

Thematic Analysis and the Knowledge Map of Environmental Psychology Studies

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ABSTRACT

In recent decades, environmental psychology has been accepted as the basic knowledge of human-environment studies in many interdisciplinary fields, including architecture and urban planning. The present study aims to generally introduce environmental psychology and show how the studies in this field have been developed and what the most popular research topics and approaches are in this field. To this end, the present research follows two main paths. The first path includes the bibliometric analysis of the articles indexed in the Scopus database between 1972 and 2022, which included the keyword "environmental psychology", and the second path includes the content analysis of 40 most cited articles (out of the abovementioned articles). The analyses were carried out by asking key people and sources and investigating major research areas, the importance, and priority of topics, research approaches, and research examples. The results indicate that environmental psychology research can be classified into four main subject clusters including "sustainability", "place", "mental health", and "consumer behavior". Moreover, behavioral and cognitive approaches were identified as the most important and widely used psychological approaches in analyzing human-environment relations. Most studies have been conducted in urban spaces, followed by commercial, residential, educational, and work environments, respectively. These studies have been carried out on various scales, from macro scales such as planning to micro scales such as interior design. A significant number of studies have focused on human perception and evaluation of environmental qualities and their results such as satisfaction and place preference. The health area has been raised in this field in recent decades and is still considered a growing area. The issue of place attachment has been raised as one of the issues receiving researchers' attention, with continuous growth throughout the studied period.

Keywords: Environmental Psychology, Bibliometric Analysis, Research Priorities, Human-Environmental Issues.

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1. INTRODUCTION

Environmental psychology, as a science, was formed following the criticism of modern living environments and inattention to humans in design. The impact of built environments on humans was considered from the 1950s and in 1970, Proshansky, Ittelson, and Rivlin announced the emergence of environmental psychology for the first time in the book "Environmental Psychology: Man and Physical Setting" (Lang 2011, 10). In these years, various institutions, publications, and conferences across the world, in cooperation with designers, psychologists, and urban planners have started to specially perform activities in this field. For example, one can refer to EDRA (Environmental Design Research Association), which was established in 1969 to develop education and research in the field of human-environment relations, and natural environments by holding annual conferences and publishing research, or the Journal of Environmental Psychology, which has been indexed in Elsevier since 1981. In Iran, in recent decades, architecture students and researchers have become more interested in the study of human-environment relations and the design of human environments. This can be understood from various books and articles published in this field, and many postgraduate architecture and urban planning theses on environmental psychology subjects. To start the activity and problem-seeking process in this field to direct research in a more positive and efficient direction, researchers and students need familiarity with the latest achievements, core issues, and active databases, or in other words, familiarity with the current knowledge map of this field. The knowledge map includes the analysis of the publications in a scientific field in different dimensions and the drawing of an overview of that field, based on which the subjects with the most and least propinquity are distinguished. A scientific map aims to identify the points of knowledge that follow the so-called rhubarb raised in the related field (Abedi Jafari, Abouei Ardakani, and Aghazadeh 2011). Among the studies identifying subject areas in environmental psychology, one can mention the classification presented by Holan (1986). According to this classification, the dominant issues raised in environmental psychology are classified into four categories: 1. Environmental assessment (issues related to satisfaction, place preference, perception of beauty and quality, etc.), 2. Cognitive maps (issues related to navigation and space legibility), 3. Environmental stresses, and 4. Spatial behavior (issues related to territoriality and personal space). In later research by Robert Gifford (2014), Steg, Berg and DeGroot (2016), and Valentin and Gamez (2010), one can see almost the same classification of environmental psychology research. This classification includes 1. Factors affecting environmental behavior and sustainable

and healthy choices in the environment, 2. Promoting pro-environmental behaviors, 3. The role of the environment, especially the natural environment, in enhancing health and reducing stress, and 4. Human-environment interrelations, including place attachment and place identity. Gifford (2014) knew the study of people's interactions in virtual environments as the welcomed and progressing subjects of this knowledge and according to Steg et al. (2017), the emergence of new approaches such as regenerative environments, quality of the environment, and quality of life, and the study of the signs of the environment are of the welcomed and progressing subjects in environmental psychology. Gifford (2016), in his book "Research Methods for Environmental Psychology" also reviewed common research methods in this field as well as common methods of recording behavior. Bibliometric studies have also been conducted in environmental psychology, albeit in a more limited scope. For example, Milfont (2013) analyzed only the articles published by the Journal of Environmental Psychology during its first 30 years of activity using bibliometric analysis or those that analyzed the publications related to this knowledge in a specific country (Lopez Lena 1997).

The present study attempts to provide a knowledge map of environmental psychology and related topics emphasizing the built environment, with a different perspective, using a mixed approach and comparing bibliometric analysis and content analysis of the most cited articles. Therefore, the main research question is as follows: What topics and issues have the environmental psychology studies focused on and how have they evolved over time? To answer this question, first, a model of human-environment problems is presented, and then, the studies conducted are examined based on the proposed model through two paths of bibliometric and content analyses.

2. A MODEL OF HUMAN-ENVIRONMENT PROBLEMS

"Problem" is considered the core of a study and the problem-seeking process is considered an essential part of a study. In the problem-seeking process of research, a research design or a framework of problems proposed in a field can be a guide for researchers. In environmental psychology, various models and patterns have been proposed to explain aspects of human-environment problems. For example, John Lang, in his book "Creating Architectural Theory", proposed a model for the content theory of environmental design, which, according to him, is a framework of "what we know and what we should know" (Lang 2011, 121). His model is a three-dimensional matrix consisting of the basic processes of behavior (perception, emotion, cognition, spatial behavior, etc.), patterns of the built environment (pattern of activity, aesthetics, etc.), and the nature

