisfaction	P2	0.88				P2	0.91			
positive relations	P3	0.86				P3	0.56			
negative relations	P4	0.70				P4	0.77			
SI			**0.80**	**0.86**	**0.56**			**0.79**	**0.85**	**0.55**
knowing people in the neighborhood	S4	0.87				S1	0.69			
trusting the neighbors	S9	0.72				S10	0.73			
looking out for one another	S1	0.67				S4	0.79			
shared help among neighbors	S7	0.83				S9	0.72			
frequency of interacting with neighbors	S3	0.64				S7	0.75			
TE			**0.79**	**0.86**	**0.62**			**0.77**	**0.85**	**0.59**
perceived ownership	T6	0.82				T5	0.73			
control-based performances	T8	0.81				T8	0.80			
spatial territory and access to communal space	T9	0.64				T9	0.81			
personalization and identity-based marking	T7	0.85				T7	0.72			

Notes: CR = composite reliability; AVE = average variance extracted; PIC = perceived interior crowding; PD = perceived density; SI = social interaction; TE = territoriality.

4.2. The moderated mediation models

After standardizing the data, multicollinearity tests were conducted. It was found that the variance inflation factors (VIF) of all predictors were all lower than 2; hence, the multicollinearity problem can be excluded. Smart-PLS software was adopted to test the moderated mediation model, in which perceived density was included as the independent variable, territoriality was included as the mediator, and social interaction was the dependent variable. In addition, perceived interior crowding was also incorporated as a moderator of paths from territoriality and perceived density to social interactions. Two moderating roles of perceived interior crowding were assessed in each group. The moderating role of perceived interior crowding in the relationship between territoriality and social interactions in non-gated communities and its moderating role in the relationship between perceived density and social interactions in gated communities was not significant. Therefore, two models are discussed below.

In gated communities (Fig. 2), a significant relationship between perceived density and territoriality was represented in the first step (B=−0.44, $p < .001$). In the second step, territoriality had a significant direct effect (B=0.65, $p < .001$) on social interactions and finally, the indirect effect of perceived density on social interactions in the third step was significant (B=−0.29, $p < .000$), supporting H2. A strong correlation between territoriality and social interactions in gated communities was represented by the results.

In non-gated communities (Fig. 3), first, perceived density had a significant direct effect on social interactions (B=−0.24, $p < .001$) and territoriality (B=−0.29, $p < .01$). Second, territoriality had a significant direct effect on social interactions (B=0.20, $p < .01$). Finally, the indirect coefficient (B=−0.06, $p < .001$) of perceived density to social interactions was significant, supporting H1 and H2.

A moderator conditions the effects of the predictor variable on outcome(s) and unlike the case of the mediator, needs to be uncorrelated with the predictor variable (perceived density). It is desirable but unnecessary that the moderator and the outcome (dependent variable) be uncorrelated. Because the considerable relationship between a supposed moderator and an outcome indicates that the hypothesized moderator might not be a conditioning variable; rather, it is an intervening mechanism, as the resultant variables are directly affected by this moderator (Evans and Lepore, 1992). Also, establishing a significant relationship between two variables is not a necessary pre-condition to testing for moderation, as evidence of an association between two variables may sometimes only be found when considered in the context of a third moderating variable (Aguinis, 2004). Referring to Table 4, there was no significant correlation between perceived interior crowding as a moderator and social interaction as an outcome variable. This result enables us to distinguish perceived interior crowding as a moderator and conditioning variable.

As shown in Table 4, in the case of gated communities, perceived interior crowding moderates the effect of territoriality on social interactions, supporting H3. In the case of non-gated communities, in particular, perceived interior crowding moderates the effect of perceived density on social interactions, supporting H4.

4.3. Interaction effects

Based on the significant moderation effect, the interaction plot was used to interpret the nature of interaction following the guidelines of Dawson (2014). Figs. 4 and 5 display the analysis of simple slope for each interaction terms on social interactions. Fig. 4 shows that the line labeled for a higher level of perceived interior crowding has a steeper gradient than the lower level of perceived interior crowding for the association of territoriality with social interactions. Thus, the association between territoriality and social interactions will be stronger at a higher level of perceived interior crowding.

In non-gated communities, the interaction terms of perceived density and perceived interior crowding are positive and significant. Fig. 5 shows that when perceived interior crowding is high, the line for the association of perceived density and social interactions has a steeper gradient. Thus, the adverse effect of perceived density on social interactions will be stronger at a higher level of perceived interior crowding.

