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Spatial Perception: A Critical Bibliometric Inquiry

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Abstract

In this study, it is aimed to answer the research question "what is the place and status of architectural research in perception studies?". At the same time, determining the validity of the VOSviewer program, which is widely used for systematic bibliometric analysis, within the scope of the study constitutes an indirect secondary objective of the research. In this direction, two consecutive bibliometric analyses, each with a different depth, were conducted to see the range of spatial perception studies and to explore its sub-expansions. In this context, two keyword groups were created for the first two phases of the study. Document type and category were restricted to determine the research framework. In this framework, the studies identified in the first phase (n=2727) and the second phase (n=243) were transferred to the VOSviewer program for bibliometric analysis and analyzed. In the last phase of the study, a flow-quantity diagram was created for the article studies identified in the second phase using the Sankey diagram generator (n=92). When the studies scanned in Web of Science were analyzed, it was found that the studies involving the concepts in the research framework were mostly related to the concept of comfort and the least related to the concept of happiness.

Keywords: *Spatial perception, bibliometric analysis, content analysis, architecture, multidisciplinary psychology.*

Mekânsal Algı: Eleştirel Bir Bibliyometrik Sorgulama

Öz

Bu çalışmada ‘‘algı çalışmaları içinde mimarlık araştırmalarının yeri ve durumu nedir?’’ araştırma sorusuna yanıt verilmesi amaçlanmıştır. Aynı zamanda bibliyometrik analizlerin sistematik olarak gerçekleştirilmesi noktasında yaygın kullanıma sahip olan VOSviewer programının çalışma kapsamındaki geçerliliğinin saptanması da araştırmanın dolaylı yoldan ikincil hedefini oluşturmaktadır. Bu doğrultuda mekânsal algı araştırmalarının yelpazesini görmek ve alt açılımlarını keşfetmek üzere her biri farklı derinlikte olan ardışık iki bibliyometrik analiz gerçekleştirilmiştir. Bu kapsamda çalışmanın ilk iki aşaması için iki anahtar kelime grubu oluşturulmuştur. Araştırma çerçevesini belirlemek üzere doküman türü ve kategori sınırlaması getirilmiştir. Bu çerçevede ilk aşamada (n=2727) ve ikinci aşamada (n=243) tespit edilen çalışmalar bibliyometrik analizlerini yapabilmek üzere VOSviewer programına aktarılarak analiz edilmiştir. Çalışmanın son aşamasında, Sankey diyagramı oluşturucusu kullanılarak ikinci aşamada belirlenmiş makale çalışmaları özelinde bir akış-miktar diyagramı oluşturulmuştur (n=92). Web of Science'ta taranmış olan çalışmalar incelendiğinde, araştırma çerçevesindeki kavramları içeren çalışmaların en çok konfor kavramı ile, en az ise mutluluk kavramı ile ilgili olduğu saptanmıştır.

Anahtar kelimeler: *Mekânsal algı, bibliyometrik analiz, içerik analizi, mimarlık, çok disiplinli psikoloji.*

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1. Introduction

Although architectural space design depends on many elements, the most important reference point is the ‘‘human being’’. ‘‘Space constantly encompasses our being. Through the volume of space, we move, see forms, hear sounds, feel breezes, smell the fragrances of a flower garden in bloom. It is a material substance like wood or stone. Yet it is an inherently formless vapor. Its visual form, its dimensions and scale, the quality of its light—all of these qualities depend on our perception of the spatial boundaries defined by elements of form’’ (Ching, 2015, p.100). As supported by Ching, architectural space represents a specific area consisting of elements such as form, material, texture, and color within certain boundaries. Although this space comes to the forefront with its physical quality in terms of separating people from environmental conditions, protecting them in a sense and allowing them to perform certain tasks, it is also of great psychological importance because it affects the moods of the individuals in it. This situation actually reveals the importance of the concept of space perception.

