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The Reflection of the Elderly's Attendance and Perception of Architectural Spaces on Cognitive Maps

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Abstract

The present study examines behavioral and cognitive responses of the elderly about spatial specifications in Kahrizak Nursing home. A simulation was performed in Depthmap. The results represent adaptive and maladaptive behavioral responses of older adults toward spatial configurations of their environment. The study population consisted of 40 senior citizens (60-80 years old) living in Kahrizak Nursing home with cognitive abilities and ability to walk. The comparability of the role of spatial syntax of the environment and the obtained cognitive maps with the elderly's sociability behaviors was examined. The study was carried out in two phases including qualitative and quantitative phases. Information gathering was done through a document-library method and the status quo in the study environment was examined through field observation. In addition, the required data was gleaned through interview and cognitive maps techniques. Two types of analyses, namely VGA and ISOVIST, were used in space syntax, which were eventually compared to the cognitive maps drawn by the elderly. The results indicated a significant relationship between the results of spatial syntax and the cognitive maps based on the elderly's perception of the space. Therefore, highlighting some spaces or neglecting others in the cognitive maps was because of the specifications and physical structure of the compound. The spaces that did not play a role in the mental perception of the participants were examined and a few recommendations were made to improve perceptibility of the spaces by the users.

Keywords*: Cognitive map, elderly, architectural space, nursing home, space syntax*

Introduction

Population aging is a growing concern of this century, which affects all aspects of society including health, social security, environment, architecture, sociocultural activities, and family. In light of this, determining the structural patterns in the perception process of the elderly is a major challenge in designing architectural spaces. Man's perception of space is recorded as a schema in their long-term memory. The schema, indeed, is an experimental tool to perceive the collected information from the environment (Knez, 2003, p.52). The purpose of the present study is to provide a perception of the elements that play a role in the mental aspects of senior citizens. The main focus, in particular, was on nursing homes as a place for spending old age. The focus on nursing homes can be explained by the current public policies about aging and the fact that this is an ongoing research project on the importance of physical and social infrastructures of nursing homes to improve the quality of life of senior citizens. The authors tried to achieve a deep perception of older adults' interaction with nursing homes and examine the factors in everyday life experience and spatial perception in them. Through this, a

variety of themes were discussed about older adults' interaction with nursing homes using their perception of space. The subjective meaning that people have about a space or their spatial perception has a longer history compared to evolution of form and space function. Therefore, lack of a general spatial perception of an environment in the user leads to inconsistency between form and its function and failure of the user to interact with the space. This can interrupt the role of space in the user's mind. What we see in today's architecture is the inefficiency of different layers of perceptions in space. The interaction between individuals and physical spaces is a mutual relationship, so that when the person-environment system is affected, the user's behavior is also affected. Given this, the present work shows the way older adults living in a nursing home perceive their space. To be more specific, it appears that man's spatial experience is formed by their perception and spatial behavior and it interacts with the known physical environment. To examine perceptions of the environment, the authors need to introduce special ideas in their studies. In the same way, the present study introduces the results of examining perception of experienced spaces by senior citizens along with highlighting expectations from the environment using cognitive maps. Authors tried to extract the users' understanding of their environment. Therefore, the actual specifications of spaces were identified along with borrowing evidence from the users' expectations. The main objective was to identify the elements affecting perception and cognition of space in senior citizens using cognitive maps. Examining the relationship between space syntax and spatial perception of older adults are of other objectives of this study.

