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Original Research Article

The Impact of Human and Environmental Components on the Occurrence of Interaction in the Landscape*

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Abstract | According to landscape definition, interaction is a key concept in landscape formation. Using strategies to increase the influence of the interaction elements (humans and the environment) in shaping and communicating with the landscape is an emerging concern that can be a major part of technology implementation in recent times. The interactive landscape is a different step towards strengthening the relationship between humans and places in a more purposeful approach. As a result, this article attempts to more precisely identify the interaction, as well as the characteristics and features that effectively improve the relationship between humans and the environment. In this regard, the environment and the occurrence of interaction, and the characteristics that affect it, are identified on the one hand, and human beings and human characteristics that affect the two-way relationship with the environment are identified on the other hand. The current study aims to answer the following question: What environmental and human characteristics are efficient in enhancing human interaction with the environment and forming an interactive landscape? This study aims to develop people's relationships with the environment and strengthen the landscape's interactive aspect. This article employs a descriptive-analytical approach to first investigate the concept of interaction and then analyze it to determine the effective indicators of interaction occurrence. Then, taking into account the importance of humans and the environment in the concept of landscape, it identifies environmental and human components that affect the strengthening of effective characteristics on the occurrence of interaction in the landscape by analyzing the contents based on human nature and the environment. This research suggests that to enhance the occurrence of interaction between humans and the environment, characteristics such as two-way relationships, activeness, variability, responsiveness, effectiveness, and affectedness need to be taken into consideration. Furthermore, the conditions of occurrence of interaction with the environment can be strengthened by using human and environmental characteristics based on their natures.

Keywords | *Interaction, Human, Environment, Landscape.*

Introduction| Various categories in landscape studies have been formed based on the study approach and time periods, such as Cultural Landscape, Sustainable Landscape, Health Landscape, and suchlike. These nominations do not imply that the findings of each of these categories are not considered in the context of an ideal landscape; rather, given the breadth of the concept of landscape, a consensus of different approaches is taken into account in the formation of the ideal landscape. In most cases, what seems obvious at first glance will be studied separately depending on the importance of the approach and its effect on the quality of the environment and landscape. The major human-environment networks shape landscapes. On the

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one hand, landscapes integrate environmental processes and, on the other hand, influence people's physical and mental health through four modes of human-environment interaction: knowing, understanding, interacting, and living within it (Wu, 2019, Nassauer, 2012, Russell et al., 2013). As a result of the obvious interaction in landscapes between human components and the environment, the researcher is initially skeptical of the issue of the interactive landscape. However, one of the main foundations of the meaning of the landscape is in crisis as a result of the modern lifestyle and the impact of the relationship between humans and the environment. Therefore, the interactive landscape approach seeks to identify two-way strategies for revitalizing and strengthening human relationships with the environment and their consequences on the landscape. To accomplish this, after reviewing the research background, the theoretical foundations of interaction and landscape, as well as the components of humans and environment as the main parties of interaction in the landscape, are discussed, and analysis and component determination take place accordingly. Strengthening the relationship between humans and the environment, as well as the concept of interaction, impacts the quality of urban spaces and creates a sense of belonging in humans. Recognizing the model that revitalizes and strengthens this relationship is thus one of the requirements that can improve the quality of the environment and life. The main goal of this research is to identify the effective characteristics of the occurrence of interaction and adapt them to the landscape approach based on the nature of humans and the environment. In this process, strengthening the relationship between humans and the environment, improving the environment's quality and the user's importance in perceiving the landscape are sought. The present study seeks to answer the question: What environmental and human characteristics are effective in strengthening interaction between humans and the environment and forming an interactive landscape?

Literature Review

The literature review of this study has been conducted in two phases. In the first phase, interaction and interactivity are discussed in terms that emphasize the significance of the relationship between humans and a thing or another human being. The second phase focuses on interaction and interactivity in landscape and architecture. In sociology, which is the study of human social life, groups, and societies, interaction is followed as a social approach (Giddens, 2010). Social interaction is the process by which we interact and react to those around us (ibid.). According to John Urry (1990), interactions lead to wonderful experiences (ibid.). Studies by pioneers such as Jean Piaget, Lev Vygotsky, Kurt Lewin, and George Herbert Mead have received attention in psychology. For Piaget and Vygotsky, the concept of interaction was drawn with the position of constructionism. Piaget pursued this goal by showing that individuals actively develop their intelligence through interaction with the physical and social environment; however, Vygotsky's research considered social relations as an integral part of human development and saw language as an artificial cultural product for cognitive and social development (Grossen, 2010). According to Lewin (following Gestalt theory), the study of interaction emerged from the assumption that subject and environment are interdependent and belong to the same context. For him, the subject's action is not understood apart from the context in which it occurred (Lewin, 1951). Mead demonstrated that intelligence (or mind) is formed through communication, or what he called the "dialogue of symbolic movements" in this case as well. Meaning, according to him, is a feature of interaction (Mead, 1967). Artists such as Marcel Duchamp and László Moholy-Nagy proposed interaction in art. Moholy Nagy's works have included interactive elements, such as a moving sculpture (in which an object leaves a trace in its path of movement) (Dehghani, 2008, 19). Interactive art has changed the roles of the audience, the artist, the artwork, and the environment, and the artist must incorporate the audience's experiences for the artwork to be discovered (Pazyar, 2020). The physical and real action of the audience, which results in a change in the performance of the artwork, is the most important feature of interactive art. Audiences' involvement in the artwork will physically and actively be mediated by computer-mediated intermediaries (Lopes, 2010). Interactive concepts define an artwork from a particular viewpoint and help the audience in identifying, defining, and perceiving the intended interactions. Furthermore, because interaction and user's experience are crucial components in digital interactive art, they will assist artists in designing, developing, and evaluating their work (Ahmed, 2018). According to what has been said about interaction in some sciences, Interaction is formed in any field between two different factors. Specific tools are used to create the interaction followed by results (Table 1). Several studies on interaction and interactivity in architecture and landscape have been conducted in recent decades. Among these, we can mention the work of Streitz et al. (1999) "i-LAND: an interactive landscape for creativity and innovation" which expresses new forms of human-computer interaction in architecture. This interaction was created by using architectural space data, new design methods, and experimental studies in the field of architecture. The ultimate result of this research is the creation of creative architecture using technology infrastructures as tools. In another study titled "The History and Development of Interactive Architecture," Yuan examines post-industrial architecture under the influence of technology. Following that, the existing changes in the

Table 1. An overview of interaction in different fields. Source: Authors.