As a result of the inevitability that the physical and psychological effects of architecture are interrelated, spatial perception based on the relationship established with climatic and environmental conditions, as well as the elements that make up the architectural space, positively or negatively affect human physiology and human psychology. For example, a dwelling that lets in the sounds of nature can positively affect the mood, while a dwelling that lets in only street and vehicle sounds will require sound insulation. Indeed, there are empirical studies that provide evidence that living in natural environments has psychological and physiological benefits compared to living in the city. One of these studies was conducted by Zhang, Tan & Yuan (2023). In their study, changes in the psychophysiological state of participants who normally live and study in the city were compared with those who entered a forest environment, and it was found that a natural forest environment had a positive effect on human psychophysiology (Zhang et al., 2023). In terms of the built environment, green buildings as a sustainable urban form can contribute to social sustainability as well as environmental sustainability by promoting people's well-being and pro-environmental behavior (Zhang & Yong, 2021). Similarly, thermal insulation needs may vary according to climate and season. At this point, it is possible to say that thermal comfort is affected by both environmental and psychological factors (Tan, Chung, Roberts & Lau, 2019). Moreover, even the ventilation type of a building in terms of thermal comfort affects the behavioral adaptations and psychological adaptations of the users of that building (de Dear & Brager, 1998). In addition, traditional and cultural habits and environmental harmony are other factors affecting perception. ‘‘Just as it is perturbing when our buildings deny their settings, so it can be pleasurable to find evidence of the opposite tendency’’ (Botton, 2006, p.221). In addition to the perception of the built environment, the perception of landscape can also change depending on cultural identity. ‘‘Socio-cultural factors, that are decisive for cultural identity and socio-cultural background, together with biological and psychological factors influence landscape perception and evaluation’’(Kamičaitytė, Grazuleviciute-Vileniske & Gadal, 2019, p.72). Even, spatial perception, which is a cognitive skill that can develop throughout life and is influenced by many different factors, can also vary depending on the expertise of individuals (Mertins, Danhier, Mertins, Schulz & Schulz, 2019).

Considering all these issues, it is seen that human perception of space depends on many variables for an ideal space design. This situation reveals how important the concept of spatial perception is in the design of an architectural space. In this context, the main purpose of this study is to determine the place and status of architectural studies within perception studies. The secondary purpose of the study is to question the validity of the Vosviewer program, which is frequently preferred for systematic bibliometric analysis, within the scope of the study. For this purposes, the Web Of Science database, VOSviever program and SankeyMatic diagram generator were used to see the range and sub-expansions of the studies on the subject of ‘‘spatial perception’’; the literature on the subject was examined within the framework of the limitations created by using the first and second keyword group.

Thanks to this study, a situation assessment has been realized by systematically looking at spatial perception research, which has a very wide range, from the intersection of architecture and

multidisciplinary psychology disciplines. In addition, this bibliometric determination will also guide the future studies on spatial perception.

1.1. Bibliometric Analysis-Space Studies

Spatial perception is related to many disciplines besides architecture. In this respect, it is inevitable that studies on the subject have been conducted in different disciplines with different methods and perspectives. In the field of spatial perception, there are relatively large-scale studies on urban design or landscape perception, as well as studies related to different building types at the architectural scale. In addition, with the effect of today's developing and widespread technology, studies on virtual spaces prepared by utilizing virtual reality are also increasing. There are many studies in the literature on the perception of spaces in individuals in related fields such as psychology as well as architecture. The diversity of these studies and the fact that they are related to more than one field makes it difficult to analyze these studies with a conventional research method. In this respect, it is very important to analyze the literature data systematically with a relatively general perspective and to look at the issue of spatial perception from the intersection of the interrelated disciplines of architecture and psychology in order to guide future studies.

Pritchard states that bibliometrics is the application of mathematics and statistical methods to books and other media of communication (Pritchard, 1969). Bibliometric research, which examines study patterns using quantitative analysis and statistics, can be descriptive in the form of revealing how many articles a particular organization has on a particular subject, or evaluative in that it can provide data on how a study affects subsequent researchers by conducting citation analysis (McBurney & Novak, 2002). In this respect, bibliometrics refers to the quantitative analysis of the relationships between documents, authors or sources such as journals in order to show the productivity, quality or impact of an individual investigator or research team (Carpenter, Cone & Sarli, 2014).