Theoretical framework

Space syntax is a graph theory used to analyze spatial layout in terms of user's movability and acceptance. Space syntax quantifies spatial design using topological distance approach in network analysis. In practice, it can be used for laying out streets or indoors and walled spaces (Zaleckis & Chmielewski, 2022). Space syntax theory is a way to express the relationship between the physics of architecture and human behavior (Kalantary et al., 2017). Using this method, designers can predict users' behavior in the designed environment. Thereby, this model can be used in designing process and establishing interaction between the physics of space and users' behavior. The concept of space syntax was first introduced by Prof. Bill Hillier in the UK in 1970. He believed that space can, to some extent, affect one's behavior (Chen, Junzhang, & Liang, 2022). Steadman, Hillier, and Hanson conducted studies in this field. In his book "*architectural morphology"* Steadman introduces this theory (Steadman, 1989), which is mostly about the theoretical foundations of architectural morphology and examines different probabilities in architectural spaces combination. In a book titled "*social logic of space"* Healer and Hanson elaborate on this theory and introduce justifying diagrams to simulate spatial patterns (Hillier and Hanson, 1984). Dawes et al. (2021) introduced, using spatial syntax theory, an efficient way to analyze the specification of spatial structure and showcased using axial analysis and the parameters in spatial analysis (Dawes, Ostwald, & Lee, 202). Space syntax theory is an attempt to describe and analyze urban and architectural spaces. The description can uncover the hidden social logics within the lower layers and give guidelines for other theories about sociocultural behaviors (Groat & Wang, 2013). Space syntax uses several spatial measures and the theoretical background and calculation process were introduced by Hillier and Hanson (1984) and expanded by Bafna (2003) and Peponis and Wineman (2002). In addition, Yamu et al. (2021) introduced a comprehensive review of space syntax concepts and analytical techniques. Perception means interpretation of feeling and it is a function of specific stimuli such as expectation, previous learnings, variable cognitive and emotional motivations, and the perceiver's decision and will (Khodapanahi & Irvani, 2000, p.33). Therefore, perception is formed by a sequence of events. As for architectural works, the perception process has three steps. Step one is the perception of the specifications of the work through the emotional perception system (Khodapanahi & Irvani, 2000, p33). Step two is where the data of the first step of perception is analyzed and step three implements rational analyses on the data of the previous step to form meaningful levels of oneself and associate them to the architectural work (Neisser, 1976). These three steps also represent who a space is experienced. The last step in the objective development is cognition that leads to one's ability to solve, alter, interpret, analyze, criticize, and evaluate things. Perception is a process inside any behavior and the source of all information extracted from the environment and phenomena. Separating the individual from the environment is not easy in perceptual processing as they are in a continuous interaction (Pakzad & Bozorg, 2014, p145). Developing cognitive maps is a process through which an individual acquires information about their relative situation and the position of a physical environment, encodes it, memorizes it, remembers it, and decodes it

(Long, 2008, p4). It is important to take into account the physical environment in perception when it comes to examining spatial cognition. The term "environmental cognition" is used by researchers to refer to man's ability to imagine and think about the world around them (Appleyard, 1973). Taking into account the breadth of the theoretical topics, a snapshot of the studies in this field is illustrated in Diagram 1.