5. Discussion

The present research contributes to the human-oriented approach to density in two ways. First, by focusing on perceived density, this work examined the effect of residential density and housing layout on social outcomes. Second by testing mediation moderated models in two groups of gated and non-gated communities, this investigation explored the potential of perceived interior crowding to moderate the relationships between perceived density and social ties in the study areas.

5.1. Mediational role of territoriality

The current SEM results were consistent with the assumption that a high perceived density is related to low social interactions in gated and non-gated communities. Perceived density is reflected upon the physical

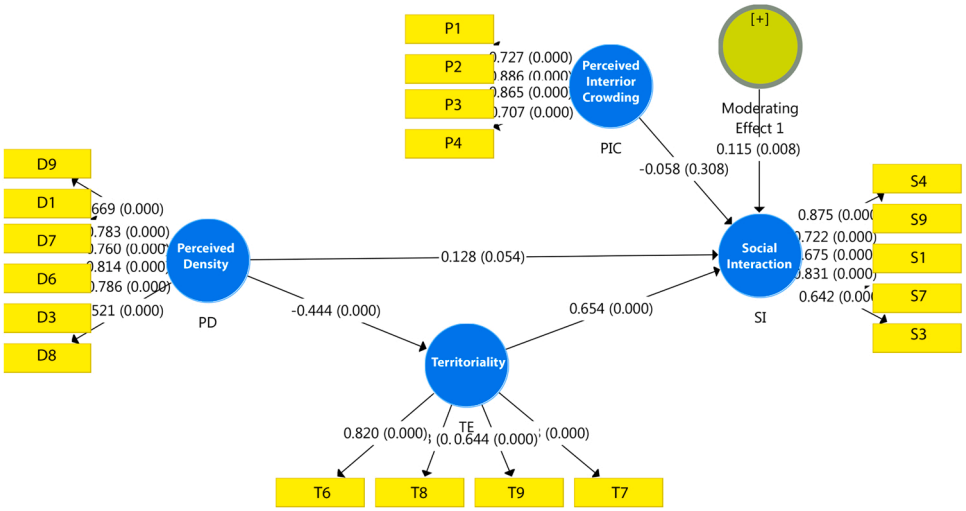


Fig. 2. Gated communities- mediated moderation model. The effect of territoriality on social interactions is moderated by perceived interior crowding.

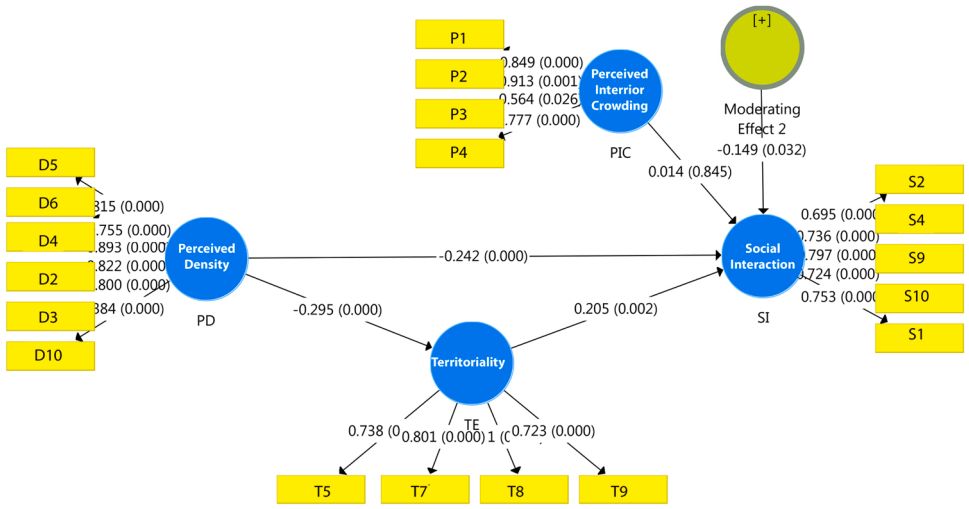


Fig. 3. Non-gated communities. The effect of perceived density on social interactions is moderated by perceived interior crowding.

Table 4
The moderation effects of perceived interior crowding in two groups, using the Bootstrap Method.