of the user (personality, organism, culture, etc.). It is used in the theoretical foundations or problem-seeking of environmental and behavioral research (Fig. 1). Canter (1983) proposed a more detailed model of how to raise the problem only in the issues related to environmental evaluation. In this model, the environment consists of three dimensions: social structure, spatial structure, and service structure. Each of these dimensions can be evaluated at different scales of use (for example, the house, its location, or the neighborhood) or at different levels of focus on details (for example, evaluating the overall feeling of the space, general qualities, or a specific characteristic of the space). In this way, he presented a model including different dimensions of the environment, various scales of the environment, and various degrees of focus (Fig. 1). On the other hand, in the approach to human-environment problems, proposed by Wepner and Demick (2002), a comprehensive and systematic

perspective is followed in the problem statement. In this approach, the environment is a system consisting of the physical environment (both built and natural environment), interpersonal environment (such as friends and family), and sociocultural environment (norms of the home, society, etc.), and human is a system consisting of physiological-biological (such as health), psychological (such as personality and self-confidence), and socio-cultural (such as the role of a person as an employee) dimensions. They believe that in a comprehensive approach to human-environment problems, all these six areas and the relationships between them should be considered. Of course, as proposed by Russell (1982), this approach expands the scope of environmental psychology and connects it with sciences such as urban sociology, anthropology, human ecology, and eco-cultural psychology.

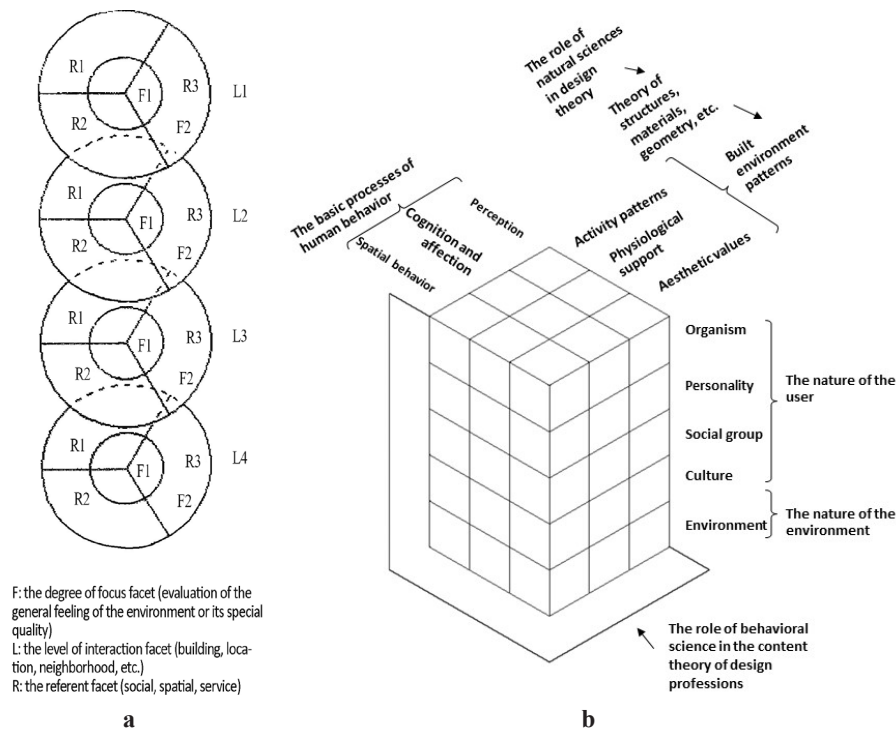


Fig. 1. Examples of Problem Statement Models in Environmental Psychology

- a) Environmental evaluation model presented by David Canter (Canter 1983).
b) Content Environment-behavior theory model presented by John Lang (Lang 2011)

In the present study, considering its focus and emphasis on the built environment and preventing the expansion of the research scope, a special model is presented for classifying the existing problems and identifying potential problems in the field of environmental psychology, which is considered the basis of the analyses in this study. This model includes two environmental dimensions (use and components of the environment) and two human dimensions (human results and psychological approaches) that can be examined with different methods and tools

(Fig. 2). Based on the presented model, the main research question, which is based on the problems of interest in environmental psychology, is raised with four sub-questions:

1. Which of the human-environment interactions is intended? (sense of belonging, social interactions, efficiency, enjoyment and motivation, legibility and navigation, health and well-being, etc.);
2. In what types of space or use is the research carried out? (housing, urban space, administrative, educational, commercial, medical uses, etc.);

3. Which of the components of the built environment is considered? (landscape, space layout, furniture, etc.);

4. Based on which "psychological approach", the human-environment relation is analyzed?

It should be explained that in the presented model, psychological approaches refer to those approaches showing how to observe and analyze behavior from different perspectives and each of them can contribute to our overall understanding of a character or behavior. Five major approaches in psychology are usually introduced as perspectives that have been used more in contemporary psychology studies: behavioral approach, cognitive approach, psychodynamic approach, biological approach, and subjective or humanistic approach (Nolen-Hoeksema, et al. 2009). The behavioral approach focuses on visible stimuli and responses and considers behaviors as the result of conditioning and reinforcement. The cognitive

approach addresses subjective processes including perception, remembering, reasoning, decision-making, and problem-solving. In the psychodynamic approach, the basic assumption is that behavior originates from the unconscious, i.e., beliefs, fears, and desires that a person is unaware of but influence his behavior. The biological approach seeks to identify the neurobiological processes of the brain that occur due to behaviors. Subjectivism psychologists believe that behavior is a function of the perceived world, not the objective world. Therefore, in this approach, the person's explanation of the situation is the basis of the analysis. In another classification, the social approach was also identified as a separate approach. Social psychology addresses the ways through which people influence each other. The social approach is based on the assumption that the main factors influencing people's behavior are related to the social situation in which a person is (Jarvis 2000).