If scientific analysis is handled in a conventional way, it is possible to encounter some limitations (Varshabi, Arslan Selçuk & Mutlu Avinç, 2022) and difficulties in terms of screening due to the increase in the number of academic publications. In fact, a conventional bibliography simply describes the structure of humanity's accumulated knowledge on a given subject to date and it kind of ignores the relationships between the studies examined (Garfield, 1983). For this reason, it is possible to say that it is difficult to carry out traditional literature surveys meticulously and completely (Snyder, 2019). However, ‘‘The bibliometric method facilitates the investigation of the relationship between research collaboration and variables pertaining to the research problem and the research environment, by applying statistical techniques such as regression, correlation, and factor analysis’’ (Subramanyam, 1982). In this respect, it is possible to say that literature reviews handled with bibliometric analysis method enable faster and more effective data collection.

Additionally, bibliometric analyses also provide an opportunity to make observations using visualization. Bibliometric mapping, which can also be called science mapping, is a spatial representation of the relationships between disciplines, fields, specialities, individual papers or authors, similar to the way geographical maps show physical and political relationships (Small, 1999). In this study, a bibliometric analysis study was conducted in which visual data from article studies related to the subject of spatial perception were also obtained.

2. Methodology

A two-depth three-phase method (Figure 1) was used to conduct a systematic bibliometric analysis to determine the place and status of architectural studies among the wide range of perception studies investigated by the discipline of psychology.

Accordingly, after the first phase, which was carried out to see the range of these studies by looking at spatial perception studies from a general perspective within the framework of the research question in order to evaluate the scientific literature in the context of spatial perception, a second phase was needed to determine the range of studies on the responses of users/perceivers who experience the space in order to explore the sub-expansions of spatial perception studies. A third phase was needed for the content analysis of the studies identified in the second phase. The interpretation of the validity

of the VOSviewer program at the point of bibliometric analysis within the limits of the research is given at the end of the analysis comments in the discussion section. In this framework, the research questions to be answered on the studies on spatial perception in the categories of architecture and multidisciplinary psychology are as follows:

For the first two phases:

- Which countries are prominent?
- Which are the most cited articles?
- Which are the prominent journals?
- What are the prominent concepts?

For the final phase:

- What is the diversity of related studies in terms of the spaces to which they relate?

In the first phase, the keywords ‘‘spatial perception’’, ‘‘space perception’’, ‘‘perception of space’’ and ‘‘perception of architectural space’’ were determined to be analyzed in the Web Of Science database. In order to identify studies containing any or more than one of these four keywords, the expression ‘‘OR’’ was used between the words. In addition, in order to examine the determined keywords within clearer boundaries, the studies to be evaluated were scanned through ‘‘title, abstract and keywords (author keywords and keywords plus)’’. In order to determine the screening framework, document type restrictions were made as ‘‘article’’ and ‘‘review article’’ to examine the prominent articles in obtaining scientific data. The data obtained in the first search were reviewed according to the fields of study. Afterwards, ‘‘Architecture’’ and ‘‘Psychology Multidisciplinary’’ were selected as ‘‘Categories’’ on the Web Of Science database. These data on studies in the fields of architecture and multidisciplinary psychology were transferred to the program called VOSviewer, which allows bibliometric analysis through the Web Of Science database. ‘‘Geographical area analysis, document analysis, source analysis, and keyword analysis’’ were performed through the VOSviewer program.

As the second step of the study, a second bibliometric analysis, which is related to the subject and has relatively narrow limitations, was conducted. For this second analysis, a second set of keywords was created in addition to the keywords in the first phase in order to obtain a narrower research framework for human responses of spatial perception among the studies scanned through the Web of Science database in the first phase. These words are ‘‘happiness’’, ‘‘comfort’’, ‘‘user satisfaction’’, ‘‘well-being/wellbeing’’ and ‘‘quality of life’’. In order to identify studies that included any or more than one of the keywords that make up this second word group, the expression ‘‘OR’’ was used between the words. In addition, the expression ‘‘AND’’ was used between the two word groups in order to scan the studies containing at least one word from the first and second word groups at the same time. In this way, a second scan was conducted to identify the studies that also included these words among the studies scanned in the first analysis. These data obtained from the Web Of Science database were transferred to the VOSwiever program similar to the first phase and the second phase of bibliometric analysis was carried out.

