Representation of Information in Large-Scale Outdoor Spaces Using Reference Frames

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ABSTRACT

Reference frames (or frames of reference) show how the knowledge of object organization is formed in the environment by the physical movement of the person or the environmental conditions where the representation takes place. This paper examines the formation of reference frames in memory to represent the spatial structure of large-scale outdoor environments, due to the lack of consideration in the research background, the lack of attention to the scale of the formation of reference frames, and the lack of ecological validity in other studies. For this purpose, two types of tests are used in this paper to change the scale of the environment as well as pointing targets. In one test, familiar and unfamiliar participants are introduced to the positions of the three building triads, by walking the path that encompasses each group. Then, maps are presented to them along with the representation of these three groups in five different directions (0-180 degrees), and they judge whether each triple group is correctly represented based on the relative positions of the buildings. In another test, participants are introduced to the position of eight unknown objects in a pedestrian-oriented environment, moving in two pre-programmed and inscribed paths (one path aligned with the sidewalk and the other misaligned, at a 45-degree angle). Then, participants use their memory, pointing to objects as targets. In both tests, the dependent research variables are the pointing accuracy and the latency in responding to the examiners’ questions. The results show that the positions of unfamiliar buildings are subjectively represented as egocentric reference frames. The allocentric frame of reference is defined by the environment when the environment is familiar, and the representation also tends to allocentric, as humans become familiar with the environment. On the other hand, object positions are subjectively represented in regular environments and distinctive by the geocentric frame, but are selected based on egocentric experience.

Keywords: Reference Frame, Egocentric, Allocentric, Representation, Large-Scale Outdoor Space.

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1. INTRODUCTION

Humans use two main reference frames, i.e., egocentric and allocentric, to represent spatial information (Ball, Birch, Lane, Ellison, & Schenk, 2017, p. 42; Paillard, 1991). Allocentric frames are categorized into three categories: object-centered, environment-centered, and geocentric (Levinson, 1996, p. 123), and this was first described by Piaget & Inhelder (1997, p. 128). Egocentric reference systems determine the position and orientation of an individual with respect to the organs of the body such as the eye, the head, and the coordinates of the body. These frames are determined by the position of the viewer in space; therefore, subsequent access to the stored spatial information depends on how the body's position information is encoded. These representations are often defined as orientation or orientation-dependent characteristics (Li, Karnath, & Rorden, 2014; Shelton & McNamara, 2001, p. 283; Waller, Montello, Richardson, & Hegarty, 2002, p. 1060). When forming an egocentric representation, it is easier to retrieve spatial information from experienced landscapes compared to new landscapes, and mental rotation processes need to be compared, such as when you enter a city from the north and define the environment for yourself based on the egocentric reference frame. However, you will be mistaken in recognizing the correct direction of the city until you know the city better and get familiar with it, since the back is always facing south and the forward facing north, as defined by the inner reference frame (Boer, 1991, p. 7; Hintzman, O’Dell, & Arndt, 1981, p. 202; Iachini & Logie, 2003, p. 730; Roskos-Ewoldsen, McNamara, Shelton, & Carr, 1998, p. 218). On the other hand, allocentric reference frames are independent of the viewer position and dependent on external elements, such as objects and other environmental characteristics (McNamara, Rump, Werner, & Review, 2003, p. 590; Mou & McNamara, 2002, p. 168; Shelton & McNamara, 2001, p. 302 (Figure 1 shows the graphical representation of these two types of representation). Spatial information stored in this case will not be affected by egocentric points of view, which were originally acquired. For this reason, allocentric spatial representation is often independent of orientation or with a free orientation (Roskos-Ewoldsen, McNamara, Shelton, & Carr, 1998, p. 220; Waller, Montello, Richardson, & Hegarty, 2002, p. 1058).

Some places are used for testing the statistical population to examine how reference frames are used by humans. In this paper, by examining the results of other researchers, by and large, it is still unclear whether spaces at a different scale with the samples under study are represented with navigation capability for direct exploration based on egocentric or allocentric reference frames. In addition, the experimental conditions of other studies are often static, or only a limited range of participants have moved into other researchers’ tests. The lack of ecological validity led this paper to the point of generalizing results from a room-scale context to real and complex environments because the reference frames are usually different in scope and spatial scale in which they are tested (Iachini, Ruggiero, & Ruotolo, 2014, p. 80; Siegel, Krasic, & Kail, 1978, p. 253). Accordingly, the role of egocentric and allocentric reference frames in recognizing and recalling large-scale outdoor environments has been less studied. Another factor that has not received sufficient attention in previous studies, namely the spatial representations of the environment, is real and test-based, which may alter the outcome of the experiment. Since previous research tested spatial memories experimentally, thus not manipulating the characteristics of participants’ learning environments or learning experiences (Werner & Schmidt, 1999, p. 470) or required observers to learn small-scale spaces from fixed view situations (Shelton & McNamara, 2001, p. 302), the theoretical framework test occurs in this paper in a large-scale outdoor environment. The main purpose is to identify the dependence or independence of the memories of large-scale spaces on their orientation and how they are represented to point to small and large targets for perception, which are changed in this paper methodically and by type of test, unlike other studies. Although a multitude of evidence suggests that the memories of small-scale
spaces are dependent on orientation (such as specific landscapes, familiar locations are usually better detected and retrieved than other landscapes), some findings suggest that large-scale spatial memories may be independent of orientation (Evans & Pezdek, 1980, p. 22; Richardson, Montello, & Hegarty, 1999, p. 728; Richardson, 1981, p. 250).