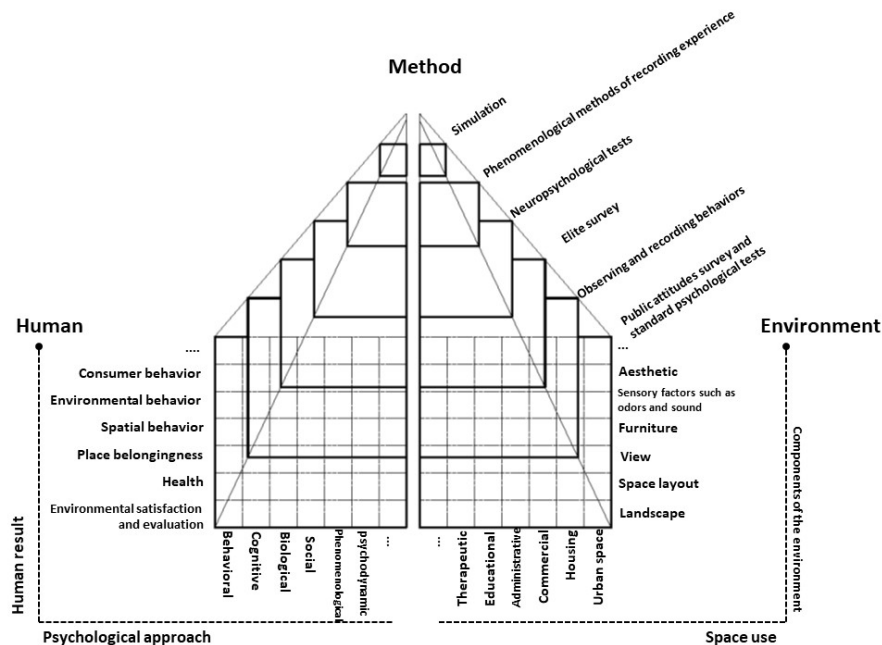


Fig. 2. A Model of Human-Environment Problems

3. METHOD

The research scope includes all articles indexed in the Scopus citation database, that are limited by the keyword "environmental psychology". To review the research published in the field of environmental psychology, two general paths were followed:

The first path includes the bibliometric analyses of all the studies obtained from the macro-scale search using the bibliometrix tool in the R software (bibliometric and scientometric software). Using co-word and co-citation analyses, this tool can provide subject clusters in the studied field. This is carried out based on the analysis of words and the extent of their use in different parts of the article by reading the Bib Tex of the articles from databases. Therefore,

in this section, the first step is to search for articles related to the topic and extract their bibliography. To this end, articles indexed in the Scopus database during the period 1972-2022 were limited by the keywords "environmental psychology" in the title, abstract, and keywords. It should be noted that human-environment interactions are studied in various sciences, which overlap in many cases, but the keyword "environmental psychology" was selected to examine the subjects that are addressed under the title of this science and with emphasis on it. With this search technique, 1457 articles were extracted and examined through bibliometric analysis in the present study. In bibliometric analysis, conceptual structures act based on co-word analysis and it is assumed that

co-occurrences indicate the relationships. The co-occurrence of words occurs when several words are used simultaneously in a document (title, abstract, or keyword). Such words form subject clusters and are probably related to each other. Conceptual structures are used to understand the subjects covered by researchers at different times (Aria and Cuccurullo 2017).

In the second path, out of the abovementioned articles, the 40 most cited articles on built environments were selected and analyzed through content analysis in the research framework. Analyzing and comparing the results of the two research paths will be a step toward determining the key subjects and their evolution.

4. FINDINGS

The number of documents published in the field

of environmental psychology since 1972 shows researchers' growing interest in the knowledge of environmental psychology (Fig. 3). The number of publications shows a significant jump since 2019, and the highest number of published articles is related to 2021 (Fig. 3). This jump can be considered the result of the expansion of studies on healthy environments and mental health in built environments due to the concerns caused by the Covid-19 pandemic. The word covid-19 is among the top 50 keywords in all articles.

The years 2004, 2011, and 2017 also indicate jumps in the publication of articles, which can be considered a basis for time classification in the analyses. So, the data are examined separately at the four sub-periods shown in Figure 3 to obtain a clearer image of how the subjects have evolved.

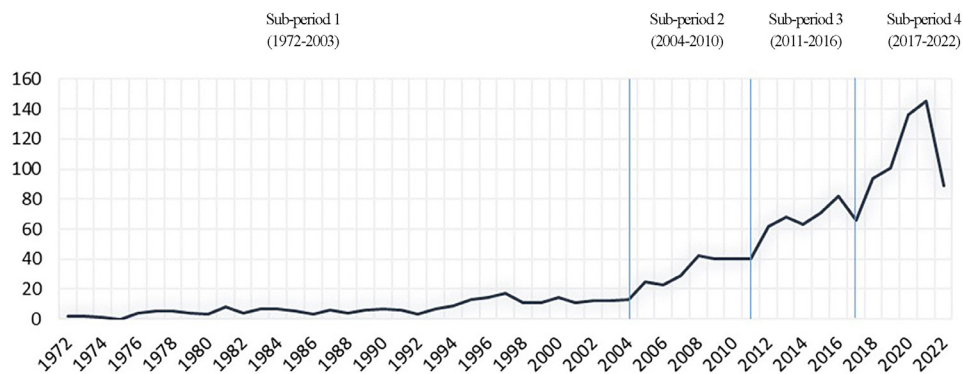


Fig. 3. Articles Indexed in the Scopus Database in the Period (1972-2022)

The sources related to environmental psychology are often active in the three fields of psychology, environmental research in architecture and urban planning, and marketing. However, the influence of this knowledge in the sources of the medical and health areas, especially in recent decades, is also significant. Table 1 presents the ten publications with the highest number of articles with the keyword "environmental psychology" in the studied period and also in the four sub-periods abovementioned. Meanwhile, the Journal of Environmental Psychology and the Journal of Environment and Behavior, which started their activities in 1981 and 1969, respectively,

and are considered the most specialized journals in environmental psychology, have pioneered the publication of international articles in this field and have been among the top sources in all four sub-periods. In the first two sub-periods until 2010, the Journal of "Business Research" was considered one of the main sources, but in the later sub-periods it was not among the top journals, and the International Journal of Environmental Research and Public Health was among the top 10 journals in the fourth sub-period, indicating a change in research focus from marketing to health issues.