In the third and final phase of this bibliometric analysis study on spatial perception, a flow-quantity diagram was created using the online Sankey diagram generator called ‘‘SankeyMatic’’ over the article studies identified in the second phase. In doing so, the words ‘‘happiness’’, ‘‘comfort’’, ‘‘user satisfaction’’, ‘‘well-being’’ and ‘‘quality of life’’, which constitute the second keyword group determined to narrow the limitations through the Web of Science database, were taken as reference. In this context, it was aimed to determine which types of buildings or fields of study were intensively studied through the article studies identified during the second bibliometric analysis. In doing so, from the studies retrieved from the Web of Science database, those whose main text was in English and Turkish and which could be related to the discipline of design were selected, and those studies that could not be related to any building type or space of study and which had a relatively weak relationship with the subject were ignored.

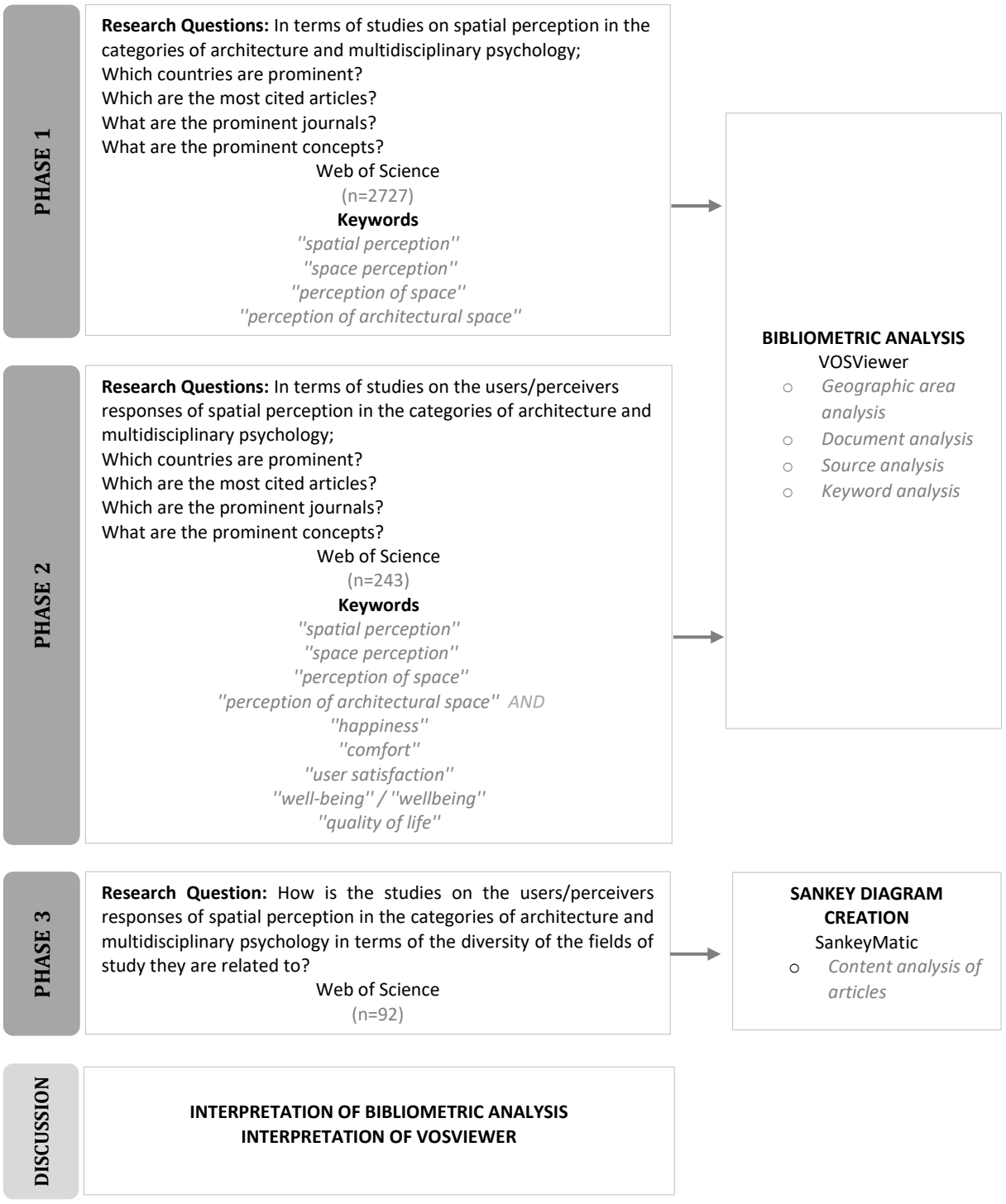

Figure 1. Research method scheme of two-depth three-phase bibliometric analysis of spatial perception

3. Bibliometric Analysis and Findings

After two in-depth analyses of the studies extracted from the Web of Science database into the VOSviewer program on ‘‘geographical area analysis, document analysis, source analysis, keyword analysis’’, a third content analysis was conducted on the limiting keywords, and related study areas of the selected articles.

3.1. Analysis Results of Spatial Perception Studies

As described in the methodology section, the keywords related to the subject to be used in the Web Of Science database were determined as ‘‘spatial perception’’, ‘‘space perception’’, ‘‘perception of space’’, ‘‘perception of architectural space’’. In the first research conducted on this database in this way, 62186 sources were identified.