2. LITERATURE REVIEW

Recent research suggests that the structure of the environment can affect the relative access to its remembered views, and even the ability to represent the views experienced subjectively. Shelton and McNamara (2001) tested the relative importance of egocentric and allocentric reference systems in the memory of one-room spaces. In the third test, the objects were placed on a square mat that had a rotational position relative to the wall of the room containing it. Participants understood the design from two fixed viewpoints, one aligned and the other misaligned with mattresses and room walls. After identifying the design, participants judged the relative directions using memory. Participants had quite accurate pointing to the objects of imagined views that were parallel to the aligned view under study. Observers who initially recognized the aligned view encoded the spatial structure of the design in reference systems aligned with points of view, using, for example, axes defined by the edge of the mattress and the walls of the room. As participants move to misaligned points of view, they still define the design as a reference system that has been established in an aligned view, as if they are now looking at a familiar object in a new orientation. Therefore, the direction parallel to the aligned view had the best performance and relative direction judgments, and there was no good performance for the orientation parallel to the misaligned view with respect to the new orientation. Observers who first learned the misaligned view should have also interpreted the space based on the reference system by which the view is defined (Blajenkova, Motes, & Kozhevnikov, 2005, p. 109; Shelton & McNamara, 2001, p. 310). One approach to architectural interior space is the direct approach outlined in Dehghan’s research (2019, p. 93). When using this approach, with the alignment and the distinct indoor edge continuity, the participant continues to position himself as horizontally as possible, no matter what changes occur in the different floors, and his or her loss rate may even increase.

In spatial memory literature, in many studies with guiding (antecedent) factors, spatial data are stored in egocentric and allocentric ways. In a key study conducted by Evans & Pezdek (1980, p. 20) and Ohtsu (2016), participants familiar with and unfamiliar with the campus of San Bernardino University were compared. They tested spatial knowledge of campus and US buildings from a participant position’s point of view to find out whether or not they processed similarly with visual stimuli, often used for mental rotation studies (Hund, 2016, p. 237; Shepard & Metzler, 1971, p. 700). Unfamiliar participants identified the environment through the map, while familiar participants relied on their long-term experience with the environment. The enclosure was introduced to all participants using maps representing the positions in the triple groups of buildings, and they had to judge whether or not each triple building complex correctly represented the interrelationships between positions. Triple sets rotated at different angles from 0° to 180°. Evans and Pezdek found that the effects of mental rotation occurred only for states rather than familiar buildings. However, the effects of rotation again occurred when buildings were unfamiliar. These results show that learning creates spatial relationships by providing orientation-dependent representations through maps. In contrast, when spatial information is obtained directly from the real world, this environment is experienced from several points of view, which may result in representations independent of orientation. However, the authors recognized that it was difficult to separate the two arguments about whether familiarity on its own or how spatial information could produce a pattern of results. Consequently, Evans and Pezdek (1980) compared several studies with a careful comparison of maps and orientation spaces.

In the study by Iachini & Logie (2003, p. 730), participants had to learn the locations of several buildings in an unfamiliar environment, on the Aberdeen campus in Scotland, by walking the paths around these buildings. Then, they have to answer their positions on a 3D map by viewing each building from various points of view, with viewing angles between 0 and 180 degrees from the starting position. The results showed the clear effect of the angle difference between the new and original points of view; therefore, the spatial representation was egocentric. The two tests were performed with deductive functions, one with varying degrees of familiarity with the campus at one time (Foley & Cohen, 1984, p. 726; Roger, Bonnardel, & Le Bigot, 2011, p. 196) and the other at the ‘estimation of distance and direction’ step (Siegel, Krasic, & Kail, 1978).

As noted in the introduction of the article, since there has been little research on large-scale outdoor environments in the literature, and that most of the pointing targets were fixed and large buildings, even the small number were carried out in outdoor environments, in previous research tests, this paper attempts to investigate the purpose of this research, which is to obtain the representation of egocentric and allocentric reference systems in this environment and to arrange these representations considering how the participants in the research test stages are acquainted with the scale of the participants’ reference targets in the large outdoor environment. As a result, as shown in Figure 2, a large-scale urban environment and two tests were used to perform this test. The relevance of the first test to the theory of research lies in the retest
of the theory of Evans and Pezdek (1980), who view the evolution of human representation through the development of experience and spatial knowledge from egocentric to allocentric. However, in their test method, they extracted data from the participants verbally that may not be error-free (in the “Research and Discussion” section, you will find the differences between the two). The second test, done by changing the scale of the pointing targets and the researcher’s manipulation, shows a sharp difference in the representation of two aligned vs. misaligned directions according to McNamara’s theory, and he believes that the aligned views are associated with a faster understanding for the viewer. McNamara has done this test in the room environment with its interior furniture.

Fig. 2. Research Formation in Two Independent Tests Using Critique and Validation of Research Background Theories

3. RESEARCH METHODOLOGY

This paper uses an empirical research approach to access and analyze data. Since the egocentric reference system is used to identify and enhance spatial knowledge in large-scale environments, pointing targets have been used under large-scale (urban-scale) environmental conditions to test this system. In this paper, reference systems were tested in outdoor environments in addition to large-scale environments, because there was less research on the knowledge and use of reference systems in outdoor environments (McNamara, Rump, & Werner, 2003, p. 590). On the other hand, targets were used to point and test participants at different scales, to identify allocentric reference systems; one was the existing buildings in the test environment, and the other was objects that could be manipulated at points where lines aligned and misaligned with the main sidewalk intersect, which will be described in two different tests later. After each test, participants will have familiarity levels and a different process for identifying the environment and collecting data. Given the importance of environmental features, a typical environment was selected, featuring two main streets with a T-shaped intersection of 31685 m². The bed of this test is a very extensive pedestrian-oriented area in Isfahan’s administrative-commercial district (District A), which encompasses ten buildings and reaches Imam Khomeini Square in Isfahan (Fig. 3).