Table 1. The List of 10 Publications with the Highest Number of Articles Indexed in the Scopus Database in the Studied Period (1972-2022) and the Sub-Periods, with the Keyword of Environmental Psychology

The List of Publications with the Highest Number of Articles in the Period (1972-2022)								
	Publications	Country	Total Number of Articles	The Most Cited Articles	Being Indexed From	Q	Hindex	IF
1	Journal of Environmental Psychology	United States	95	3	1981	1	102	7.6
2	Environment And Behavior	United States	36	1	1969	1	125	6.5
3	Frontiers In Psychology	Switzerland	31	0	2010	1	133	4.2

The List of Publications with the Highest Number of Articles in the Period (1972-2022)

	Publications	Country	Total Number of Articles	The Most Cited Articles	Being Indexed From	Q	Hindex	IF
4	Sustainability	Switzerland	26	0	2009	1	109	3.8
5	PsyEcology	Britain	19	0	2010	3	13	-
6	Ecopsychology	United States	15	0	2009	3	28	-
7	International Journal of Environmental Research and Public Health	Switzerland	14	1	2004	1	138	4.6
8	Journal of Business Research	The Netherlands	12	3	1973	1	217	10.9
9	Facilities	Britain	11	0	1999	1	49	-
10	Urban Forestry and Urban Greening	Germany	9	2	2002	1	87	5.7

The List of Publications with the Highest Number of Articles in the four Sub-Periods

1972-2003		2004-2010		2011-2016		2017-2022	
Journal of Environmental Psychology	34	Journal of Environmental Psychology	25	PsyEcology	13	Frontiers In Psychology	27
Environment And Behavior	17	Journal of Business Research	5	Journal of Environmental Psychology	12	Journal of Environmental Psychology	24
American Psychologist	5	Psicologia e Sociedade	5	Ecopsychology	10	Sustainability	23
Revista de Psicologia Social	5	Environment And Behavior	4	Environment And Behavior	7	International Journal of Environmental Research and Public Health	11
Environmental Management	4	Ceskoslovenska Psychologie	3	Advanced Materials Research	6	Ekoloji	8
International Journal of Phytoremediation	4	Energy Policy	3	Applied Mechanics and Materials	5	Environment And Behavior	8
Annals of Tourism Research	3	Facilities	3	Frontiers In Psychology	4	Facilities	6
Design Studies	3	Journal of Social Issues	3	Psychology and Society	4	PsyEcology	6
Journal of Business Research	3	Landscape and Urban Planning	3	Resources, Conservation, and Recycling	4	Advances in Intelligent Systems and Computing	5
Society and Natural Resources	3	Psicologia: Teoria e Pesquisa	3	Urban Forestry and Urban Greening	4	Archnet-IJAR	5

In the four columns of sub-periods, the publications that are among the top 10 publications in the studied period are marked in the background color.

Most of the experts active in the field of environmental psychology are often psychologists from psychology departments rather than environmental design and planning experts. Among the most active experts in publishing international articles, for example, one can mention Victor Verdugo from the University of Sonora, Mexico, Robert Gifford from the University of Victoria, Canada - who was also the editor of the Journal of Environmental Psychology between 2004 and 2016 - and Linda Steg from the University of Groningen, the Netherlands. This causes the

universities of Sonora, Victoria, and Groningen to be among the five active universities in this field. A remarkable point on the research interests of active authors is the existence of sustainability approaches alongside environmental psychology, indicating the development of research in this field in the human dimensions of sustainable development and environmental behaviors, as well as the relationship of psychological studies with issues such as energy conservation, climate change, recycling, so on (Table 2).

Table 2. Ten Authors with the Highest Number of Publications (Books and Articles) Indexed in the Scopus Database in the Studied Period (1972-2022), with the Keyword of Environmental Psychology

	Author	University	Specialty	Published Book
1	Victor Corral-Verdugo	University of Sonora, Mexico, Department of Psychology	Psychology and sustainability Environmental Psychology	Psychological Approaches to Sustainability: Current Trends in Theory, Research, and Applications ¹
2	Linda Steg	University of Groningen, The Netherlands, Department of Psychology	Sustainability, energy, environmental psychology, and social psychology	Applied social psychology, Understanding and managing social problems Environmental Psychology: An Introduction ²
3	Robert Gifford	University of Victoria, Canada, Department of Psychology	Environmental psychology, social psychology, personality psychology	Environmental Psychology: Principles and Practice ³
4	Liliane Rioux	Nanterre University, Paris	Environmental psychology	Le confort au travail: que nous apprend la psychologie environnementale? ⁴
5	Marino Bonaiuto	Sapienza University, Italy, Department of Social Psychology	Social psychology, applied psychology, management psychology	Che cos'è la psicologia architettonica ⁵ Introduzione alla psicologia sociale discorsiva ⁶
6	Giuseppe Carrus	Roma Tre University, Italy, Department of Educational Sciences	Environmental psychology, and sustainability	Psicologia ambientale, sostenibilità e comportamenti ecologici ⁷
7	Ariane Kuhnen	The Federal University of Santa Catarina, Brazil	Environmental psychology, psychology, and sustainability	Reciclando o cotidiano: representações sociais do lixo ⁸
8	Taciano L Milfont	Victoria University, New Zealand, Faculty of Psychology	Environmental psychology, social psychology, cross-cultural psychology	
9	Andreas Di Masso	University of Barcelona, Spain, Department of Social Psychology	Social psychology, political and cultural psychology	
10	Wokje Abrahamse	Victoria University, New Zealand, School of Geography, Environment and Earth Sciences	Environmental psychology, human dimensions of environmental changes	Energy Conservation Through Behavioral Change: Examining the Effectiveness of a Tailor-made Approach ⁹ Encouraging Pro-Environmental Behaviour: What Works, What Doesn't, and Why ¹⁰

4.1. Major Research Areas in Environmental Psychology Studies

Conceptual structures can be used to classify articles in major research areas in the studied period. The conceptual structure draws a network of words connected depending on their co-occurrence in the articles. In this network, the thicker the connection line between two words, the stronger the co-word relationship between them. As a result, the keywords

with more co-occurrences are considered to be related and are placed in subject clusters defining the major research areas in a field. The following diagram shows the most used 50 keywords by the authors to draw the conceptual network structure. The co-word analysis of the extracted articles in the studied period (1972 to 2022) presents four subject clusters, which are marked in different colors (Fig. 4). Table 3 presents the keywords related to each cluster.