Context	Approach	Interaction Parties	Tools	Results
Sociology (Giddens, 2010)	Social	Human-Human	Language	Creation of new experience
			Symbol	Creation of different communities
Psychology (Lewin,1951, Mead,1967, Grossen,2010)	Individual and social	Human-Physical environment Human-Social environment	Language	Developing intelligence and mind
			Symbolic movement	Social and cognitive growth
				Making sense of belonging
Art (Lopez, 2010)	Individual	Audience-Artwork	Computer	Changing the display of artwork

city's shape have been evaluated in various social, cultural, and artistic dimensions based on its history. This study divides interactive architecture into three stages: the creation stage, the development stage, and the present stage. Yuan believes that interactive architecture can help to create a clear picture of the new world and that is dependent on modern technology. According to a medium, life becomes an experience, and observation becomes interaction in interactive architecture (Yuan, 2011). In another study titled "Revitalization of dead space through interactive interventions," architecture is used as a reactant, responsive, and interactive phenomenon. The physical form of the work, as well as the virtual technology employed, establish a link between the architectural work and the user. Because of the necessity of duality in the occurrence of interaction, it is possible to revive different spaces through this interaction with the user (Cravalho, 2015). The article "Interactive Textures for Architecture and Landscaping: Digital Elements and Technologies" discusses landscape formation in the context of interactivity. The physical form, society, and digital technology all play different roles in creating an interactive landscape. Interaction can be defined as a digital connection between humans and virtual materials, and the interactive landscape is ultimately temporary (Wiberg, 2010). Practical examples of interactive landscape and related technology are discussed in the "Interactive landscape" book. The issue's practical and executive aspects are examined, emphasizing changing the environment created by technological intelligence. The use of an artistic function to create dynamic relationships between architecture, people, and digital culture is explored in this book, leading to digital landscape design (Chong & Rijk, 2011). Cantrell and Holzman's "Responsive Landscape" book provides a comprehensive overview of design projects that use responsive technologies and investigate their relationship to landscape and environmental space. Eventually, this study proposes the presentation and construction of a practical framework with a focus on the incorporation of responsive technologies in landscape architecture (Cantrell & Holzman, 2015). The structure of interaction in different sciences and the tools used to establish interaction between human beings and other factors can be used, according to a review of the subject in research. Specialized studies on the interaction between architecture and landscape have emphasized the importance of technology and digitalization in shaping an interactive landscape or architecture, which is the main difference between this study and the previous ones. This paper aims to lay a foundation for an interactive landscape. Meanwhile, it is critical to recognize and utilize the potential of humans and the environments. Although technology is a tool in landscape design, it is not the primary foundation of the interactive landscape framework.

Theoretical Foundation

Considering the significance of the concepts of interaction and landscape in this research, theoretical foundations discuss interaction and its meaning on the one hand and landscape and its influential components, which include environmental and human components, on the other hand. These elements shape and improve the aspect of interaction in the landscape.

• Interaction and interactive

The word interaction consists of a prefix (inter) and a noun (action). Its prefix (inter) means "intermediate," "opposition," or "sharing" between different things, places, or people. Its main component (action) refers to something that happens or is done, such as a change, manner or method, activity, process, event, effect, or result (Merriam-Webster, Oxford Learners Dictionaries, Longman, 2020). There are also two approaches to the meaning of the word interaction: one means being reciprocally active or influencing each other that occurs between two or more people or things. Another meaning is the two-way electronic communication that is established directly between the user and the computer. Everything that happens by the computer or similar

device is a reaction to the user's actions (ibid.). According to the terminology of interaction, duality is a prerequisite in forming interaction. Furthermore, components that include the concepts of each group were chosen based on the meanings of the word and its conceptual classification (Fig. 1). As a result of conceptualization and conceptual weighting, the components of interaction, activeness, variability, responsiveness, effectiveness, and affectedness are recognized as interaction occurrence components. Because the current study aims to increase the occurrence of interaction in the landscape, a review of the landscape's meaning is necessary. The reciprocity principle in interaction necessitates determining the parties of the interaction in the landscape. The occurrence of interaction in the landscape and the characteristics of the landscape affecting this occurrence can be strengthened by recognizing the elements of the interaction.

• Landscape

Landscape naming occurred when the place underwent a change, which was formed by inventing a new relationship with the environment and establishing a new location (Berque, 2013). As a result, landscape architecture emerged as the science and art of transforming various areas of the earth through the use of natural and artificial elements (Britannica, 2022). Landscape's reliance on two main elements makes it difficult to understand by removing each of them; the first is the environment, which includes human, and the second is the human being who seeks to understand and communicate with the environment. Landscape is the sum of the visible parts, including the layers and intersections of time and culture that make up a place (Steiner, 2008, 4). It is important to emphasize that landscape is a living and dynamic being that is influenced by human and their relationship with the environment. Moreover, landscape is an association of memories that occurred in the environment for a long time and affects the relationship between humans and the landscape, followed by changing humans' culture and civilization (Mahan & Mansouri, 2017, 26). One of the landscape's crucial components is the field of semantic association that the environment provides for people, as well as how these meanings are interpreted and what they convey (Rapoport, 2013). In an exalted deduction, landscape is a phenomenon achieved through our perception of the environment and the interpretation of the mind; in fact, the landscape is an objective-subjective phenomenon that is sometimes separated into objective and subjective dimensions to facilitate its study and abstraction. (Mahan & Mansouri, 2017, 26). A landscape is interpreted by humans based on its cultural and social context. This requires two-way communication between humans and their environment. Humans cannot interpret without an object, but if there is no human being to interpret and perceive, an object or landscape is just a physical object with no meaning (Mehrabani Golzar & Dabiri, 2016). The landscape is a visible and dynamic process of development on the surface of the earth that results from the interaction of living, human, and non-living elements and changes with place and time (Pungetti & Makhzoumi, 1998). The landscape approach is a practical aspect of the definitions of landscape theory, which includes three components of conceptual nature, principles, characteristics, and the management process. In the meantime, its conceptual nature is the principle of identifying and evaluating human information, environment, and interaction between the two, and derived from the definitions of landscape theory, the scope of its application and generalizability is achieved with multiple goals (Masnavi, Motedayen, Saboonchi & Hemmati, 2021, 31). Humans and the environment are two factors that shape the interaction in the landscape, according to the definition of landscape. Therefore, understanding