3.1. Participants

In this paper, participants were selected by stratified random sampling. In the first test, 36 subjects participated, 18 familiars (9 males and 9 females) aged 21-28 years, and 18 unfamiliar (9 males and 9 females) aged 21-28 years. Familiar participants worked in several buildings in District A, selected because of their commuting to the offices there. They agreed to
voluntarily participate in this test. All familiar participants had worked there in the selected area for one to five years prior to the test. Furthermore, they all crossed the two main streets every day to reach their workplaces. The unfamiliar participants had never seen District A before the test. They were undergraduate freshmen who had come from Isfahan Industrial and Payam-e-Noor universities and from surrounding cities to Isfahan. In the second test, unfamiliar participants different from the first test were used, including 24 students (12 females) aged 20-25 years from Isfahan University of Technology, with prior consent.

3.2. Field of the test and its components

**First Test:** Among the various business-administrative areas, District A was selected as a field for this test. The main buildings of District A were plotted in a two-dimensional black and white map, as shown in Figure 3. In this area, nine buildings were selected according to the following criteria. Buildings in this area could be navigable without any problems, as well as form triples of buildings that could be seen from all similar points of view, and allow participants to follow homogeneous paths around each triplet (about 320 meters). The nine buildings (called A-1, A-2, A-3 to A-9) were combined by such a method to create three groups of three: The first three: A-1, A-2, A-3 = a, the second triplet: A-4, A-5, A-6 = b, and the third triplet: A-7, A-8, A-9 = c). Around each triplet, a starting point and an endpoint that were connected by a path were identified on the ground by a black dot, first on the map and then in the real environment. Upon arrival, participants were allowed to view the three buildings simultaneously. Based on the original map shown in Figure 1, each of the test maps was drawn from the triple buildings with only the proper name, and the rest of the information was deleted. An example of these maps is shown in Figure 5. The size of the maps was A4, black and white, two-dimensional with a scale of 1:1000 relative to the environment. Each triplet was shown with the original rotation (0° (Fig. 3)), which could also rotate at 45, 90, 135 and 180 degrees. In addition, each triple was presented within the buildings, either by means of actual relative positions (5 integer triples) or by changing their positions (5 inaccurate triples). For each triplet, 10 maps and ultimately 30 test maps were generated with each angular rotation, along with all true and false triangles.

![Fig. 3. Scope of the Tests with the Three Classes of Buildings Comprising it](image)

**Second Test:** As with the first test, this test was performed on Sepah Street in Isfahan, near Imam Khomeini Square, a pedestrian street. At this point, participants learn eight-object positions on the street. Two paths were used separately to influence the experience of egocentricity of the environmental structure, both of which are inscribed on one street (Figure 4). The aligned path was turned parallel to the main street, and the misaligned path with the 45-degree angle in a zigzag manner. The objects are located near the intersections of two paths. The sections of the route were 180 m in length and 240 m in length, and the routes were not visible. Eight objects were identified near the intersections of the two paths (max. 20 m). Since some kind of obstruction was created by the length of the street and other objects, the whole design was not visible from one point. Four groups of participants were defined for a combination of path (aligned and misaligned) and pedestrian direction (in the opposite direction and field direction), and each group experienced the test location in four directions (aligned (0, 90°, 180° and 270° and misaligned (45°, 135°, 225°, and 315°). Participants were randomly selected for the groups, with each group comprising approximately a number of men and women.
Since the aim was to evaluate the relative and possible importance of midpoints, observer experiences, and the structure of the environment in shaping spatial memory, it was hypothesized that spatial relationships that are clearly identified by a particular spatial reference system could be retrieved from memory. However, it should be deduced from spatial relationships that are not explicitly specified under the conditions of the spatial reference system (Klatzky, 1998, p. 16).

3.3. Steps to Recognize and Process of the Tests

First Test Recognition Step: Participants were asked to memorize as accurately as possible the names and positions of the buildings they encountered along the path taken by the examiners. Specifically, the examiners emphasized to participants that they had to focus on the buildings of their positions and did not need to remember other characteristics of the environment. In addition, participants had to close their eyes before entering District A. Upon reaching the starting point of every building triad, the examiner would open the participants’ eyes and say the name of the first building. Participants had 6 seconds to observe the building and were then directed to the next building, which was named and observed for 6 seconds. This process was performed for each category of buildings. Participants were guided to the endpoint after walking en route again, which should take a total of 20 seconds to look at the three buildings. Then, they were blindfolded and examined in terms of memory; they had to name the buildings in the order of their visual order. If the memory was correct, participants would be directed to the starting point for the next triplet, and if not, the learning process would be repeated. The learning process took approximately 30 minutes per person.