Table 3. Subject Clusters showing the 50 Most Used Keywords in Environmental Psychology Articles in the Studied Period (1972-2022)

Cluster	Keywords
1 Sustainability	Environmental psychology, environmental perception, quality of life, values, behavior changes, restorative environments, sustainable behavior, stress, sustainability, attitudes, environmental values, sustainable development, environmental attitudes, environmental behavior, pro-environmental behavior, children, environmental education, environmental concerns, social psychology, risk perception, biophilia, working environments, social norms, public space
2 Place	Place attachment, sense of place, place, place identity
3 Health	Well-being, health, mental health, built environment, nature, risk perception, covid 19, green space
4 Servicescape	Emotions, aesthetics, architecture, design, servicescape

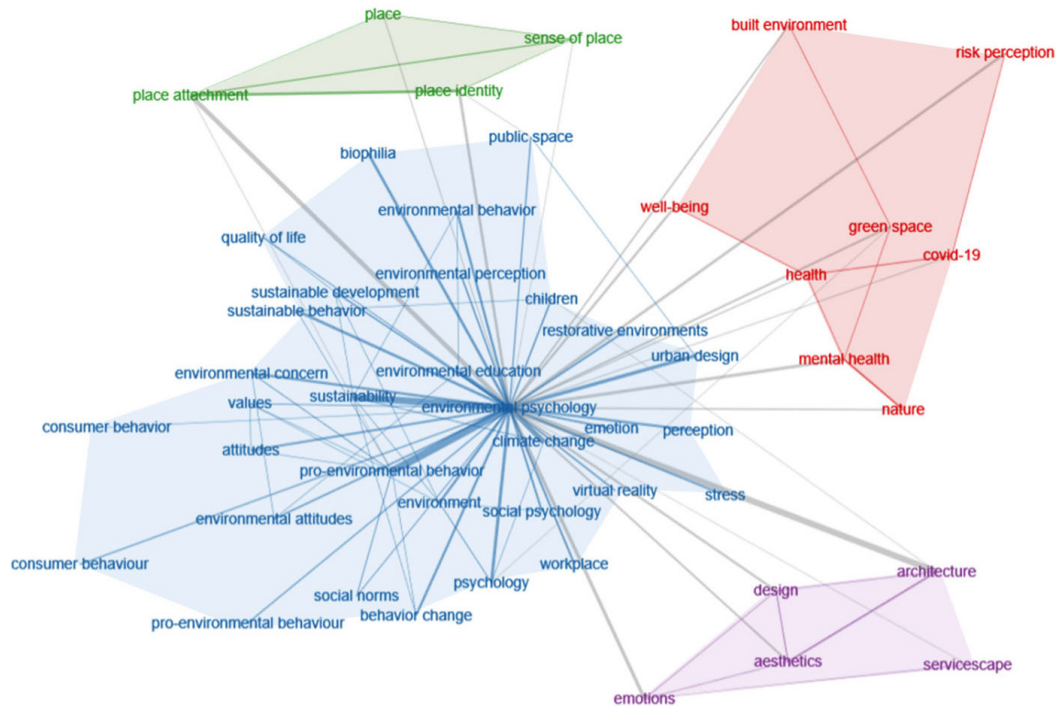


Fig. 4. Co-Word Network and Clustering of 50 Most Used Keywords in Environmental Psychology Articles in the Studied Period (1972-2022)

In this way, one can categorize environmental psychology research into four main research areas. The first category seeks to develop sustainable and pro-environmental behaviors; the second category focuses on the issue of place, sense of place, and place identity; The third category addresses the role of the environment in mental and psychological health, and the fourth category, which is mentioned as "servicescape", examines the influence of the environment on consumer behavior and it is an interdisciplinary field of architecture, psychology, and marketing.

In addition, the co-occurrence of words and their placement in a cluster indicate the relationships between them. For example, according to the keywords presented in Table 3, one can conclude that in a category of research examining the servicescape and its effects on consumer behavior, the aesthetic effects of the environment on people's emotions have been studied (Cluster 4). It can be concluded that the effects of the environment on health have been more investigated with perceptual approaches and in urban and landscape design and natural environments (Cluster 3). Also, behavioral approaches and the study of pro-environmental behaviors play a key role in the relationship between psychology and sustainability (Cluster 1). Another remarkable point in the co-word network (Fig. 4) is that the two words

"environmental psychology" and "sustainability" have the strongest co-word relationship among other words. As mentioned in the research interests of the authors, this reveals the expansion of psychological approaches to the sustainable development problem.

4.2. Evolution of Problems Raised in Environmental Psychology Studies

According to the proposed problem-seeking model, the 40 most cited articles were analyzed using content analysis. The intended articles were selected from those articles that have investigated the relationship between human variables and the built environment. In this way, review articles (except for studies whose output was a theoretical framework or conceptual modeling) and those articles in which no environmental variable was directly mentioned, were excluded. Some of the most cited articles in the field of environmental psychology have been carried out on virtual environments, and many environmental psychology and sustainability researches and those studies on pro-environmental behaviors, which are among the most cited articles, have addressed the educational and normative issues related to the environment. So, they were excluded from the analysis. The selected articles and the results of their thematic analysis are presented in Table 4.