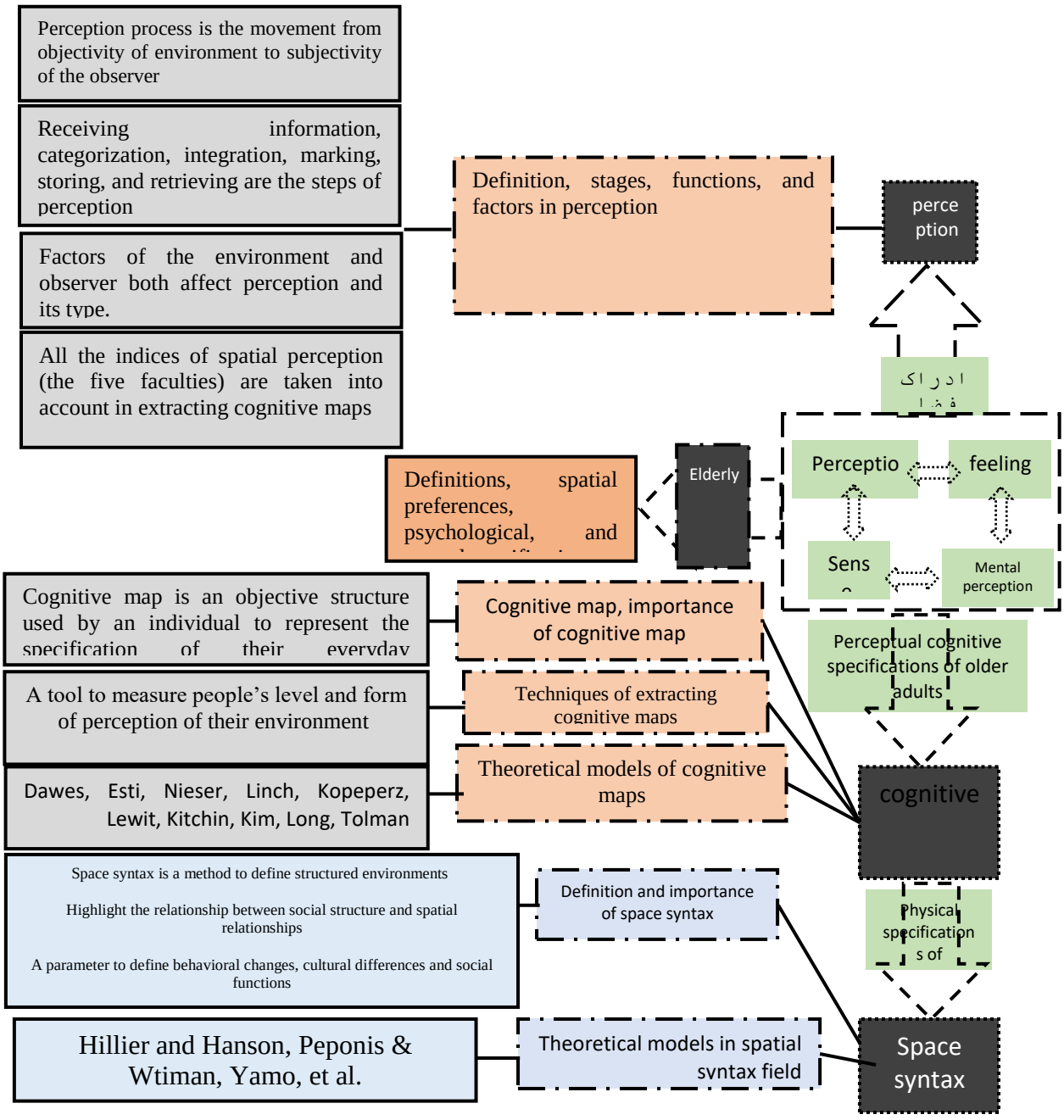


Diagram 1- Theoretical framework of the relationships between feeling, perception, cognitive maps, and spatial syntax (source: the authors)

Methodology

The study was carried out as a theoretical-applied work through a combined method. In terms of nature, the study was a combination of simulation method and descriptive-analytical method. Data gathering was done through library review and observation; if needed, field observation was also conducted. The plan axial map of

Kahrizak Nursing home was developed in Depth Map, which was then analyzed through logical reasoning through generating analytical maps and tables. Two types of analyses were used for space syntax.

1- VGA (relationship between spaces)

2- Isovist (observability)

Eventually, the analyses based on space syntax were compared with the older adults' cognitive maps and the relationship between cognitive maps and space syntax was examined.

The area under study

Kahrizak Nursing home is located at Dr. Hamikzade Blvd., further up Kahrizak Town, Old Qom Road, Tehran (Fig.2). The nursing home was opened in 1973 in a plot of land with an area of 420,000m2 and 180.000m2 roofed area as the largest nursing home in Iran. An aerial photo of the compound is illustrated in Figure 2. It is notable that Kahrizak Compound hosts MS patients and the disabled along with senior citizens.