First Test Data Collection Step: After the learning phase, participants’ eyes were closed and directed to the test point away from District A inside the field, where three-dimensional buildings were not visible. After removing the blinds, the examiners presented the test maps to each participant (30 tests at a time). All angular dimensions (0, 45, 90, 135 and 180), three-dimensional structures (“a” true and false, “b” true and false, and “c” true and false) (and the order of presentation were balanced and uniform among participants). (An example of these maps is illustrated in Figure 5). For each participant, the maps were arranged with regard to their order and kept on a vertical slab using a loop. This step determined whether the maps were properly represented in relative spatial positions between the three buildings or not, such as, do they re-establish relative spatial relationships as they are in the real world? The accuracy and latency in the performance of the participants were measured. Correct judgments would score 1 and misjudgments 0. The latency was recorded by examiners using a stopwatch since the participant saw the map to their judgment. Each participant completed the test phase in 5 minutes.

![Fig. 4. The Second Step of the Test Showing the Aligned and Misaligned Lines and Pointing Targets between Them](image)

![Fig. 5. An Example of the Test Maps of Triple A-1, A-2, and A-3 Shown at Right Angles of 0, 90 and 180 Degrees](image)
Second Test Recognition Stage: Participants’ eyes were closed before entering the street to take steps to limit their visual experience of knowing conditions, and not knowing where they were due to city conditions. They were guided to a corner of the route, somewhere near the site of the concession (Fig. 4), and the blinds were removed. Participants were instructed to learn the locations of the objects they were trained to guide along the route. They were told to track the position of the objects as they walked, but did not need to be reminded of other features of the street. The examiners named the objects and stopped for a few seconds each. Participants were allowed to stop whenever they wanted and to look around and be more precise about where each object was located. Participants had only the restriction that they had to keep their body rotating at all times and were only allowed to rotate their heads, not their bodies. After completing the route, participants were asked to name the objects, in order to be seen by them. This cycle was repeated about twice, each of which took about 25 minutes to identify. All participants were largely familiar with the positions of objects at the end of the recognition phase.

Second Test Data Collection Step: Participants were directed to a measurement site located in the post-recognition field. The initial independent variable in the relative orientation judgment was the imagined direction. Each test consisted of three object names. The two objects are intended as imagined directions (“Imagine you are near the shore and facing the traffic light”), the third object is the target (“point to the green trash can”). Eight directions aligned with the paths (aligned and misaligned) were used (0° to 135°) clockwise and 0° aligned with the traffic light-direction for the green bucket. 32 object pairs were created from these orientations, which were combined with three target objects, comprising a total of 96 tests (12 tests for each orientation). Target objects were selected to balance the pointing along with the positions and the number of times they happened. The configuration of objects allowed for pointing directions from 23 to 135 degrees, from 225 to 315 degrees. Similar to the first test, questions were written on A4 paper at this stage and participants made their judgments by pointing their hands in different directions. The angle indicated by the participant’s hand toward the target object is the horizontal image he points to on the ground, measured using a digital angle gauge at 360 degrees around the individual, and compared to the correct angle if incorrect. The delay in responding to the stopwatch was recorded by observers. The tests were completed in approximately 40 minutes per person.

4. RESEARCH FINDINGS

In the first test, the results were calculated based on 3-way ANOVA for combination methods such as familiarity (familiar vs. unfamiliar) and gender as independent variables between-subject and rotation degrees (0°, 45°, 90°, 135°, and 180°). As independent variables within-subject. The dependent variables were accuracy (mean correct judgments) and response time (mean delayed judgments). Also, in the second test, the dependent variables were angular error averages (alignment vs. misalignment) and response time, which were analyzed by analysis of variance with respect to route conditions, travel direction (clockwise vs. counterclockwise) and direction Imagined (°., 45,..............315). Tukey HSD test was used to analyze the effects of the effects, the effect sizes were also calculated and expressed using the η² index.

4.1. Pointing Accuracy

In the first test, analysis of variance showed that the main effect of familiarity was more accurate (F (1,28) = 6.35, η² = .18, p = .017, familiar participants (mean = 27.40, SD = 15.76) than unfamiliar participants (mean = 24, SD = 15.76). The follow-up test showed that the angle of 0° (mean = 29) was more accurate than all angles of 45°, 90°, and 135° (with at least P <0.05). Significant interaction was found between familiarity and rotational angles: F (4,112) = 3.03, η² = .10, p = .02. The two groups showed different trends: familiar participants were mostly accurate at angles of 0°, 90°, and 180°, while the accuracy of unfamiliar participants decreased as the angle of rotation deviated from 0° (Fig. 6). Follow-up analyses showed that this interaction was more accurate for familiar participants with 0° rotated angle maps than for 90°, 135° and 180° rotated maps for unfamiliar participants, due to spatial judgments; in addition, 90° and 180° angles for participants. It was more accurate than 135 degrees for unfamiliar participants (at least P <0.05). Finally, the 0° angle was significantly more accurate than the 45° angle for the familiar participants, while the 0° angle was more accurate than the 90° and 135° angles for the unfamiliar participants (at least P <0.05). A main effect of index was found for gender: F (1,28) = 4.33, η² = .14, p = .04. This is because men were more accurate than women: men = 27 and SD = 15, and Women = 24 and SD = 15.76. There was no significant interaction between gender and familiarity, although unfamiliar women were less accurate than the other groups: F (1,28) = 2.84, η² = 0.09, P = 0.10.
In the second test, the mean absolute angular error in the pointing judgment in Fig. 7 is presented as a function of pedestrian and imaginary direction. Tests that exceeded 90 degrees or had a response time of more than 60 seconds were excluded from the analysis components (6.6%). A separate analysis did not show significant effects of gender. The directional effect was specified with respect to the target accuracy [F (7,140) = 3.06, MSe = 47.88, p = .005], but the pattern of results was different for the two target groups [F (7,140) = 2.45, MSe = 47.88, p = .021]. Under alignment conditions, binary comparisons showed that the reference error was equally low for familiar biases of 0°, 90°, 180°, and 270° and unfamiliar bias of 135° [ts (140) ≤ 1.34, ps ≥ .18] and for These directions were significantly lower than the other directions [ts (140) ≥ 2.05, ps ≤ .042]. Under asymmetric conditions, the reference error for the imaginary direction of 135° and the uniform increase with the angular distance was the lowest [quadratic contradiction: p = .012, t (140) = 2.54]. The pointing error was lower under the alignment condition than under the alignment condition [F (1,20) = 6.73, p = .017], indicating that users’ comfort in spatial memory under par conditions was generally higher. Extra analyzes under alignment conditions show that views along the route are more accurate than parallel views that do not match along the route (for example, “Imagine you are standing next to a parking lot and looking at a forbidden park sign”; You stand next to the shack and you have electricity).