Table 4. Research Problems in the Most Cited Articles with the Keyword of Environmental Psychology

	Research Purpose	Psychological Approach	Use	Human Effects	Components of the Environment	Method	Source	Citation
1	The role of emotional reactions induced by the store atmosphere on the time and money spent by consumers	Behavior recognition	Commercial	The pleasure of consumer behavior	Aesthetic dimensions	Observing and recording behavior, and public attitude survey with a semantic differential scale	(Donovan et al. 1994)	784
2	The role of place attachment in people's social participation	Social psychology	Public space	Place attachment	Place	Conceptual modeling	(Manzo and Perkins 2006)	595
3	To test the attention restoration theory: the advantages of natural landscapes in the restoration of capacities to direct attention	Recognition	...	Attention restoration	Landscape	Attention test	(Berto 2005)	591
4	The effect of visitors' emotions in the theme park environment on their satisfaction and behavioral intentions	Recognition	Urban space	Satisfaction	Landscape	Public attitudes survey	(Bigné, Andreu, and Gnoth 2005)	567
5	Discussing how is the belief in the restorativeness of nature and how this belief form the preference for natural spaces and addressing the effect of contact with nature on human health.	Recognition	Public space	Satisfaction Place Preference Health	Landscape	...	(Van den Berg, Hartig, and Staats 2007)	454
6	Impact of ambient odors on mall shoppers' emotions, cognition, and spending	Behavior recognition	Commercial	Perception of quality	Sensory factors in the environment (odors and sound)	public attitude survey with a semantic differential scale	(Chebat and Michon 2003)	436
7	The relationship between place attachment, satisfaction, and pro-environmental behaviors	Behavior recognition	Urban space (park)	Satisfaction Pro-environmental behavior Place attachment	Place	Observing and recording behavior, and public attitude survey	(Ramkissoon, Smith, and Weiler 2013)	405
8	Factors affecting public acceptance and understanding of the benefits of renewable energies	Recognition and perception	Landscape	satisfaction acceptance	Municipal facilities	Public attitude survey	(Zoellner, Schweizer-Ries, and Wemheuer 2008)	369
9	The relationship between neighborhood green space and mental health	Recognition and perception	Landscape	satisfaction acceptance	Municipal facilities	Public attitude survey	(Beyer et al. 2014)	354
10	The relationship between environment, pleasure, arousal, and behavioral intentions in a restaurant	Recognition	Service-commercial	Pleasure, satisfaction, consumption behavior (spending time and money)	Aesthetic dimensions	Public attitude survey	(Ryu and Jang 2007)	350
11	The role of the physical environment in evaluating the services provided, excitement, emotions, and subsequent behavioral intentions (willingness to spend time and money)	Recognition	Service	Satisfaction, consumer behavior (spending time and money)	Aesthetic dimensions	Public attitude survey with a semantic differential scale	(Wakefield and Blodgett 1999)	331
12	A model of the relationship between the social-physical environment in the servicescape and consumer behavior	Recognition	Commercial	Consumer behavior (repurchase intention)	servicescape	Conceptual modeling	(Tombs and McColl-Kennedy 2003)	324

	Research Purpose	Psychological Approach	Use	Human Effects	Components of the Environment	Method	Source	Citation
13	Environmental qualities and customer perception of waiting time	Recognition	Service, Commercial	Perception of time	Aesthetic dimensions	Conceptual modeling	(Baker and Cameron 1996)	312
14	Developing the phenomenological topic of the house in environmental psychology with the subjects raised in social sciences	Social psychology, phenomenology	House	Lived experience	Place	...	(Moore 2000)	310
15	The relationship between urban green spaces and the citizens' perception of well-being in periods of heat stress	Recognition	Green space	Well-being	Landscape and thermal quality of space	Public attitude survey	(Laforteza et al. 2009)	302
16	The relationship between the amount and type of green space in people's living environment and their health, well-being, and sense of security	Recognition	Green space	Health Well-being Security	Space layout	Public attitude survey	(Groenewegen et al. 2006)	293
17	Analysis of emotional experience in three different urban spaces including green space	Biological approach	Green space	Emotional experience Health	Landscape	Neuropsychological test	(Aspinall et al. 2015)	277
18	The role of the emotional experience of the environment in consumer purchase behavior	Recognition	Commercial	Emotional experience Consumer behavior	Place	Conceptual modeling	(Machleit and Eroglu 2000)	264
19	The relationship between identity, place attachment, and climate	Recognition	Residential	Place identity Place attachment	Climate	Public attitude survey	(Knez 2005)	225
20	Environmental knowledge assessment	Biological approach	Urban space	Way-finding	Space layouts	Neuropsychological test	(Aguirre and D'Esposito 1997)	212
21	Categorization of environmental scenes based on knowledge, behavior, and relationships	Recognition	...	Perception of the environment	Landscape	...	(Tversky and Hemenway 1983)	211
22	Identifying the dimensions of tourist aesthetic judgment	Recognition	City	Perception of beauty	Aesthetic dimensions	Public attitude survey	(Kirillova et al. 2014)	201
23	The role of music and ambient scent in customer evaluation of the store and selected products	Perception and recognition	Commercial	Perception of the quality of consumer behavior (product selection)	Sensory factors in the environment (odors and sound)	Public attitude survey	(Spangenberg, Grohmann, and Sprott 2005)	199
24	The relationship between climate factors (temperature, airspeed, and cloudiness) with perception and place preference	Perception and recognition	Urban space	Place preference	Air quality	Public attitude survey, Instrumental measurements of air quality	(Eliasson, et al. 2007)	191
25	Identifying the dimensions of dinescape in the restaurant	Recognition	Restaurant	Place assessment	Aesthetic dimensions	Public attitude survey	(Ryu and Jang, Dinescape: A scale for customers' perception of dining environments 2008)	166