Figure 2- Kahrizak Nursing home (source: Kahrizakcharity.com)

Figure 3 – Site plan of Kahrizak Nursing home (source: Authors)

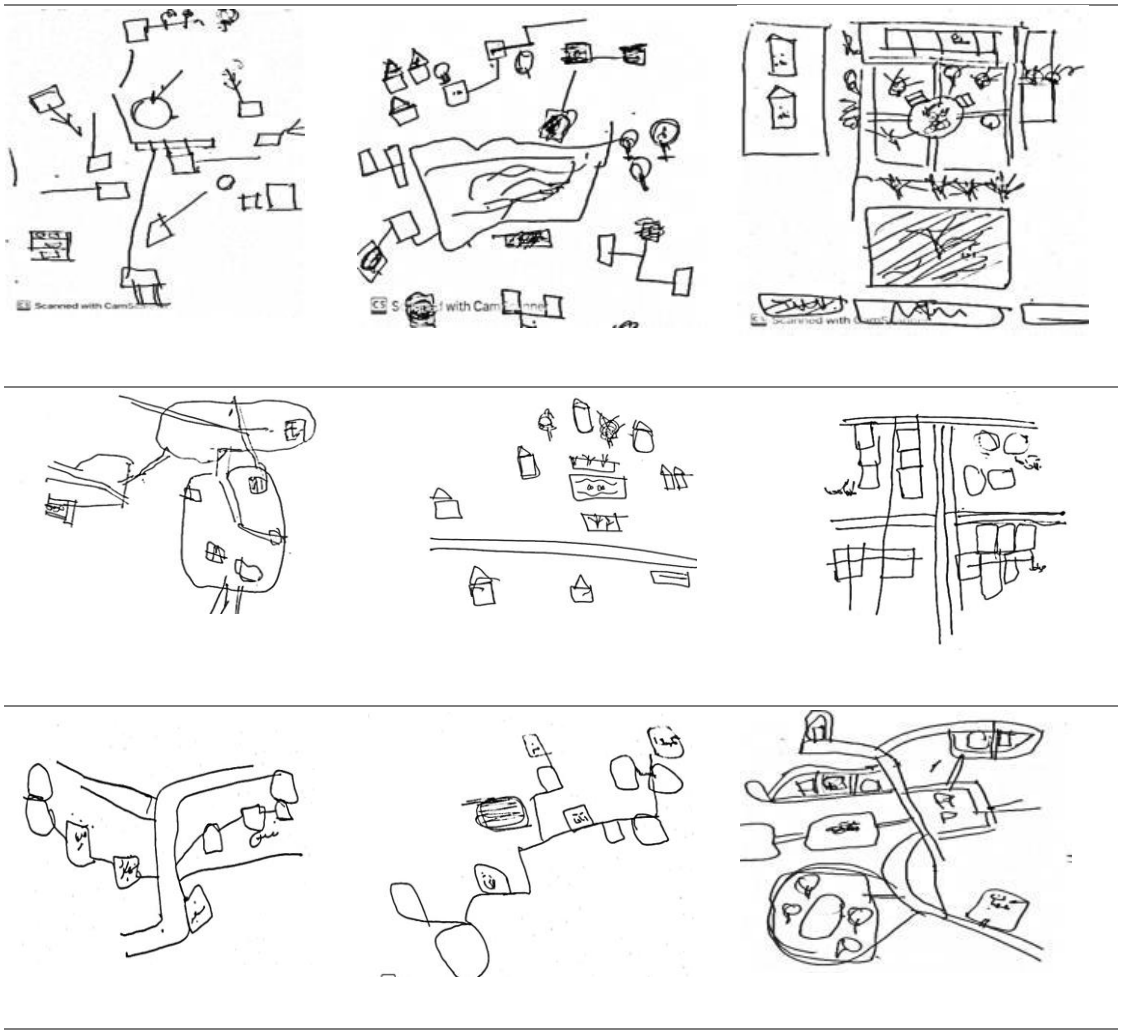
The study population included 40 older adults (60-80 years old) with general consciousness, ability to walk, high cognitive and walking performance, and a desire to participate in the study. The participants had no communication problems.