### 4.2. Latency

In the first test, analysis of variance showed that the main effect of familiarity was F (1,25) = 6.78, η² = 0.40, P = 0.006, because the unfamiliar participants (mean = 4.60 and SD = 2.23) were slower than the familiar participants (mean = 3.27 and SD = 1.37). Women were significantly slower than men: F (1,25) = 6.50, η² = 0.21, P = 0.01. The relative mean of men was = 3.9, SD = 1.62 and that of women was = 4.4, SD = 2.15. There was no significant effect at rotational angles (F < 1). Instead, there was a significant interaction between familiarity and rotational angles F (4,100) = 2.57, η² = 0.10, P = 0.04. As shown in Fig. 8, familiar participants were faster at angles of 0, 90, and 180 degrees, exactly as they pointed out. In contrast, unfamiliar participants were Faster at 45 and 135 degrees. Follow-up analyses showed that the
interaction was due to familiar participants at 0° angles faster than unfamiliar participants at 90°, 135°, and 180° angles (with a minimum of p < 0.05). In addition, unfamiliar participants at 180 degrees were faster than unfamiliar participants at 90 degrees. Overall, this pattern of results confirms the familiarizing effect of 180- and 90-degree axis facilitation. Regarding gender, the main effect appeared due to men (mean = 3.52, SD = 1.70) being faster than females (mean = 4.35, SD = 2.13): F (1,25) = 6.49, η² = 0.21, P = 0.02. The interaction between familiarity and gender revealed the statistical index: F (1,25) = 3.71, η² = 0.13, P = 0.06. Unknown women were slower than all groups, unfamiliar, males = 4.1, SD = 1.7, females = 5.4, SD = 2.4 and familiar, males = 3.7, SD = 1.4, females = 3.4, SD = 1.3.

In the second test, the delay in responding creates no patterns similar to angular error; there is no evidence of speed and accuracy swapping. The correlation between the mean latency and the mean angular error along the imaginary directions was 0.73 for the aligned linear group and 0.67 for the misaligned linear group.

5. CONCLUSION

The retest of different theories in this paper shows that individuals use egocentric representations and individual decisions at a low level of familiarity with the environment, and represent and investigate the position of objects in the environment, which can be a large-scale building block, depending on their location in space. However, this representation gradually becomes an allocentric representation as to the level of familiarity with the environment increases, and one can find the position of the building blocks relative to each other and the environmental and contextual conditions in the environment. This problem is much more pronounced in the first test and in men than in women and certainly increases with increasing familiarity, so that representation will not occur egocentric. Another result that is important in the second test of this article is that representation may also be allocentric for people with low levels of familiarity, provided that the environment is highly orderly or has a very important sign in the environment. As the pointing accuracy lines are more in line with the physical elements of the environmental index, the larger the scale of the outdoor environments (such as building blocks) are with the main and secondary passages, the more orderly and indexed the environment, the orientation, and formation of memories. And human spatial knowledge in that environment will be faster and representations will shift to allocentric. However, if a person has more experience in that environment, his performance will be much better. Another factor in increasing the probability of allocentric representations is the presence of a marker in the environment that indicates itself as a sign and is also known as geocentric representations, which is an inherent representation of a man in McNamara’s view. In other words, humans represent the spatial structure of large-scale environments as reference systems defined by environmental characteristics. In this case, spatial relationships not only store egocentric views but also structure them based on allocentric reference systems, which is an allocentric system. Consequently, if there is an indicator element in an environment such as an old field (present article), a river or lake, an old cue, and identity, in addition to the person using the geocentric reference system, the geocentric reference system also helps. To the individual for the mental formation of the environment, with a lower error than the egocentric reference system (Fig. 9). Researchers are advised that the characteristic of the environment and its spatial differentiation from the human point of view, the way the geocentric mental representation of spatial cues is a practical, yet novel, issue in the field, given the background weakness in cue type.
END NOTE

1. The object-centered frame of reference is the nature of what is moving towards the earth, such as a person, a projective object.
2. It is an environment-centered reference framework, such as rooms, buildings and regional privacy. They define very stable areas that depend more on earth than on moving objects.
3. Orientation is by path integration (blind orientation) based on geocentric reference systems. Geocentric reference systems define spatial relationships according to the characteristics of the environment, such as the perceptual direction of gravity, the angle of the sun, the Earth’s magnetic field, and the signs.
4. It refers to McNamara’s (2001) research that conducted a test in a room.
5. In Figure 1, the navigation paths are plotted, a path around the ternary of buildings (A-1, A-2, A-3) marked with twenty navigation points.
6. Independent variables
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Dehghan, N.