When the results of the analysis of this initial information are analyzed, it is observed that there are studies in more than 250 research areas in terms of Web of Science Categories, and most studies on this subject are in the field of ‘‘Neuroscience’’ with a rate of 15.906%. ‘‘Experimental Psychology’’ ranks second with 11.070% and ‘‘Psychology’’ ranks third with 8.336%. This situation reveals the intensive relationship between the studies on this subject and psychology. However, with reference to the words in question, 879 studies in the field of ‘‘Architecture’’ ranked 32nd with a rate of 1.414%, while ‘‘Psychology Multidisciplinary’’ ranked 10th with 2252 studies.

Following the overview of research areas in the context of Web of Science Categories, ‘‘architecture’’ was first selected as the ‘‘category’’ on the Web of Science database and the studies (n=879) in this field were reviewed. When the studies on the subject in the field of ‘‘architecture’’ are analyzed according to years, it is determined that although there has been an increase since 1997, most publications belong to 2019. Afterward, only ‘‘multidisciplinary psychology’’ was selected as the ‘‘category’’ through the Web of Science database and the studies (n=2252) conducted in this field were reviewed. When the studies on the subject in the field of ‘‘multidisciplinary psychology’’ were analyzed according to years, it was found that studies on the subject started to be conducted in 1980, at least one study was conducted every year except 1984 and 1990, and although some years varied, there was a regular increase in the studies on the subject as of 1991.

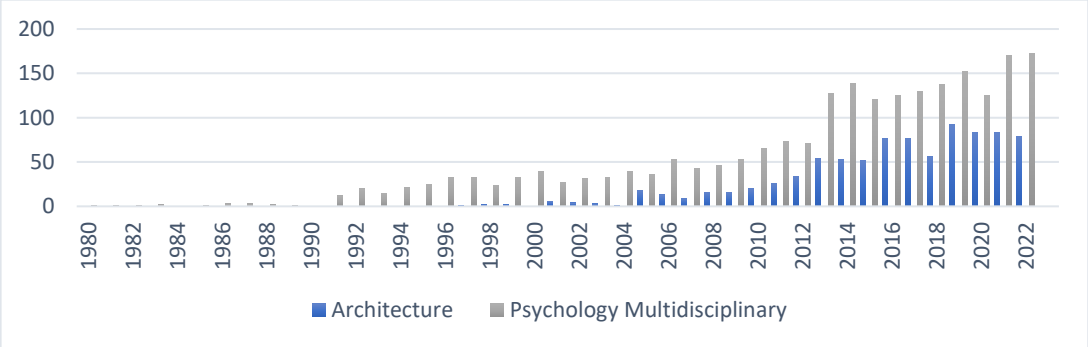

Figure 2. Distribution of publications by year in the architecture and multidisciplinary psychology categories within the framework of phase 1 keywords