Findings

Findings based on Cognitive maps of older adults

The participants were asked to make a drawing of their surrounding environment along with all elements engraved in their mind. The maps were qualitatively examined and the spaces mentioned by the participants and those not mentioned in the maps were determined and compared with the results of space configuration. Some of the cognitive maps made by the participants are pictured in Table 1.

Table 1- Cognitive maps drawn by the participating older adults



Two types of space syntax analysis were used including VGA analysis (based on relationship of spaces) and Isovist analysis based on observability.

The findings based on Isovist analysis (visual quality)

Isovist analysis is used to examine visual quality so that a space is analyzed based on compactness, occlusivity, and drift magnitude.

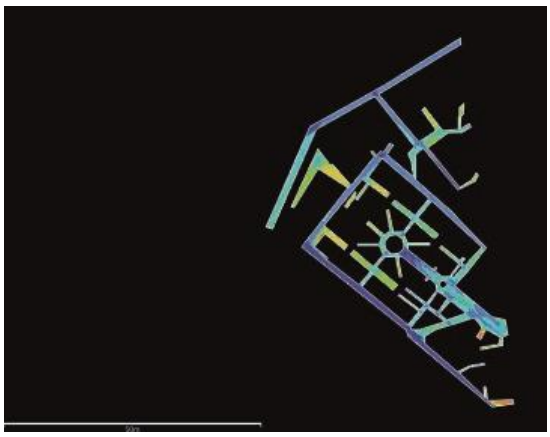


Figure 4- Analysis of compactness in the area under study

Figure 4 illustrates the analysis of the compactness so that warmer colors represent corners and spots with a lower compactness for the user. In addition, cooler colors represent spaces with a higher compactness. In this study, the sections at the edges of the compound have a better compactness and the sections leading to the dormitories and workshops have a low compactness.

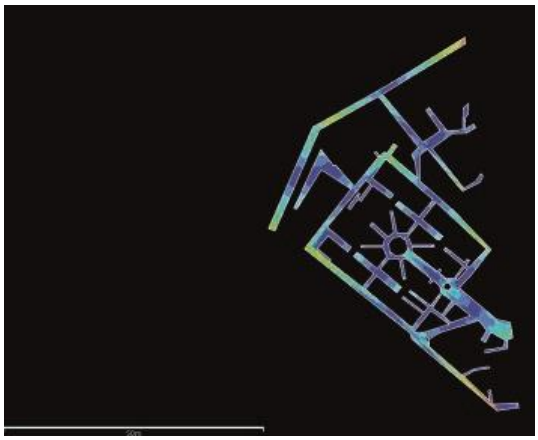


Figure 5- Analysis of drift magnitude in the area under study

Figure 5 illustrates drift magnitude in the area under study so that the cooler colors represent higher drift magnitude for the user, where activities and interactions are more frequent. Warmer colors represent repulsion magnetite. The image has a perfect match with the cognitive maps made by the participants. The routes leading to workshops and dormitories are spaces mostly neglected by the participating older adults.

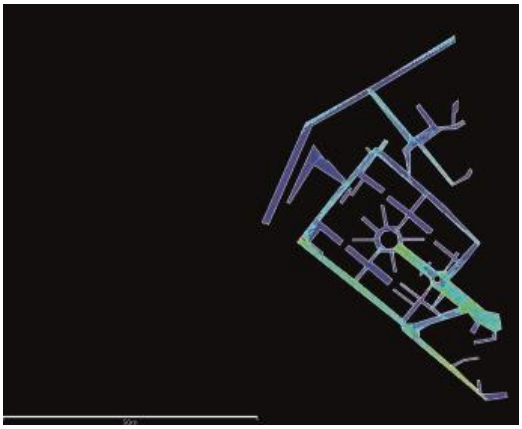


Figure 6- Analysis of occlusivity in the area under study

Figure 6 illustrates the level of occlusivity, which implies that users can discover specific points in the space when they are present in the space. The warmer colors represent spaces that have a higher potential for being discovered by users. Through a comparison of the cognitive maps and occlusivity parameters, it is clear that older adults are not interested in discovering new spaces. Spaces with higher occlusivity are the least emphasized spaces in the cognitive maps drawn by the participants.