**HOW TO CITE THIS ARTICLE**


DOI: 10.22034/AAUD.2020.102361

URL: [http://www.armanshahrjournal.com/article_102361.html](http://www.armanshahrjournal.com/article_102361.html)
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مقایسه این چشماندازهای دارد (توزیع زمینی که از سمت سه‌سانتی‌متر تا سه‌سانتی‌متر شماره وارد شده می‌شود و بر اساس چارچوب مرجع خودمدار می‌تواند را برای یک نمونه می‌کنند ولی تا زمان شناخته به‌سرعت از شهر و آنتن بکار. در تشخیص جهت درست شهر دیگر هنگام خواهد شد. زیرا طبق تعیین چارچوب مرجع ذاتی همان است مرکزی و جلو رو به سمت شمال است. (Hintzman, 2002, p. 7)


مرجع چارچوب مرکزی می‌تواند نمونه‌ای و است. با توجه به آن درست است. این موارد با مشخصات آن مشخصه‌های جهت‌گیری و یا واکنش به جهت‌گیری تعیین Li, Karnath, & Rorden, 2014; Shelton & Kail, 1978, p. 253


شکل 1: گرافیکی از نحوه بازنمایی چارچوب مرجع خودمدار (سمت راست) و دیگرمدار (سمت چپ)

(Proulx, Todorov, Taylor Aiken, & De Sousa, 2016)

برای بررسی نحوه استفاده از چارچوب مرجع توسط انسان‌ها از مکان‌های بارز آزمون جامعه انسان استفاده می‌شود. که در این موارد با بررسی نتایج دیگر محکمان، در مجموعه هر نوع نیست که این است. این در مقایسه Lachini, Ruggiero & Ruotolo, 2014, p. 80; Siegel, Krasic, & Kail, 1978, p. 253
نقدی بر ادبیات موضوع

تحقیقات اخیر نشان می‌دهد که ساختار مرجع می‌تواند سلسیسیا به دیدگاه‌های سبز و سبز‌ترین آن را تاکید دهد. این نتایج درباره اثرات مرجع و هزینه‌های آن بر عملکرد یک انسان را در این زمینه مطالعه می‌باشد.

1. پیشینه‌شناسی، تغییرات و تاثیرات در اثرات و نگاه‌های مرجع

در این بخش، تغییرات در اثرات و نگاه‌های مرجع درباره اثرات مرجع و هزینه‌های آن بر عملکرد یک انسان را در این زمینه مطالعه می‌باشد. 

2. نتایج و بحث

نتایجی که در این بخش پیشنهاد شده‌اند، شکل‌گیری آنها در اثرات و نگاه‌های مرجع درباره اثرات مرجع و هزینه‌های آن بر عملکرد یک انسان را در این زمینه مطالعه می‌باشد.

3. نتیجه‌گیری

نتایجی که در این بخش پیشنهاد شده‌اند، شکل‌گیری آنها در اثرات و نگاه‌های مرجع درباره اثرات مرجع و هزینه‌های آن بر عملکرد یک انسان را در این زمینه مطالعه می‌باشد.
محک دانش فضایی انسان‌ها با چرخش‌های مختلف
پیشینه ضعف در زمینه‌های فضایی در محیط‌هایی با مقیاس‌های و اهداف اشاره‌های مختلف

آزمون دوم
آزمون اول

۱۳۹۸. زمستان ۲۹ شماره‌های ۱۳۹۸ ماهنامه معماری و شهرسازی آرمان شهر
بازنگری اطلاعات در فضاهای خارجی بزرگ-مقیاس با استفاده از چارچوب های مرجع

1.1

شروع تحقیق

در این مقاله از روش تحقیق جنگی برای دستیابی به داده ها و تحلیل آنها استفاده شد. از انجاکه برای شناخت و افزایش داشتن فضایی در محیط های بزرگ-مقیاس از سیستم مرجع خودمان استفاده می شود. برای این مقاله، از اهمت و اهمیت شرکت، ناحیه محیطی، میانه، بزرگ، مقیاس، آزمون سیستمهای مرجع در این مقاله، در محیط حضور اتفاقات، زیان تحقیقات کمتری برای پرورش شناختی تهیه است. در مقاله McNamara، Rump، & Werner، 2003, p. 590 سیستم راهبردی از اینکه برای اشکالات، در ساخته شرکت، در ساخته مراجع انتخاب که می‌تواند، سیستم را مبتنی بر اساس محاسبه و نیست ساخته گروه با اینکه برای انتخاب از ساخته شده، با اینکه برای انتخاب گروه، از ساخته شده، برای انتخاب از ساخته شده، با اینکه برای انتخاب از ساخته شده، برای انتخاب از ساخته شده، با اینکه برای انتخاب از ساخته شده، برای انتخاب از ساخته شده، برای انتخاب از...
آزمون دوم: مرحله شناخت این آزمون نیز ماندآزمون اول، در خیابان سی واقع در شهر اصفهان در نزدیکی میدان امام خمینی به امکان انجام است. این مرحله شامل هشت سطح است که در این مرحله شرکت‌کنندگان موقعیت‌ها را در خیابان‌های یک‌طرفه یا چندطرفه برمی‌گردد. دو سامانه به صورت جداگانه برای انتقالی تجربه خودداری‌ها ساختار محیطی استفاده شده که هر دو سامانه محیطی در حالی که در نزدیکی تکاپی‌های دو سامانه قرار دارند. پس از دو سامانه همراه به هم می‌گردد و سه مسیر همراهی ۱۸۰ متر و غیره مسیر ۲۴۰ متر طول داشت.