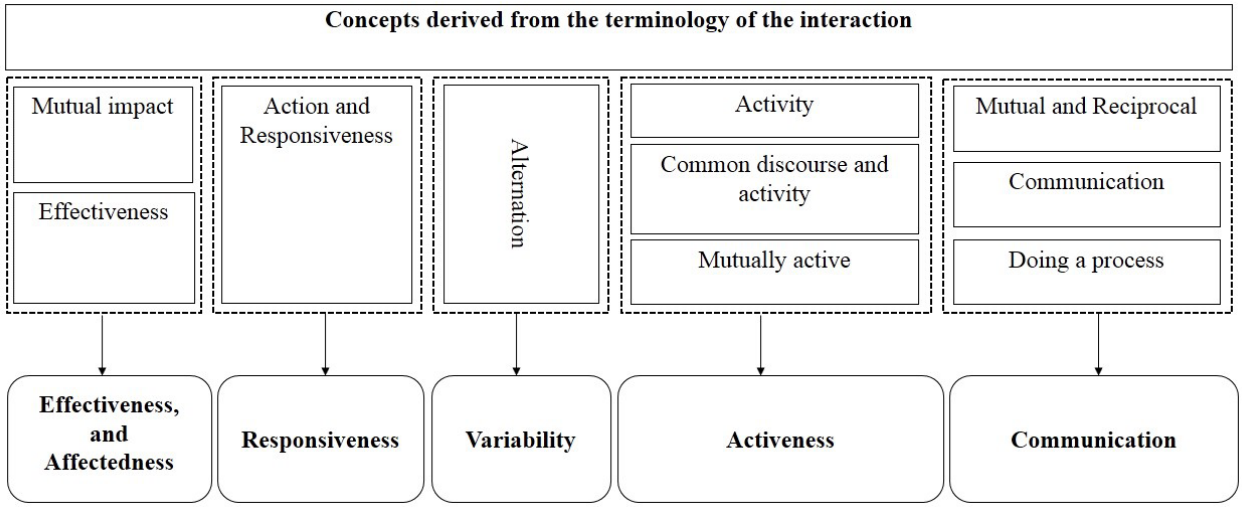

Fig. 1. Components of the interaction occurrence according to the meanings and concepts derived from it. Source: Authors.

the environment and human nature is required to identify the influential criteria for the occurrence of interactions. Other criteria mentioned in the landscape definition are the human, the environment, or the common zone between humans and the environment. Hence, according to Figure 2, it is possible to identify the human and environmental criteria derived from the concept of landscape.

• Environment (one of the parties of interaction in the landscape)

Environment is a broad concept. The environment's nature and its affordance are effective in recognizing environmental components. Some studies distinguish the difference among physical, social, psychological, and behavioral environments. The physical environment includes geographical places; the social environment includes institutions made up of individuals and groups; the psychological environment includes people's subjective images; and the behavioral environment is a collection of factors to which a person responds (Lang, 2007). Environmental psychologists have defined different types of environments based on their nature, which are outlined in Table 2.

According to Table 2, the environment nature is defined in different layers. However, these layers cannot be considered individually in the planning of the environment, such as landscape which is an objective-subjective concept. Several of these layers are objectively and explicitly perceived, while others are perceived subjectively and implicitly. This attitude emphasizes the importance of paying attention to different layers of the environment as perceived by users. Indeed, environmental perceptions define the environment's affordances or opportunities for doing action. The environment can offer, provide, and furnish the necessary affordances for living beings (Good, 2007, 270). It means that the living creature and the environment are complementary (Gibson, 1979, 127). Gibson's theory of the affordances of the environment is the main essence of the development of environmental psychology and is the foundation for considering activity as part of the interactive relationship among the actor, other physical factors, and environmental systems (Greeno, 1994). The physical configuration, or structural pattern, of an object or behavioral place, according to Gibson, is a factor that makes it usable for certain activities. Some desires are more easily satisfied by an object or a terrestrial, living, or cultural environment than others, and some activities in a specific configuration of the built environment meet the needs of some people but not the needs of others (Lang, 2007). The affordances of the environment are used to provide opportunities in the environment that meet the possibility of attracting users with a variety of needs and activities, as well as to strengthen human presence in it and human interaction with the place. Costall emphasizes that the point of interest in the theory of environmental affordances is that human becomes acquainted with objects through practically encountering them in the environment (Costall, 1981). It is crucial to understand how different elements function as affordances of the environment with users and their characteristics, as well as the system of activities and norms based on their lifestyle when discussing interaction with the man-made environment. As a result, in any environment, it is necessary to pay attention to the opportunities and limitations, as well as their relationship with the user's characteristics, and this necessitates paying attention to the context, physical, behavioral, perceptual, social, and cultural characteristics of users in designing the environment. It is necessary to pay attention to the two aspects of the environment's explicit and implicit affordances and to predict the affordances of the designed environment. That is, the expected affordances of the design are recognized and regarded by taking into account the evident and hidden aspects of the design context, which

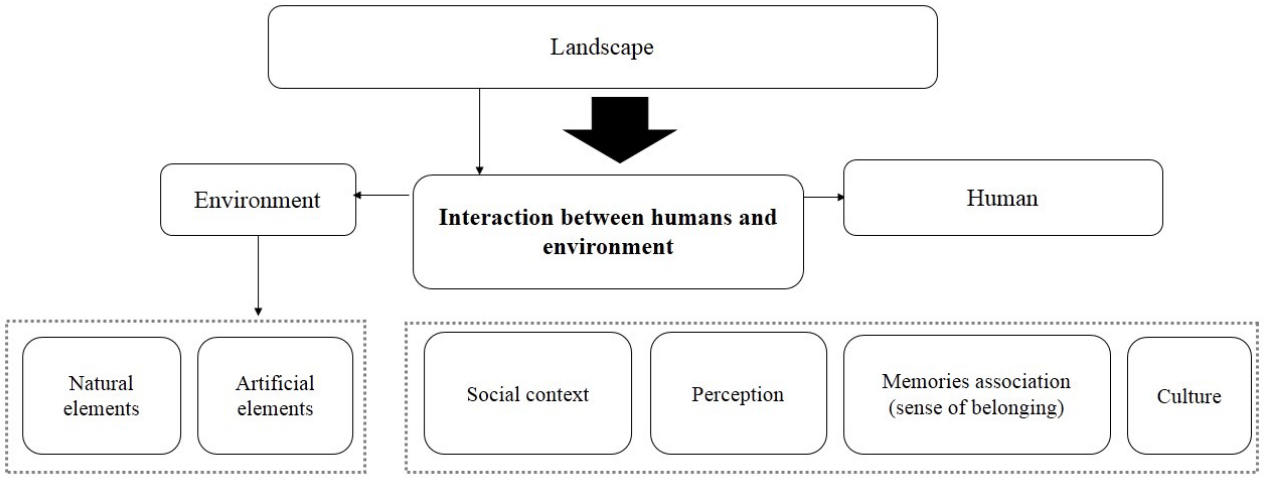

Fig. 2. Criteria derived from the concept of landscape. Source: Authors.