Findings based on VGA analysis (relationship between spaces)

The VGA analysis relies on measuring the relationship between spaces and a space is analyzed using parameters controllability, integration, and clustering coefficient.

Figure 7- Analysis of Controllability in the area under study

As illustrated in Figure 7, the warmer colors represent spaces invisible for the observer (cozy corners) and cooler colors represent spaces where interactions are more common (spaces where users have a wider space under control).

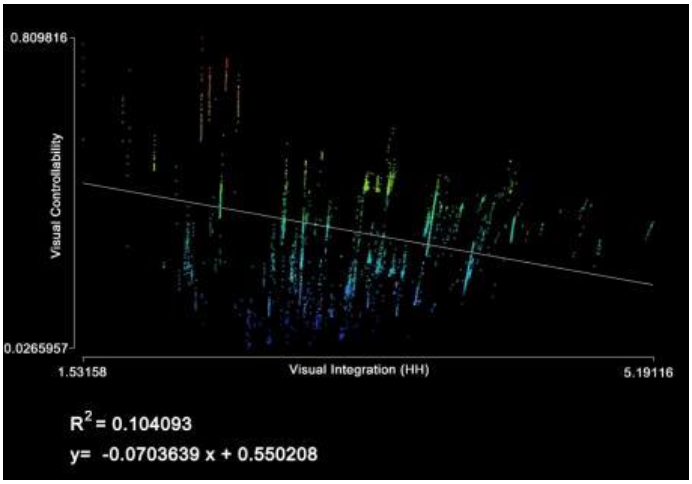


Figure 8 – Diagram of the correlation of interactive spaces

Taking into account the value of R2 in Figure 8, this compound does not have acceptable interactive spaces. The dark points at the lower section of the diagram represent spaces that are suitable to trigger an interaction between users. Therefore, to improve interactions in the uses, more emphasis should be placed on such spaces.

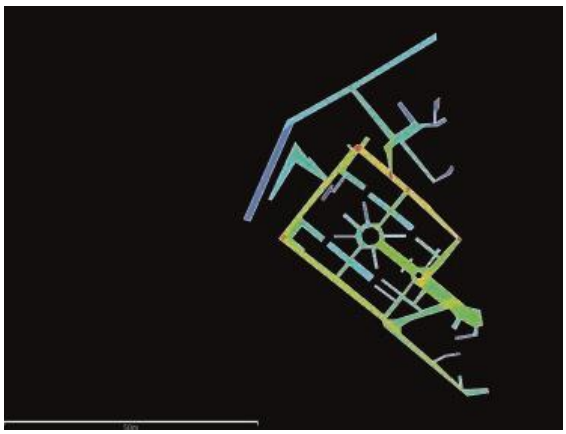


Figure 9- Analysis of integration in the area under study

Figure 9 represents integration level in the area under study. Integration in the routes marked with warmer colors is higher so that these routes can lead to interactive spaces.

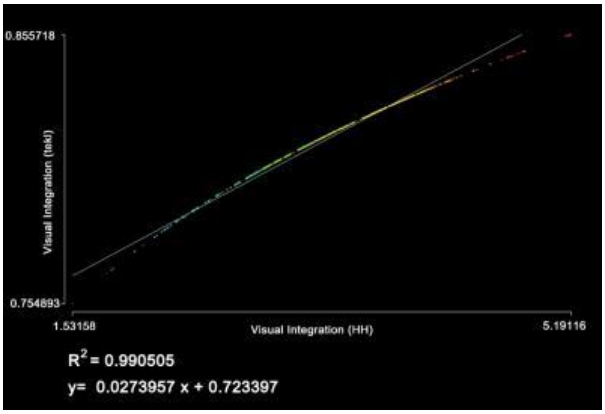


Figure 10- Diagram of the correlation of integration

Given the value of R2 in Figure 10, the integration of the compound is high in general, which highlights the potential to form interaction centers for users and communication nodes thanks to the high accessibility level.