<table>
<thead>
<tr>
<th>فضایی کننده</th>
<th>چهار تراز اشیاء و دیگر</th>
</tr>
</thead>
<tbody>
<tr>
<td>خیابان ۱</td>
<td>چهار تراز اشیاء و دیگر</td>
</tr>
<tr>
<td>خیابان ۲</td>
<td>چهار تراز اشیاء و دیگر</td>
</tr>
<tr>
<td>خیابان ۳</td>
<td>چهار تراز اشیاء و دیگر</td>
</tr>
<tr>
<td>خیابان ۴</td>
<td>چهار تراز اشیاء و دیگر</td>
</tr>
</tbody>
</table>

آزمون دوم: مرحله دوم آزمون به نمایش خطوط هم‌ترات و غیره‌مترات و اهداف اشاره‌ای بین آن‌ها

<table>
<thead>
<tr>
<th>فضایی کننده</th>
<th>چهار تراز اشیاء و دیگر</th>
</tr>
</thead>
<tbody>
<tr>
<td>خیابان ۱</td>
<td>چهار تراز اشیاء و دیگر</td>
</tr>
<tr>
<td>خیابان ۲</td>
<td>چهار تراز اشیاء و دیگر</td>
</tr>
<tr>
<td>خیابان ۳</td>
<td>چهار تراز اشیاء و دیگر</td>
</tr>
<tr>
<td>خیابان ۴</td>
<td>چهار تراز اشیاء و دیگر</td>
</tr>
</tbody>
</table>

"می‌تواند از حافظه بایزابی شود، در حالی که ارتباط فضایی که به صراحت در شرایط انسام‌نامی به مسیر کننده که به‌صراحت به بسیاری مرجع فضایی خاص مشخص می‌شود. 

از انجا که هدف از ویژگی‌های نسبی و ممکن تقاطع‌های میانی، تجربه ناظران و ساختار محیطی در شکل‌دهی خاطرات فضایی است. فرض بر آن است که روابط فضایی که به صراحت با توجه به مسیر مرجع فضایی خاصی مشخص می‌شود.
مرحله شناخت و فرا آیند آزمون‌ها
مرحله شناخت آزمون‌ها: از شرکت‌کنندگان خواسته می‌شد تا یک مکان بندی‌شده و موقعیت‌های ساخت‌مانندی‌های که با آن مواجه می‌شوند را در اختیار بررسی کنند، به‌طوری که توسط آزمون‌گران طی می‌کنند، به حافظه بسپارند. مخصوصا، آزمون‌گران به شرکت‌کننده‌ای تأکید کردند که موجب ساختن‌های موفقیت‌بخشان تأکید کنند و نزدیک‌تر به فضا و سطح اندازه‌گیری مشخصه‌های محیط نسبت عاده به آن، شرکت‌کننده قبل از ورود به متغیرهای ساخت‌مانند ساختن‌های موفقیت‌بخشان مجدداً می‌شود و سپس به سازمان اجرایی شده گردند. یک مورد از این مراحل وارد می‌شود.

**شکل 5:** نمونه‌ای از نقشه‌های آزمون از سه‌تایی الف، 2-الف، 3-الف که با زاویه‌های 90، 120 و 180 درجه به‌صورت درست و نادرست نمایش داده شده‌اند.

**مقایسه با داده‌های آزمون‌های ساخت‌مانندی:**

مرحله آزمون‌ها در لحاظ حفاظت بررسی‌های بررسی‌رسان‌ها و ساخت‌مانندی‌ها نیز به‌طور کاملاً محدود و محدود می‌شود و آن‌ها به راحتی به‌صورت فضایی برای درک و ساخت‌مانندی‌ها آماده می‌شوند.
مبحث و شهرسازی ارزمات شهر
شماره ۲۹ (میستان ۱۳۹۸)
این متن را به زبان انگلیسی نمایش نمی‌دهد. لطفاً متن را به زبان فارسی بخوانید.

شکل 6: دقت در اشاره میان گروه‌های آشنایی نااکتش و نااکتش در آزمون اول

شکل 7: دقت در اشاره در آزمون دوم میان گروه‌های آشنایی نااکتش و نااکتش در خطوط هم‌زیر و غیرهم‌زیر

در آزمون دوم، معیار میانگین خطای زاویه‌ای مطلق در فضا‌ها در شکل ۷ به‌عنوان تابعی از مسیر پیاده و جهت تصویر ارائه شد. آزمون‌هایی که خطای خط را از ۹۰ درجه و یا زمان پاسخ‌گیری فراط میانه بود، از مؤلفه‌های تجزیه و تحلیل کارکنش‌های شدتی (دیوید. تحلیل توابع قابل توجهی از جنبه را نشان نداد. این گروه شکل تصور بدفست ارائه به هدف دقت در اشاره در آزمون اول دو گروه، هم‌زیر و غیرهم‌زیر است. تحلیل های اضافی در شرایط هم‌زیر و غیرهم‌زیر نشان می‌دهد که دیده‌ها در امتداد مسیر از دیده‌های موازی که منطبق بر امتداد مسیر نیست، دقت تر است (نظیر، تصویر گردی شما در کنار کانکس ایستادهای و به تابلوی پارک ممنوع نگاه می‌کنید» در مقابل «تصویر کنید شما در کنار کانکس ایستادهای و به سمت تابلوی پرچم‌داری»).