Table 2. Environment and its nature based on the views of theorists. Source: Authors.

Nature of environment	Physical environment	Social environment	Psychological environment	Behavioral environment
Types of environment	Natural environment (Hellpach, 1911)	Social environment (Hellpach, 1911; Altman,1990; Porteous,1977)	Cultural environment (Hellpach, 1911; Gibson, 1979)	Personal environment (Kirk cited in Porteous,1977)
	Geographical environment (Koffka, 1935; Gibson, 1979; Sonnefeld cited in Porteous,1977)	Phenomenal environment (Lewin cited in Stemberger, 2019; Kirk cited in Warf, 2010, 978)	Practical and perceptual (Sonnefeld cited in Porteous,1977)	Phenomenal environment (Stemberger, 2019; Warf, 2010, 978)
			Phenomenal environment (Lewin cited in Stemberger, 2019; Kirk cited in Warf, 2010, 978)	
	Objective environment (Jakle, Brunn, & Roseman, 1987)	Subjective environment (Jakle, Brunn, & Roseman, 1987)	Conceptual environment (Porteous,1977)	Subjective environment (Jakle, Brunn, & Roseman, 1987)
	Phenomenal environment (Lewin cited in Stemberger, 2019; Porteous,1977)		Subjective environment (Jakle, Brunn, & Roseman, 1987)	

include natural, physical, and human (social and cultural) characteristics (Daneshgarmoghadam & Eslampour, 2013, 83). Thus, the theory of environmental affordances enables landscape designers to improve the interaction between the environment and humans by designing behavioral places in addition to physical features. It is accomplished through the implementation of specific behavioral activities. Indeed, the more users perceive the environment's various affordances, the greater the possibility of forming particular behaviors will be. The consequences will be strengthening interaction and communication with the environment that is influential in the interactive landscape issue.

• Human (The other party of interaction in the landscape)

Focusing on human cognition and identity can make research closer to achievable and generalizable results and avoid reaching superficial, group, and transient decisions. Empirical, philosophical, and religious anthropology can be used to understand human nature. Each relevant scientific discipline in experimental anthropology identifies and investigates one dimension of human personality (Trigg, 2003). This article employed experimental anthropology and scientific anthropology. Psychology was considered one of the sciences related to scientific anthropology. Human nature was analyzed in psychology from three points of view: Behaviorism, Cognitivism, and Humanism. According to behaviorists, the empirical study of human behavior is the only way to proceed with accurate theories about human nature. Besides, they oppose any attempt to explain human behavior in terms of mental essences (Stevenson, 1974). Behaviorists focus primarily on human behavior and consider it as a stimuli function. Human behavior is, in fact, the response to stimuli (Mesbah, Zarean, Biria, Aghatehrani, Rahnemaei & Shameli, 1995, 246). Habits, attitudes, readiness, and talents, according to behaviorists, are not inherent and do not originate from human nature, but are imposed on humans as a result of contact with the environment. Cognitivists use perceptions and cognitions to interpret human behavior and emotion (Schultz & Schultz, 2015). According to the cognitive model, the person's environment and interaction with the environment, as well as the style of his upbringing and influential people in his life, form the foundation of the human belief system. Environmental events provide the individual with sensory data, which he uses to achieve perception and cognition. Individual beliefs are stable components of an individual's cognitive system that are activated by events and categorize and encode the information and perceptions that enter the individual's cognitive system (Soltan Alghoraei & Badri Gargari, 2006, 74). This approach believes that humans are free and can define and justify themselves, bringing their uniqueness to the forefront. Their life continues as long as they are in communication and in sync with others. Each human being's individual experience has the highest value and importance in his life (Shafie Abadi & Naseri, 2017, 121). In general, in this theory, human behavior and emotions are assumed to be subject to his beliefs, and behavioral or emotional consequences are largely independent of events. This means that the individual's emotional and behavioral reactions are based on the individual's perception and knowledge of the events, rather than the incident and events that occurred (Akouchakian, 2002, 101). Humans, according

to humanism, are constantly changing and growing. From this viewpoint, human existence precedes nature, so they create their nature. This significant point expresses his liberty and authority, as well as his responsibility for his existence. In other words, human existence implies the possibility of being. It could be something other than what it really is (Soltan Alghoraei & Badri Gargari, 2006, 75-76). According to this doctrine, every potential human being possesses all of the goodness within him, but he must strive to make it a reality. The perfect human being has realized his inner potential forces; such a person is Self-actualization (Najafi, Mani & Kalantari, 2015, 154). When reviewing the different psychological approaches, it is evident that they are not comprehensive in dealing with human beings. Therefore, every concept can assign a particular layer. These are determined by behaviorism, cognitivism, and the humanism approaches as the different layers. Figure 3 refers to the components of these approaches with layers that assess their impact on the criteria of interaction occurrence. Considering the importance of man and the environment in the formation of interaction and the fact that the occurrence of interaction in the landscape is the result of a correlated relationship between humans and the environment, it is evident that studying humans and the environment concurrently will aid in better identifying the issue.