Figure 11- Analysis of clustering coefficient in the area under study

Figure 11 illustrates the clustering coefficient of the space. The map actually shows the corners with lower observability (warmer colors) and higher clustering coefficient. Therefore, such spaces have fewer users. The cooler colors, on the other hand, represent spaces with a lower clustering coefficient, where interactions take place. It is notable that analyzing clustering coefficients in Isovist is different from that in VGA. Individuals in Isovist look for spaces to discover, while clustering coefficient in VGA refers to far corners with a lower observability. In Kahrizak Nursing home, there are several spaces that appear too far for the users so that they are less interested in those spaces.

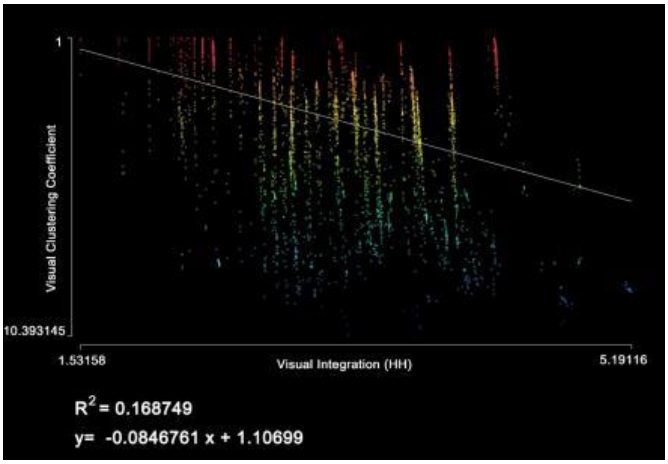


Figure 12- Integration correlation diagram

Given the value of R2 in Figure 12, the correlation of clustering coefficient of the compound has a low observability in general so that clustering coefficient of the compound is high. An explanation for this is the several hidden corners from the user's viewpoint. The cooler colors at the lower section of the diagram indicate spaces with lower clustering coefficient in the compound to which the users are more interested in. In general, the compound needs to decrease clustering coefficient through creating more interactive spaces for the users.