	Research Purpose	Psychological Approach	Use	Human Effects	Components of the Environment	Method	Source	Citation
26	The relationship between the perception of wideness and narrowness in store aisles and variety-seeking buying	Behavior recognition	Commercial	Consumer behavior (variety-seeking buying)	Space layout	Observing and recording behavior	(Levav and Zhu 2009)	164
27	The relationship between street greenery, the feeling of thermal comfort, and beauty evaluation	Recognition	Urban space (street)	Comfort and satisfaction	Landscape Thermal quality Aesthetic dimensions	Public attitude survey, Instrumental measurements of air quality	(Klemm et al. 2015)	161
28	The relationship of ambient noise in the working environment with work stress, well-being, and job satisfaction	Recognition	Working environment	Health Satisfaction Well-being	Sensory factors in the environment (odors and sound)	Public attitude survey	(Leather, Beale, and Sullivan 2003)	153
29	Surveying public attitudes toward naturalistic versus designed landscapes	Recognition	Green space	Place preference	Landscape	Public attitude survey	(Özgüner and Kendle 2006)	139
30	The role of ambient music in the store and customers' musical taste in the perception of the quality of services and products, pleasure, and pleasant feeling.	Recognition	Commercial	Pleasant, satisfaction Perception of quality	Sensory factors in the environment (odors and sound)	Public attitude survey	(Sweeney and Wyber 2002)	129
31	Assessing consumer behavior in service environments	Behavior	Service-commercial	Emotional responses Consumer behavior	Environment	Public attitude survey	(Foxall and Greenley 1999)	120
32	Qualitative evaluation of hospital landscape design in terms of mental health, security, solitude and interactions, intimacy, and identity	Recognition	Therapeutic	Mental health Security Social interactions	Landscape	Public attitude survey Elite attitude survey	(Curtis et al. 2007)	118
33	The effect of digital signage in mall atmosphere on the behavior of customers	Recognition	Commercial	Consumer behavior	View	Public attitude survey	(Dennis et al. 2010)	115
34	The consumer retail search process	Behavior	Commercial	Way-finding	Space layout	Observing and recording behaviors	(Titus and Everett 1995)	105
35	The relationship between the quality of the school building and the school facilities and the school attendance and educational achievement	Recognition	Educational	Place preference efficiency	Environmental facilities	Psychological test	(Durán-Narucki 2008)	104
36	Identifying and comparing color preference in several East Asian countries	Recognition	...	Preference	Aesthetic dimensions	Public attitude survey	(Saito 1996)	103
37	Tourists' emotional experience of hotels	Phenomenology	Accommodation (hotel)	Satisfaction	Place	Recording experience (interview)	(Brunner-Sperdin, Peters, and Strobl 2012)	101
38	The relationship between place and sense of community	Social psychology	Place attachment	Place	Conceptual modeling	(Long and Perkins 2007)	11
39	The influence of store aesthetics on customers' evaluation of private label brands	Recognition	Commercial	Quality assessment	Aesthetic dimensions	Public attitude survey	(Richardson and Alan Dick 1996)	11
40	The soundscape of urban parks and the place preference of citizens	Behavior	Urban space	Place preference	Sensory factors in the environment (odors and sound)	Observing and recording behavior, and public attitude survey	(Irvine et al. 2009)	98

To identify common research trends and emerging or fully developed subjects in this field, the frequently used keywords, in addition to the most cited articles, were also examined in the intended model of this research. In this way, the keywords were categorized, and conceptually similar words were placed in the same category. Although this method may not provide a deeper analysis, it provides the ability to review a large number of sources. Table 5 compares the results of the two analysis methods used in the present study. The results indicate that the study of human results from the aspects of environmental evaluation (satisfaction and place preference), mental health,

environmental behaviors, and consumer behavior are popular topics among researchers, followed by place attachment, place identity, and improvement of focus and attention, which have been simultaneously considered in some research. A significant part of the research has been done in urban and public spaces, followed by service-commercial, residential, and administrative spaces. Of course, therapeutic spaces have received special attention in recent decades. The analyses indicate that most of the studies have been analyzed with cognitive and behavioral approaches, followed by social psychology and biological psychology approaches.

Table 5. Frequently Used Subjects in Environmental Psychology Studies

	Psychological Approaches	Use	Human Effects	Study Scale
Co-word Analysis of all Articles	Behavior	Urban Space	Health	Place
	Cognition and Perception	Residential	Satisfaction and Preference	Landscape
	Biological Psychology	Service and	Well-Being and Quality of	Space Layout
	Social Psychology	Commercial	Life	Aesthetic Dimensions
		Educational	Place Attachment	Sensory Factors in the
		Administrative	Environmental Behavior	Environment (Odors and
			Place Identity	Sound)
			Consumer Behavior	Furniture
Content Analysis of the Most Cited Articles			Focus and Attention	View
	Cognition and Perception	Urban Space	Satisfaction and Preference	Landscape
	Behavior	Service and	Consumer Behavior	Aesthetic Dimensions
	Social Psychology	Commercial	Health and Well-Being	Place
	Biological Psychology	Residential	Perception of Quality	Sensory Factors in the
	Phenomenology	Administrative	Place Attachment	Environment (Odors and
		Educational	Place Identity	Sound)
		Therapeutic	Focus and Attention	Space Layout
			Environmental Behavior	Air Quality
				Facilities

A major part of the research related to environmental evaluation, along with the concepts related to customer behavior, has been carried out mostly at the scales of interior architecture and servicescape, and on the space layout, aesthetic dimensions, and the measurement of the sensory factors (odors and sound) in the interior of service-commercial spaces. Satisfaction has been associated with measuring efficiency and stress levels in administrative environments and with enjoyment, place preference, health, and place attachment in urban spaces. Mental health has been often studied in urban spaces and landscapes, and attention to the biological psychology approach in data analysis in this field is significant. Studies related to place, place attachment, and place identity have also been focused on the cognitive or social psychology approach and have been carried out in urban spaces.