	Gated					Non-gated				
	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Moderating Effect of PIC on(TE>SI)	0.115	0.115	0.044	2.615	**0.009**	–	–	–	–	–
Moderating Effect of PIC on(PD>SI)	–	–	–	–	–	-0.149	-0.135	0.069	2.175	**0.030**
PD -> SI	0.128	0.134	0.067	1.907	**0.057**	0.242	0.243	0.065	3.697	**0.000**
PD -> TE	-0.444	-0.451	0.049	9.130	**0.000**	0.295	0.304	0.050	5.869	**0.000**
PIC -> SI	-0.058	-0.069	0.058	1.002	**0.316**	-0.014	-0.033	0.073	0.199	**0.842**
TE -> SI	0.654	0.657	0.049	13.403	**0.000**	0.205	0.207	0.067	3.051	**0.002**

Note: *p < .05. **p < .01. ***p < .001. Using the Bootstrap Method.
PIC = perceived interior crowding; PD = perceived density; SI = social interaction; TE = territoriality.

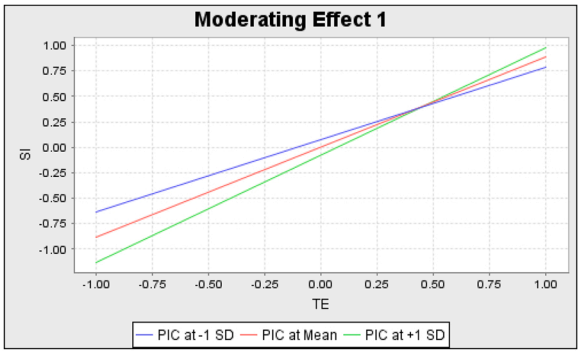


Fig. 4. Plot for the interaction effect of perceived interior crowding and territoriality on social interaction in gated communities.

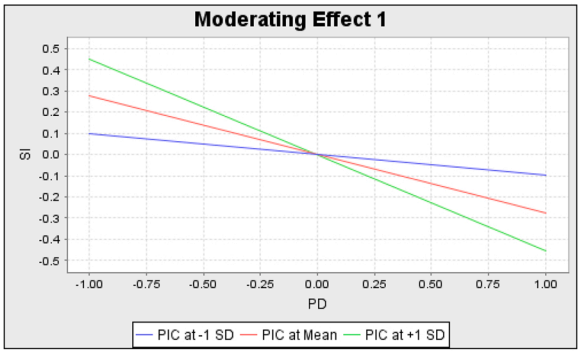


Fig. 5. Plot for the interaction effect of perceived interior crowding and perceived density on social interaction in non-gated communities.

form, layout, and design (Mousavinia et al., 2019). Therefore, in determining the optimal density, attention should be paid to the experience and perception of density resulting from the design. Visual exposure and overlooking may be perceived as more of a problem in gated areas. In comparison, in non-gated areas, design attributes such as visual relations to communal open spaces and presence of green spaces may affect density perceptions (Table 3), as Kearney's study (2006) showed. Based on the importance of visual access to communal spaces in perceived density indicators, it can be suggested that community surveillance or "eyes on the street" (Jacobs, 1961) is a vital piece of the territorial puzzle within non-gated communities.

It is helpful to note that the theory development can be enriched by mediation analyses and insight into the mechanisms explaining a relation between two variables. By understanding these mechanisms, it is possible to make effective intervention decisions and policies (Wells and Harris, 2007). In both gated and non-gated communities, the mediational role of territoriality confirms that the lack of appropriate territorial functioning results in a decrease in social ties in high-density environments. Based on factor loading of territoriality indicators, the current findings highlight the importance of personalization and

perceived ownership in gated communities. These results share several common points with previous findings focused on explaining the role of personalization in marking territory and stating individuals' identities to others (Laurence et al., 2013; Perkins et al., 1996). Meanwhile, in non-gated communities, the high factor loading of spatial territory in territoriality indicators suggests its important role in mitigating negative impacts of high levels of perceived density. Previous studies have indicated that social interaction and privacy are two issues that must be in balance (Altman, 1975). Isolation is caused by an overemphasis on privacy, and the loss of a private life results from out-of-control interactions. Regarding non-gated communities, physical privacy presented by a spatial territory is required for social performances.

The considerable direct effect of perceived density on social interaction is noteworthy in non-gated communities, emphasizing the significance of subjective judgments of situations. The results of this investigation complement those of earlier studies that assumed numerous environmental features are related to perceived safety by their capacity to create natural surveillance (Newman, 1972). Finally, social interaction can be occurred when residents feel safer and they have more opportunities to view and control outside (Foster et al., 2010).