• Human-environment relationship

In terms of the quality of human-environment interaction, Amos Rapoport (1990) proposed three psychological theories, including "environmental determinism," "environmental possibilism," and "environmental probabilism." According to environmental determinism, the environment influences human behavior, perception, and emotion. According to this viewpoint, each stimulus elicits a distinct response. In this context, the environment primarily refers to climatic and geographical conditions, though it can also refer to the artificial environment (Rapoport, 2013). According to this theory, the physical environment creates a kind of compulsion to use a specific type of behavior, and the issue of behavior and culture has no place in this theory (Khatibi, 2013, 67). The environmental possibilism viewpoint defines the physical environment as a context that creates possibilities and constraints for behavior; however, the environment is not a determinant of behavior but rather the possibility of some other behaviors. According to this viewpoint, human behavior is impressed by the environment (Rapoport, 2013). According to this theory, the physical environment creates a kind of compulsion to use a specific type of behavior, and the issue of behavior and culture has no place in this theory (Khatibi, 2013, 67). The environmental possibilism viewpoint presents the physical environment as a context that creates possibilities and constraints for behavior; however, the environment is not a determinant of behavior but rather the possibility of some other behaviors. According to this viewpoint, human behavior is impressed by the environment (Rapoport, 2013). While people can have different behaviors in an environment and care about individual motivations, the design features and factors of the artificial environment influence the probability of specific behaviors, according to probabilism (ibid.). According to this theory, the environment increases the likelihood of

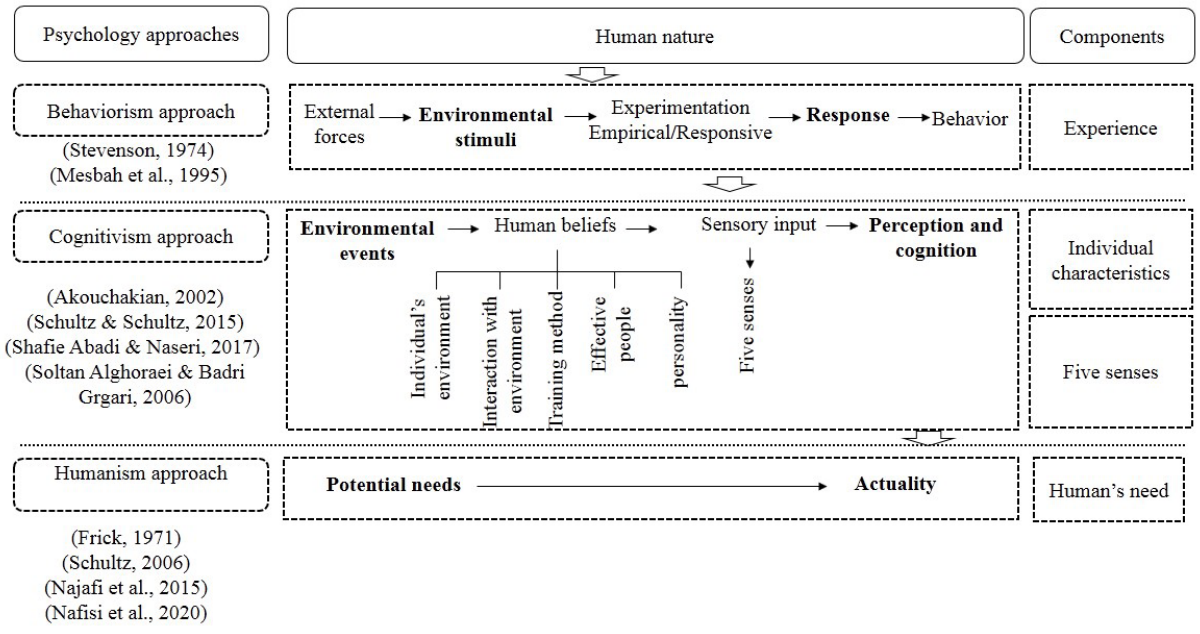

Fig. 3. Human nature as seen through various psychological viewpoint, and the resulting human components. Source: Authors.

certain behaviors by providing specific physical conditions. There is a discussion about diversity and the right to choose here (Abbaszadegan, 2005, 81). There are different points of view on how humans and the environment interact in environmental psychology. Theories have been developed based on each of these attitudes. The fundamental theories of human-environment relationships can generally be divided into three parts. Some of them assume that humans dominate the environment, while others presume that the environment dominates humans, and interactive theories aim to balance the relationship between humans and the environment (Shahcheraghi & Bandarabad, 2015, 32). Each theory about the human-environment relationship leads to a process in the relationship between humans and the environment. It results in emphasizing a specific characteristic of the environment. According to the human-environment process in determinism theory, the environment's stability leads to its dominance over humans and the environment's role in behavior. The theory of possibilism focuses on diversity, whereas the theory of probabilism focuses on flexibility. According to these characteristics, environmental stability can attribute to the environment's dominance over humans and reduced interaction between humans and the environment; diversity and flexibility in the environment lead to improved human interaction with the environment and, as a result, a more balanced bilateral relationship (Fig. 4). The theoretical framework of the research can be developed after reviewing the subject's literature and considering the concepts of landscape, humans, and environment (Fig. 5). We can understand the significance of the characteristics that improve the interaction between humans and the environment by considering the relationship and location of various human and environmental criteria in their place and relative to each other. Some refer to human characteristics, while others refer to environmental characteristics that increase the affordances of the environment based on the user's correct cognition and provide the possibility of the environment being responsive to the users.

Research Methods

The current study has been conducted based on a qualitative approach. To achieve the objective and answer research questions in theoretical foundations, it has been considered to study the sources about the concept of interaction, both lexically and by exploring its place in some landscape-related sciences. The meaning of landscape, as well as human and environment, were then considered and used in selecting effective environmental and human criteria in the occurrence of interaction in the landscape. Following that, criteria of interaction occurrence and human and environmental components are recognized by using theoretical foundations and logical reasoning, content analysis, and the location of the components relative to each other. Finally, the last result was obtained after validating and selecting components using the Delphi method, using the opinion of landscape experts, and applying the analysis and survey results.