شکل ۷-۴: زمان تأخیر در آزمون اول، تحلیل واریانس ارائه آشنا بودنی‌ها 180° و 270°.
در آزمون دوم، تأخیر در پاسخگویی گروه‌هایی را نشان می‌دهد. افراد در سطح پایین آشنایی با محیط خودمادر و صمیمی‌های فردی استفاده می‌کنند و موقعیت این کنندگان در محیط که می‌تواند در مقابل برگ، بلک ساخته‌های باشند باشد و تا جایی که موقعیت خود در فضای پازنامی یا بیشتری را در محیط بیشتری باشد، می‌تواند از افراد سطح پایین آشنایی با محیط کنند.

5. گزارش‌گیری

آزمون‌های تکراری غربال‌گری در این مقاله نشان می‌دهد که در آزمون‌های تکراری، افراد در سطح پایین آشنایی با محیط خودمادر و صمیمی‌های فردی استفاده می‌کنند و موقعیت این کنندگان در محیط که می‌تواند در مقابل برگ، بلک ساخته‌های باشند باشد و تا جایی که موقعیت خود در فضای پازنامی یا بیشتری را در محیط بیشتری باشد، می‌تواند از افراد سطح پایین آشنایی با محیط کنند. 

این مقاله با آزمون‌های تکراری، افراد در سطح پایین آشنایی با محیط خودمادر و صمیمی‌های فردی استفاده می‌کنند و موقعیت این کنندگان در محیط که می‌تواند در مقابل برگ، بلک ساخته‌های باشند باشد و تا جایی که موقعیت خود در فضای پازنامی یا بیشتری را در محیط بیشتری باشد، می‌تواند از افراد سطح پایین آشنایی با محیط کنند.
مباحثی به مقياس بزرگ را بهصورت سیستم‌های مرجع تعیین‌شده توسط مشخصه‌های محیطی باز‌نمایی می‌کند، در این حالت روابط فضایی، نه تنها دیده‌ای خودماندار را دیگر نمی‌کند، بلکه بر اساس سیستم‌های مرجع زمین‌مدار که نوعی سیستم دیگر مدار است، نیز ساختارشده می‌شود. درنتیجه اگر عصری شاخه در محیط نظیر میدانی قدیمی (مقاله حاضر)، رودخانه و یا دریاچه‌ای، نشانه‌های قدیمی و دارای هویت وجود داشته باشد، علاوه بر استفاده فرد از سیستم مرجع خودماندار، سیستم مرجع زمین‌مدار نیز با خطای کمتری نسبت به خودماندار به فرد برای کرایه دیدگی محیط کمک می‌کند (شکل 9). به محض اتصال شیوههای می‌تواند که با توجه به ضعف پیشینه در نوع نشانه، نشانه محیطی و تمایلات فضایی آن از دید انسان‌ها، نحوه باز‌نمایی دیدگی زمین‌مدار نسبت به نشانه‌های فضایی، موضوعی کاربردی و در عین حال بی‌بین در این زمینه می‌باشد.

شکل 9: دیاگرام نحوه باز‌نمایی چارچوب‌های مرجع بر اساس نسبت آشنایی با محیط

<table>
<thead>
<tr>
<th>چارچوب مرتبه دیگر مدار</th>
<th>چارچوب مرتبه خودماندار</th>
</tr>
</thead>
<tbody>
<tr>
<td>سطح آشنایی با محیط</td>
<td>کم</td>
</tr>
<tr>
<td>هویت و تشکیل با هویت در محیط</td>
<td>زیاد</td>
</tr>
<tr>
<td>محیط منظم و هم‌ارزی در محیط</td>
<td>شاخه با محیط</td>
</tr>
</tbody>
</table>
پی نوشت

1. Egocentric
2. Allocentric

3. جارچوب مرجع: شی، ماهیت ان چارچوبی است که نسبت به زمین حرکت می‌کند، نظر شخص، شی پیش آمده (جلو آمده).

4. جارچوب مرجع محیط: مبنا، نظر اندازه، ساختمان‌ها و حریم منطقه‌ای است. آن‌ها نواحی به‌سیار تابعی را تعریف می‌کنند که بیشتر به زمین وابسته هستند تا به اشیای با قابلیت حرکت.

5. جهت گیری به کمک ادامه مسیر (جهت‌بایی کور) بر اساس سامانه‌های مرجع زمینی‌داده، سامانه‌های مرجع زمینی‌داده، روابط فضایی را با توجه به وضعیتی محیط، نظر جهت ادراکی گرانش، زاویه جهت حورشید و میدان مغناطیسی زمین و نشان‌ها.

6. Piaget & Inhelder

7. اشتهای بی تحقیق مکان‌سازی در سال ۲۰۰۱ دارد که در انتقال به اجسام آزمون برداخته است.

8. View
9. Shelton
10. McNamara
11. Evans
12. Pezdek
13. Aberdeen

14. منطقه انف تاکوگاری شد.

15. در هر ۱ مسیری پیمانی ترسیم شده، یک مسیر در اطراف به تابی ساختمان‌های (الف-۱، الف-۲، الف-۳) با نقاط بیستگانه پیمانی مشخص شده است.

16. 3-Way Anova
17. Between-Subject
18. Within-Subject

19. متغیرهای مستقل
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DOI: 10.22034/AAUD.2020.102361

URL: http://www.armanshahrijournal.com/article_102361.html