5.2. Perceived interior crowding as a moderator

Although the association between two variables is explained by the mediators, moderators address the conditions under which two variables are related or the circumstances affecting the nature of the relationship (Wells and Harris, 2007). Residents' lives are mostly spent inside their dwellings, and their total stated feelings are strongly associated with the way space is organized within the dwelling unit. Based on the literature review, crowding is a widely acknowledged source of psychological response and behavior that detracts from housing quality (Rollings and Evans, 2019; Laurence et al., 2013).

In gated communities, the findings indicate that when perceived interior crowding is high, a higher level of correlation exists between territoriality and social interactions. This finding does not support the idea that residents' capability to retreat into completely private space induces aggressive boundary-control behavior in public (Zimring, 1981). In non-gated communities, higher levels of negative correlation were found between perceived density and social interactions when perceived interior crowding was high. This finding is in line with previous studies. For instance, the results of a study in London indicated that when residents' homes are overcrowded, they perceive their locality with higher density (Burdett et al., 2004). Residents with a high level of interior crowding may be less capable of regulating social and visual contact, influencing their sense of personal control (Brown et al., 2009). Furthermore, incapability to control social interaction was connected to psychological distress and helplessness (Evans and Stecker, 2004). Residents who perceive more control over open spaces and a pleasant view from their home may experience weakened impacts of perceived interior crowding.

Supporting previous findings (e.g., Thornock et al., 2019), the moderating role of perceived interior crowding show that perceived density and perceived interior crowding are different experiences. Individuals' feelings about their spaces influence their relationships with others and considerably affect the procedures occurring within the residential environment.

6. Conclusion

Although the density is crucial to managing the sustainability of urban areas, some concerns have emerged about its social impacts in high-density environments. On the one hand, due to the necessity of implementing a more people-oriented urbanization policy, there is now a growing body of literature measuring social impacts of residential density based on individuals' perceptions and emphasizing the effects of the built environment. On the other hand, in some countries, when planners propose a new urban neighborhood, the gated community is usually the default neighborhood form (Zhao and Zou, 2017, p.78). This type of neighborhood has become the choice for many people in Iran. It is assumed that gated communities can create a sense of neighborhood identity (Blandy and Lister, 2003); however, criticism of enclosing residential environments indicates that gated areas can have adverse impacts on the sociological system of their community (Elhadary and Ali, 2017). Addressing density and community enclosure impacts, urban planners and designers can be effective in designing urban spaces which encourage social cohesion among residents. It is crucial for those making future policy decisions for gated and non-gated communities to comprehend social impacts considering both subjective and objective measurements.

The aims of the current study were (a) to evaluate the link between perceived density and social interactions on a neighborhood scale while controlling for residential density and socio-economic status; (b) to investigate the mediating role of territoriality in the relationship between perceived density and social outcomes (c) to explore the moderating role of perceived interior crowding, and (d) to compare these relations in gated and non-gated communities.

The findings showed that it is misleading to regard gated communities in the same way as non-gated communities. Similarities and differences exist between the two in mechanisms of social processes. The results of the presented models (Fig. 6) suggest that in both groups of communities, territoriality mediates the effect of perceived density on social interactions. The psychological procedures, including the perception of environmental cues and the social processes inherent in residents' informal control affecting the residents' territoriality, can explain the relationship between density and social interactions.

This study provides strong empirical evidence that arousal and control are distinct mechanisms (Evans and Lepore, 1992). Density has a mediated impact on the social consequences explained by territoriality and control. This would be true as long as arousal as an additional mechanism intervenes between density and behavior. Perceived interior crowding can intensify the adverse impacts of perceived density and negatively affect residents' social interactions. It appears that perceived interior crowding is significant in understanding how housing layout influences social interactions. These findings underscore the notion that perceptions of how one feels about the space within the home environment impact social dynamics.

The findings of this research have considerable implications for policymakers on promoting more sustainable housing environments

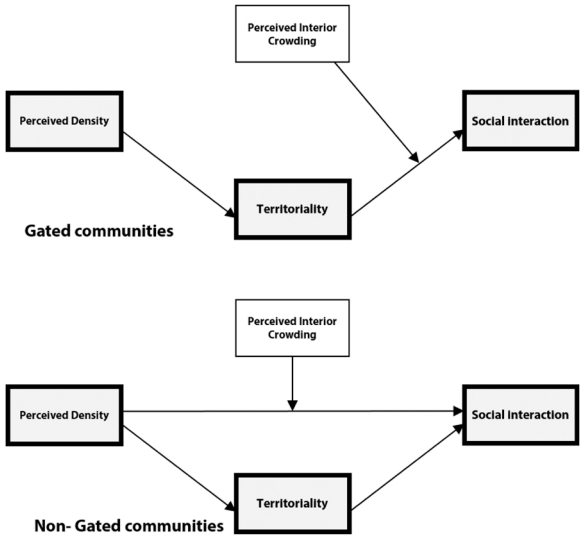


Fig. 6. Mediated moderation models in gated and non-gated communities.