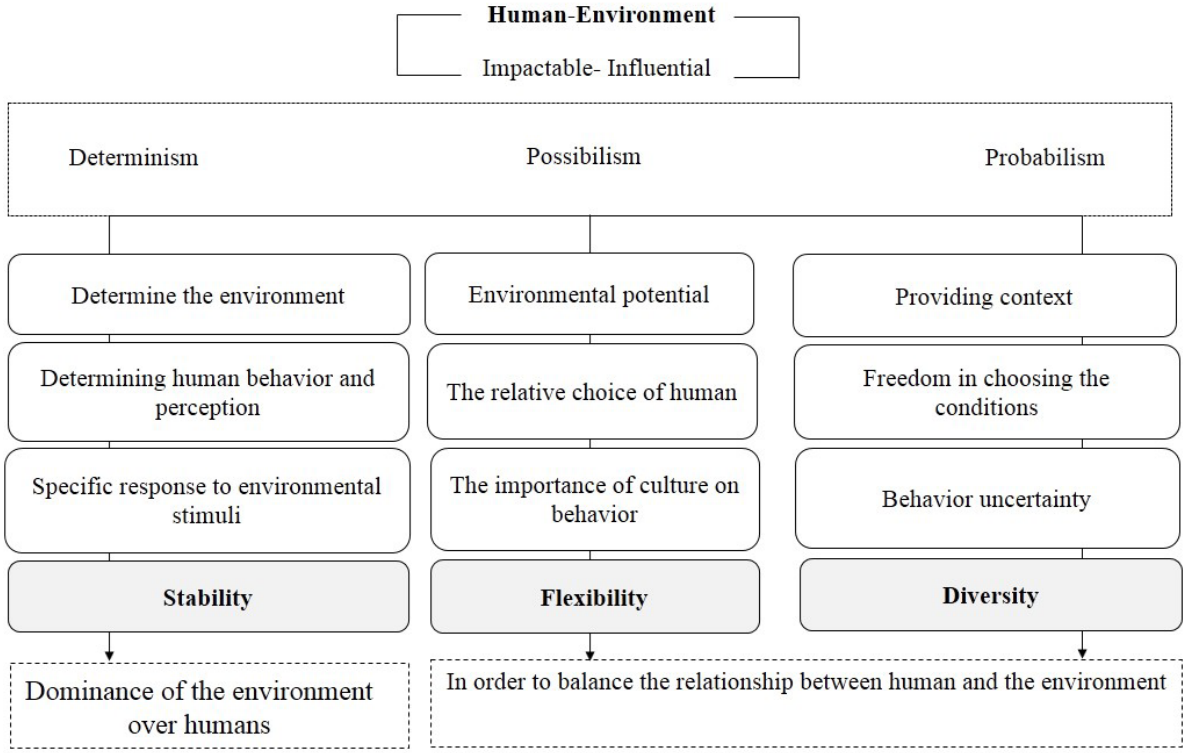

Fig. 4. Approaches to the formation of human-environment relationship based on basic theories. Source: Authors.

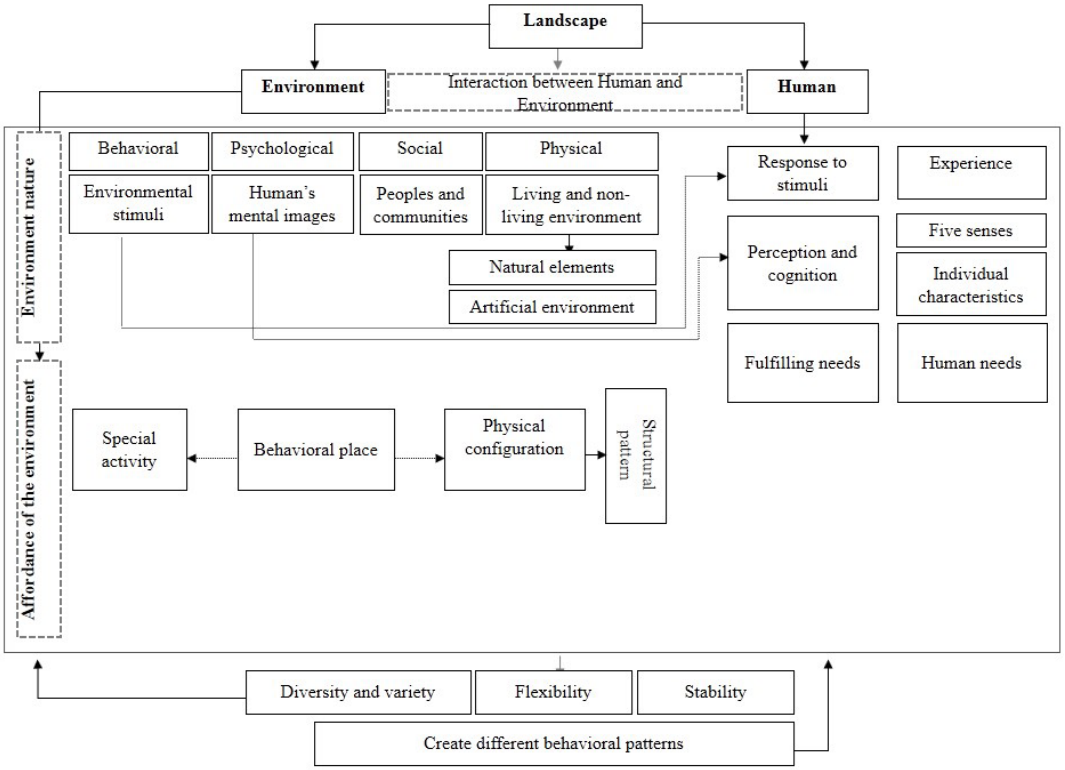

Fig. 5. Theoretical framework of research based on theoretical foundations. Source: Authors.

Discussion: The occurrence of interaction in landscape and the impact of human and environmental components on it

The discussion over the occurrence of interaction in the landscape is followed by an evaluation of the components of the theoretical foundations of interaction in the field of landscape. For this purpose, the effectiveness of the components of the interaction in establishing a correlated relationship between humans and the environment is measured in the landscape. Then, human and environmental components, which are the result of reviewing the meaning of landscape, human and environment, and their relationship, are evaluated in two stages to determine the extent of their impact on the components of the interaction occurrence. In the first step, according to what was mentioned before, environmental and human components are selected using experts' opinions. Then the impact of these components on the criteria of the interaction occurrence in the landscape is measured.