The major difference between the two analysis methods is related to studies in the field of sustainability and environmental behaviors. Since most of these studies address teaching behaviors and the role of norms in behaviors such as recycling or

water consumption, they are not considered the built environment research, while this issue accounts for a significant part of the articles. According to the co-word network, the field of environmental psychology and sustainability has been identified as the broadest field, but the subjects raised in it don't significantly emphasize the built environment design. As mentioned earlier, since the most cited articles were selected for analysis based on their direct focus on the built environment, many articles related to the field of sustainability were excluded from the analysis.

In this section, another remarkable point to is the publication year of the most cited articles, which affects their content analysis. Obviously, more recently cited articles have addressed more recent subjects. Among the analyzed sources, the articles published from 2010 onward address the subjects of health, satisfaction, and environmental comfort, indicating the growing importance of these subjects in research in this field. And instead, the articles on consumer behavior and the servicescape are often related to before 2005, and from the review of

sources, one can conclude that the priority of these topics has been reduced.

Another way to know the history, importance, and development of each of the subjects and approaches is the analysis of conceptual structures in the co-word network. The co-word network can be analyzed based on the two principles of "centrality" and "density". That word related to a greater number of other words has a higher level of centrality, so, it can be concluded that it is more correlated with different subjects. Density refers to the internal correlation between the points in the network, which is equal to the frequency of the word. By analyzing these two characteristics, words (subjects) can be classified into 4 categories as follows (Fig. 5):

1. Subjects with high centrality and high density (the

upper right quadrant): This category of subjects is both important and well-developed in the knowledge studied and considered driving subjects in research.

2. Subjects with low centrality and high density (the upper left quadrant): This category is developed but isolated in the knowledge studied or is of importance in marginal subjects.

3. Subjects with low centrality and low density (the bottom left quadrant): This category is underdeveloped and marginal in the knowledge studied and can indicate declining or emerging subjects.

4. Subjects with high centrality and low density (the bottom right quadrant): This category is underdeveloped but of great importance in the knowledge studied (Aria and Cuccurullo 2017).

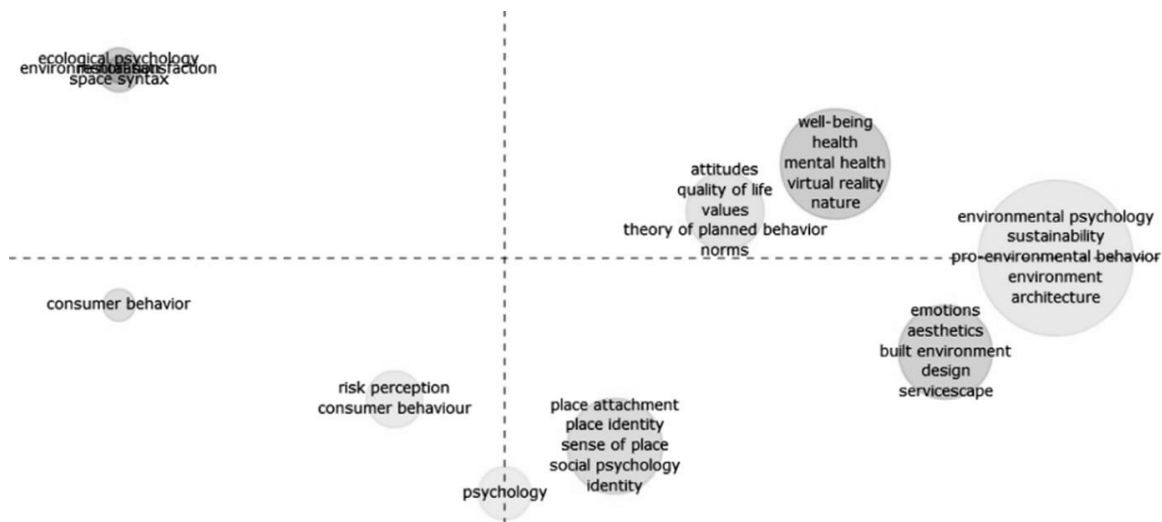


Fig. 5. Thematic Map of Keywords used in Environmental Psychology Articles Indexed in the Scopus Database in the Period 1972-2022.

The thematic map of keywords shows that the subjects of sustainability, environmental behavior, health and well-being, and quality of life are the driving subjects in this knowledge and are important and developed in the research, meaning that they have been used in many studies and have been discussed in relation with various other subjects. Although the subjects related to place are very important and have been addressed in many studies, they are insignificantly related to other subjects. And as mentioned, consumer behaviors are considered declining subjects.

5. CONCLUSION

The present study aimed to draw the knowledge map of environmental psychology, which was developed to identify widely used research problems, and examine their evolution, and existing gaps. The research problems in the reviewed studies were analyzed in four dimensions including environment use, components of the environment, human results,

and psychological approaches, based on the proposed human-environment problems model. According to the research results, the popular research problems in the field of environmental psychology can be categorized into four clusters: 1. The relationship between psychology and sustainability and the promotion of sustainable and pro-environmental behaviors, 2. The role of the environment in mental health, 3. Place studies (sense of place, place attachment, and place identity), and 4. servicescape. Behavioral and cognitive approaches have continuously been the dominant approaches in the study of human-environment problems in different sub-periods, and the biological psychology approach is considered a newly emerging approach that has been growing in popularity in recent studies. However, approaches such as psychodynamic and phenomenological approaches have been less developed in the analysis of problems related to the built environment. Environmental psychology research has been carried out more in urban spaces,

followed by commercial, residential, educational, and administrative uses. Of course, as the importance of health discussion has increased, therapeutic spaces have also gained special importance.

In the field of human-environment interactions, subjects related to environmental evaluation (preferences, satisfaction, pleasure, and perception of quality and beauty), health, and promotion of pro-environmental behaviors are generally important and developed subjects in environmental psychology. However, the relationship between pro-environmental

behaviors and the built environment have less considered. The subjects related to place attachment and place identity have been very important and developed subjects in all sub-periods, despite their few relationships with other subjects. It should be noted that the present study aimed to identify the major research areas, the problems that have been raised, or those that can be raised in the future in environmental psychology, and it is required to study each of the major research areas separately to identify minor problems.

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