especially in the context of developing countries. First, at the moment, urban planning usually occurs via a top-down approach using the concept of residential density as the number of dwelling units per area. However, focusing on the quantitative dimension and providing ranges for 'optimum' densities is not sufficient. Quantitative measurements, standards, and benchmarks for sustainability in the built environment cannot explain how space supports social outcomes. This goes in line with the literature, in which top-down approaches to housing policies are typically criticized for lacking an understanding the contextual conditions and challenges deeply grounded in reality (Iaione, 2016). Housing policies need to be more flexible in their conceptualization of density. Although the taxonomy of density may provide a useful starting point for policy-makers, considering various types of density and knowing more about their interaction effects is important.

Second, since gated communities did not appear overnight, they will not disappear in the short run and certainly will be the major landscape of Iranian cities for decades (Einifar et al., 2019). Therefore, there is a need for a holistic approach to looking for a way to make them more livable. The key design attributes in gated and non-gated communities can be different from each other depending on the cultural context. In this regard, in gated communities, providing visual privacy and a lack of visual exposure contributes to lower level of perceived density. This study indicates the importance of environmental affordance to definition of boundaries and emergence of personalization to reduce the adverse effects of high levels of perceived density. Instead, a lack of control and visual contact with nature in non-gated communities leads to the higher level of perceived density and spatial territory can counteract the adverse effects of high levels of perceived density.

Third, the most important implication of these findings for policy formulation is that the provision of adequate physical distancing and marked territories in shared spaces coupled with dwellings adaptable to user's need remain necessary prerequisites to ensuring improvement of resident's social life in cities. This study highlights the need to support people in middle-class neighborhoods, where many families live in crowded households. Such support could include, for example, investments for deigning affordable homes where individuals could have privacy and find suitable spaces. A greater understanding of the needs and expectations of residents are required for density-based solutions.

The current study makes several theoretical implications in housing literature. The first theoretical contribution is that the study covered the gap where most of the previous studies investigate the relationship between quantitative densities with several behavioral factors, neglecting the role of community enclosure. Second, this study considers as one of a few studies empirically investigated the relationship between density and social outcomes within developing countries where cities are growing rapidly due to their high economic growth rate, and at the same time they are facing serious challenges of housing. Third, current study findings related to crowding models and interpretations of significant hypotheses as described in the discussion will boost the related knowledge, distinguishing between gated and non-gated communities.

The present work may be valuable for researchers who seek to better comprehend the multiple factors influencing the social life in residential environments. This study has several limitations that could be potential for further research. First, using cross-sectional data limits the results. In terms of future research, a longitudinal study is required to better comprehend the relationship between the variables over time. Second, the critical point here is that the level of social impacts will depend significantly on the socio-economic context of residential environment. Considering the socioeconomic status of residents as a control variable, this study is also limited to neighborhoods with similar SES, representing a small portion of the world's socioeconomic, environmental, and cultural experiences. A better comprehension of the role of SES will be possible by studying a more differentiated neighborhood selection. For example, focusing on low-income populations who encounter multiple psychological and environmental stressors (Abdul Aziz and Sani Ahmad, 2012) is suggested. Finally, to direct housing policies in high-density living circumstances, it is essential to identify multiple design features affecting the perception of density and the design elements that enable people to deal better with high interior densities.

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Data availability

Data will be made available on request.

Appendix A

The application for Monte Carlo power analysis for mediation models was used to determine the sample size. To facilitate use of the power analysis method based on Monte Carlo confidence intervals, Schoemann et al. (2017) created an application (Available at: https://schoemanna.shinyapps.io/mc_power_med/). The default option in the app is to enter a correlation matrix and the standard deviations of the variables, which are used to transform the correlation matrix to a covariance matrix. In the running sample size, Schoemann et al. (2017) suppose that focal predictor X correlates with the mediator M at approximately.35, M correlates with the outcome variable Y at approximately.25, and the X and Y variables correlate at approximately.10. Additionally, they suggested the standard deviations of X, M, and Y to be 1.00, 1.50, and 2.00 respectively.

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