• Components of the interaction occurrence in the landscape

Following semantic matching of the components, five characteristics: communication, activeness, responsiveness, variability, effectiveness, and affectedness, were chosen as components of the interaction and interaction occurrence based on what was discussed in the theoretical foundations (see Fig. 1). The effect of the characteristics of the interaction occurrence on creating a correlated relationship between humans and the environment in the landscape was assessed using experts in this field to generalize the characteristics of the interaction occurrence in the landscape (Delphi method). Accordingly, the results are presented in Fig. 6. Communication, as a necessary and obvious condition for the formation of interaction between humans and

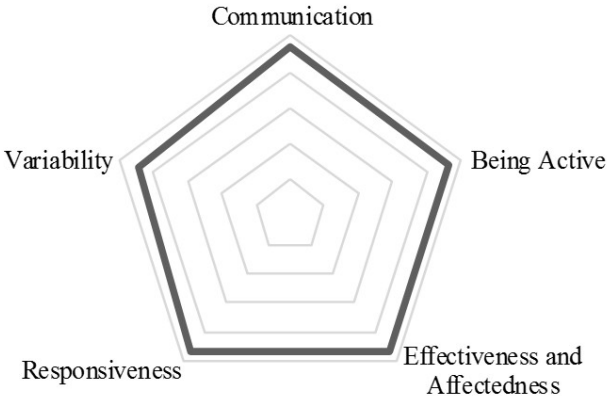

Fig. 6. Evaluating the components of the occurrence of interaction in the landscape in the Delphi method. Source: Authors.

the environment, has the highest score when evaluating the components of the occurrence of interaction in the landscape (with an average of 4.73, Level 1). Following that activeness, responsiveness, effectiveness, and affectedness were considered influencing indicators of interaction occurrence with the same valuation (with an average of 4.64, Level 2). Variability (with an average of 4.45, Level 3) is also accepted as the final effective indicator, but somewhat with less frequency (Fig. 7).

• Human and environmental characteristics affecting the occurrence of interaction

The following section selects human and environmental characteristics and discusses the extent to which they influence the components of interaction occurrence. The initial selection of human and environmental characteristics was accomplished by reviewing and analyzing the theoretical foundations of the meaning of the landscape and human nature. Then Delphi method was used in two stages to analyze these components. Experts selected the final human and environmental characteristics from the ones in the first stage (Fig. 8). In the next step, these characteristics were evaluated with the components of the interaction occurrence in the landscape. As a result, the effect of environmental characteristics on interaction characteristics, such as natural elements, artificial elements, structural patterns (physical layer of the environment), activity, attractiveness, flexibility, and diversity (psychological and behavioral layer of the environment), can be investigated. Human characteristics, associations of memories, experiences, personality traits, and the five senses are all evaluated. To study the impact of these components on the occurrence of the interaction, the degree of correlation between human and environmental characteristics and the interaction occurrence components were evaluated using the Delphi method and a questionnaire. The data analysis results of the effect of these two aspects on each other show that, generally, environmental characteristics are more effective in interacting in the landscape because they have a higher average than human components. On average, among environmental characteristics, flexibility in the environment, use of natural elements, diversity, the definition of specific activities, attractiveness, and structural patterns, and at last artificial elements have the greatest to least impact on the formation of interaction occurrence in the landscape (Table 3). On average, the five senses (due to sensory data from the environment), belonging sense, experience, and individual characteristics will have the most to the least impact on interactions in the landscape, respectively (Table 4). The influence of environmental and human characteristics on the impactful components of interaction occurrence was assessed through data analysis, as presented in Table 5. The analysis results indicate that among environmental factors, the use of natural elements, flexibility, attractiveness, activity, diversity, structural pattern, and artificial elements have the highest to the least impact on human-environment communication, respectively. The following factors will have the greatest to the least impact on activeness in the landscape, respectively: flexibility, natural elements,

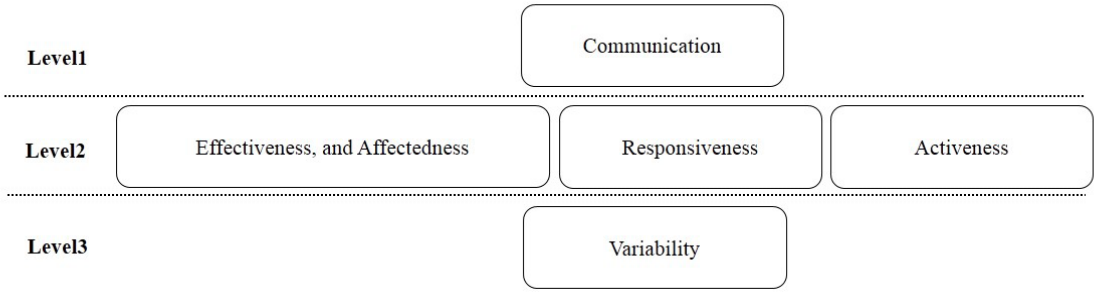

Fig. 7. Different levels of influence of components on interaction occurrence. Source: Authors.

Table 3. The average of the effect of environmental components on the formation of the interaction occurrence. Source: Authors.

Environmental components	Flexibility	Natural elements	Diversity	Activity	Structural pattern	Attractiveness	Artificial elements
Average	4.5	4.4	4.2	4.1	3.6	3.6	2.9

Table 4. The average of the effect of environmental components on the formation of the interaction occurrence. Source: Authors.

Human components	Five senses	Association memories (belonging sense)	Experience	Individual characteristic
Average	4.1	3.8	3.6	3.1