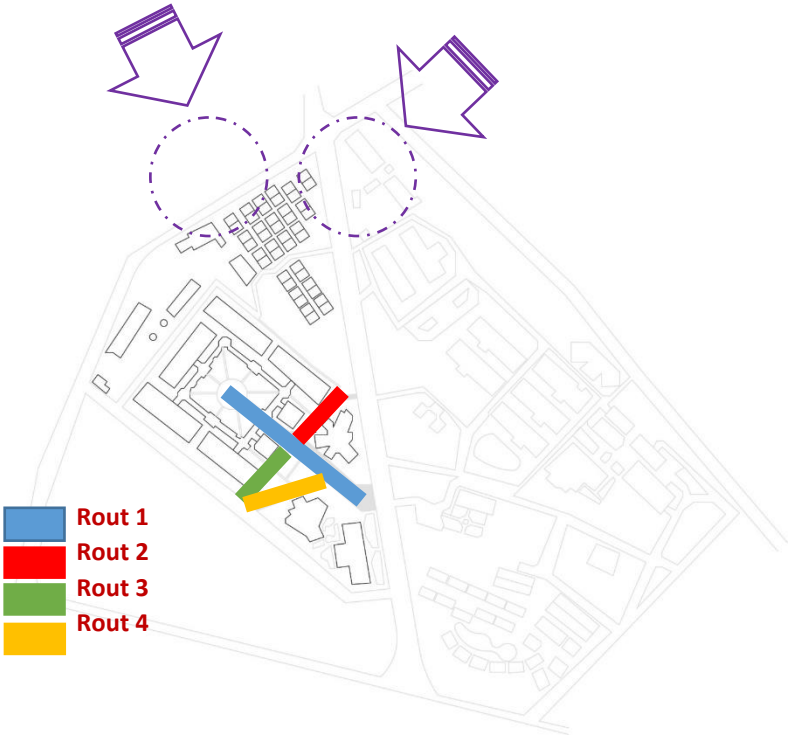


Figure 13 - The routes highlighted based on the analyses on the map

As illustrated in Figure 13, route No.1 leads to the dormitories and the central spaces of the yard. Route No.1 covers the space behind the dormitories that lead to the personnel's dormitories. Route No.3 leads to a part of the open space and the space behind the dormitories. Finally, route No.4 leads to the workshops, which are highlighted by a circle. This area is not mentioned in the cognitive map drawn by the participants and given the results of space syntax analysis, it can be used for developing interactive space for senior citizens.

Conclusion and recommendation

The analyses of cognitive maps of the participants indicated that the workshop spaces of the nursing home included tailoring, carpet weaving, and wood carving workshops were the gathering and common places where the senior citizens could interact. These places can be used to improve cognitive and perceptual capabilities of senior citizens; however, these spaces were mostly neglected by the officials as highlighted by the majority of the cognitive maps drawn by the participants. In addition, the authors' observations at different hours of the day supported this conclusion. Despite the acknowledgement by the officials of the active presence of the senior citizens at workshop spaces, there was no specific use of these spaces except the workshops. The majority of the users of workshops were disabled and the elderly were not interested in being present in workshops. Even the opportunity to earn money was not enough to convince the older adults to have an active presence at workshops. One of the desirable gathering spaces for the older adults, which was highlighted in different ways in the cognitive maps, was a part of the compound where the water display was at its center. This space was marked in the analyses as the yard leading to the dormitories. This space was the only desirable common space for the older adults living in the compound.

Taking into account the results of space syntax analysis, the parameters of Isovist and VGA, and through making a comparison between the cognitive maps of the older adults, it can be concluded that spaces with low

compactness were either neglected in the cognitive maps or located in the wrong way. This highlights the importance of high compactness in spaces designed for older adults. Drift magnitude, which can make a space a good choice for interactions and activities, was the lowest in the sections leading to workshops. This can explain the reluctance of the elderly to use such spaces. Occlusivity is a parameter related to discovering new spaces and as our analyses showed, the highest level of occlusivity and discovery of space was at the spaces leading to workshops and the spaces at the end of the compound. Given the lack of interest in these spaces in the participants, the older adults are not interested in finding new spaces. This conclusion was also supported by the field observations as the older adults preferred walking the same route frequently rather than experiencing new spaces. Finding a preferred route and using it several times was the first priority in their spatial syntax. As shown by the analyses, controllability refers to one's control on and ability to observe a space. As shown by the cognitive maps drawn by the participants, the space leading to the water display and the route had the highest controllability. In addition, this space was the most interesting space by the participants, which indicates that the older adults prefer open spaces with the highest controllability over cozy and private corners. The analysis also showed that there were very few interactive spaces in the compound, which justifies the lack of attendance of senior citizens and participation in group works in the space of nursing homes. Taking into account the high level of integration in the compound, there is a good potential for formation of interaction centers and communicational groups. The analyses, based on clustering coefficients, highlighted far corners with low observability in the plan, which are not interesting spots for older adults so they usually avoid such spaces and do not perceive them.

The future works on the cognition of space by older adults and designing spaces for older adults should examine cognitive differences between different age groups. These works can also examine the features that create spatial desirability from older adults' viewpoints. In addition, the design of urban spaces must support spatial orientation in older adults. Historic sites, natural landscaping, buildings with higher usability and better accessibility can enhance urban eligibility in older adults. The experimental technique of cognitive maps introduced by Lynch and optimized by Epliard tries to extract the user's perception of the experienced environment. The technique identifies the actual specifications of the space and also provides evidence of users' expectations.

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