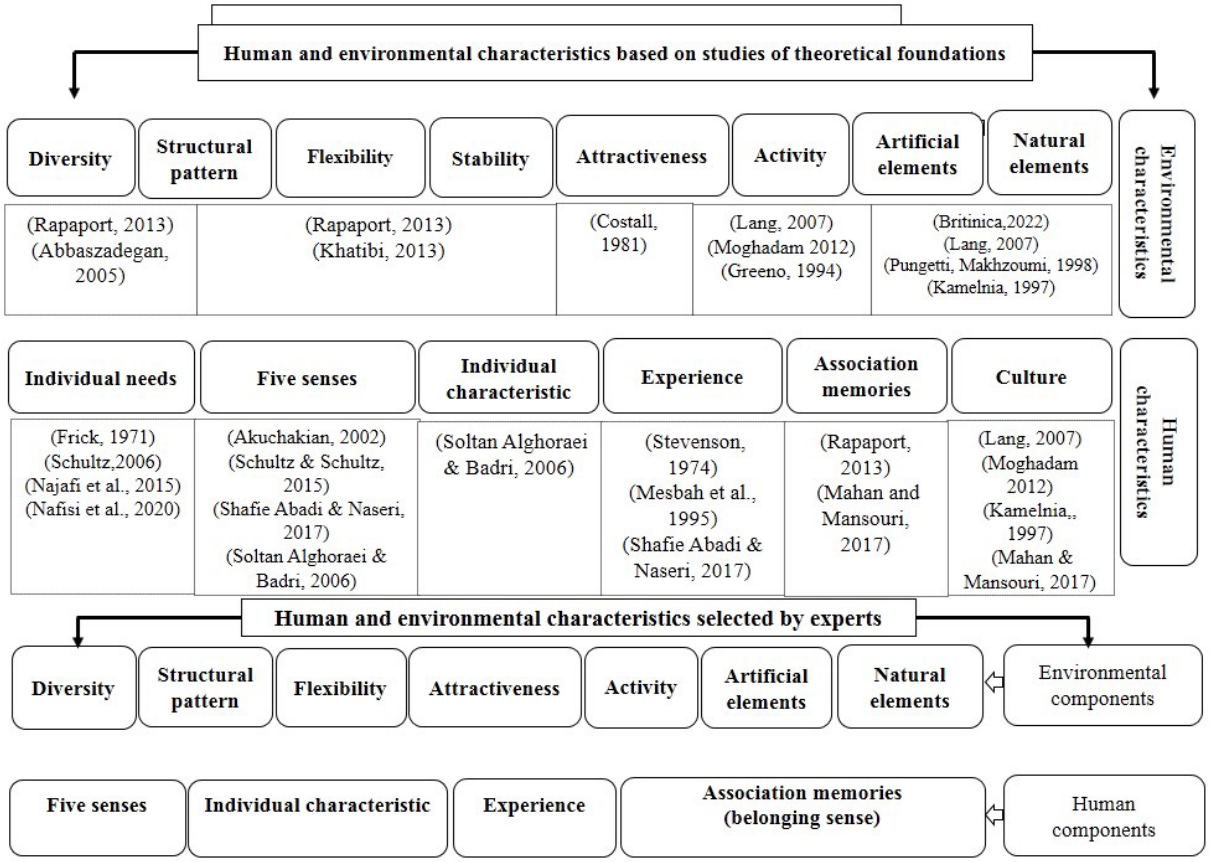

Fig. 8. Human and environmental components selected based on concepts and theoretical foundations. Source: Authors.

attractiveness, structural patterns, diversity, and activity and artificial elements. The extent of landscape variability will be influenced most by flexibility, natural elements, diversity, activity, structural patterns, artificial elements, and attractiveness. The environment's responsiveness and the landscape's impact on the user will be influenced most by flexibility, diversity, natural elements, activities, structural patterns, artifacts, and the attractiveness of the environment. The effectiveness and affectedness of the user and the environment in the landscape will be most influenced by flexibility, natural elements, activity, diversity, attractiveness, structural patterns, and artificial elements. In terms of human characteristics, belonging sense, five senses, experience, and individual characteristics have the greatest to least effect on human-environment communication. Experience, belonging sense, five senses, and individual characteristics have the greatest to least impact on the extent to which people are active and the variability of the landscape. The five senses influence landscape responsiveness most, while experience, belonging sense, and individual characteristics have the least. The five senses, belonging sense, experience, and individual characteristics will have the greatest to the least effect on the effectiveness, and affectedness between user and the environment.

Conclusion

The improvement of interaction occurrence in the landscape and the formation of the interactive landscape require a stronger connection between humans and the environment as the primary factor in forming a correlated relationship. Studies on human cognition and the environment demonstrate that strengthening this relationship is related to improving the affordance of the environment. In addition, it relates to the user's perception of more affordances and the formation of a specific behavior in the environment. It is possible to promote environmental affordances by emphasizing specific perceptual environmental features in different layers of the environment. According to the research findings, paying attention to environmental characteristics such as flexibility, use of natural elements, diversity, and more impactful activity can increase the affordance of the environment and strengthen interaction in the landscape. When we discuss the environment and environmental characteristics in the context of shaping and improving the quality of the landscape, we cannot ignore the impact of humans and their individual and social characteristics in recognizing and perceiving these characteristics. According to the findings, stimulating the five senses, creating a sense of belonging, and paying attention to

individual and social experiences of users in landscape design all contribute to increased human-environment interaction and the creation of an interactive landscape. The formation of communication with all of the different layers of the defined environment, as well as the perception of the environment's affordances and the formation of interaction occurrences, necessitates attention to the human presence in the environment. Considering different individual and social aspects of humans as users in the design and planning of the landscape and achieving solutions to strengthen the relationship between humans and the environment affect the creation and increase of the interactive aspect in the landscape. Although in the current study, different indicators were determined and measured according to the characteristics of the environment and humans, the possibility of expanding and completing this process is possible by adopting different research approaches, which can make it possible to achieve a comprehensive theory of the interactive landscape.

Table 5. Value arrangement of environmental and human components based on the extent of the impact on the interaction occurrence. Source: Authors.

Interaction occurrence components	Environmental components					Human components		
Communication	Natural elements	Flexibility / Attractiveness / Activity	Diversity	Structural pattern	Artificial elements	Belonging sense Experience	Five senses	Individual characteristic
	5	4.5	4	3.5	3	5	4.5	4
Activeness	Flexibility	Natural elements / Attractiveness / Structural pattern / Diversity / Activity		Artificial elements Belonging sense Five senses		Experience	Individual characteristic	
	4.5	4		3		4	3	
Variability	Flexibility	Natural elements / Diversity / Activity	Structural pattern	Artificial elements / Attractiveness Five senses		Experience / Belonging sense	Individual characteristic	
	4.5	4	3.5	3		3	2	
Responsiveness	Flexibility / Diversity / Natural elements	Activity / Structural pattern		Artificial elements Belonging sense / Attractiveness		Five senses	Experience / Individual characteristic	
	4.5	4		3		4	3	
Effectiveness, and Affectedness	Flexibility / Natural elements	Activity / Diversity	Attractiveness	Structural pattern	Artificial elements	Five senses	Belonging sense Individual characteristic	Experience
	4.5	4	3.5	3	2.5	5	4	3.5

Endnote

*This article is extracted from "Neda Farsi Astaneh"'s Ph.D. thesis entitled "Operational Interactive Landscape Patterns in Contemporary Urban Open Spaces of Tehran" that is done under supervision of Dr. "Mehdi Haghighatbin" and advisement of Dr. "Zahra Rahbarnia" in 2022 at the Faculty of Art, Tarbiat Modares University in Tehran, Iran.

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