Then, the fields of ‘‘architecture’’ and ‘‘multidisciplinary psychology’’ were selected together as categories to determine the study boundaries. It was determined that the total number of studies that belong to these two disciplines together was 3129. Since the year 2023 was ongoing during the study period, it is not included in the annual change graph visualization.

Among these studies, ‘‘article’’ and ‘‘review article’’ were selected as document types in order to examine the articles that stand out in obtaining scientific data. In this way, a total of 2729 studies prepared in the fields of architecture and multidisciplinary psychology, 2558 ‘‘articles’’ and 171 ‘‘review articles’’, were selected for bibliometric analysis in the first phase. These studies were scanned by their names before being transferred to the VOSviewer program. As a result of this scanning, it was realized that 1 study was included with the Early Access version and another study was registered twice. In order for the data to be obtained from the study to be right, only 1 sample of these two studies was subjected to examination; therefore, 2727 studies were identified to be imported into the VOSviewer program. After this first look, the information on the article studies identified on the Web of Science database was imported into the ‘‘VOSviewer’’ program and the bibliometric analysis was continued through the VOSviewer program.

3.1.1.Geographical area analysis

While there are 101 countries with publications in the related field, 24 countries have 25 or more publications. In terms of countries, the country with the most publications in the relevant field is the USA. It is followed by the England and Germany. However, when all publications are considered in terms of continent, Europe is the continent with the most publications (Figure 3). While no studies have been conducted in the related field in Africa, only Brazil from South America has conducted research on spatial perception. In this part of the analysis, the data obtained from Vosviewer were

used only to determine the countries with the most publications on spatial perception.Thanks to this determination, it has been determined that spatial perception is a universal subject.

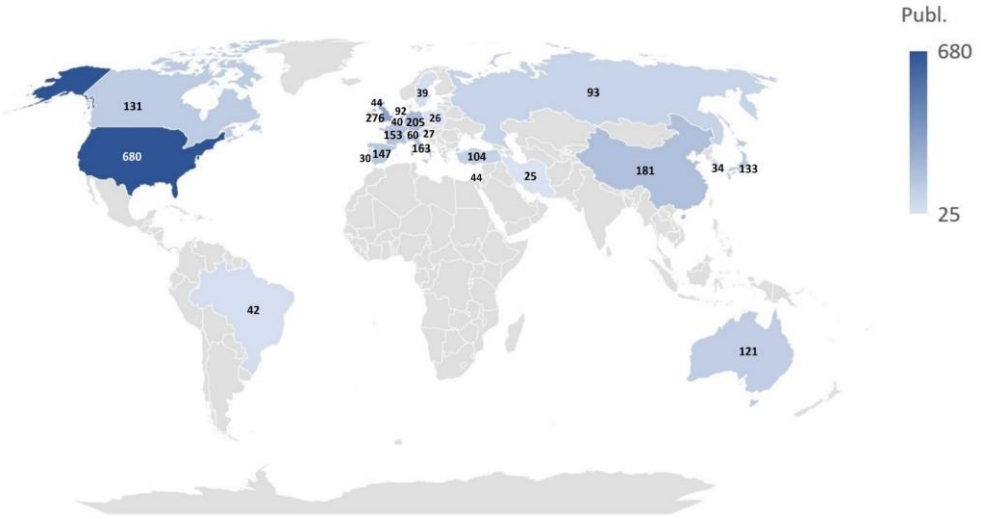

Figure 3. Map image of countries with 25 or more publications within the framework of phase 1 keywords and number of publications

3.1.2.Document analysis

Of the 2727 documents on spatial perception in the fields of architecture and multidisciplinary psychology, 2061 were cited at least once. The table of the 10 most cited documents is given below. (Table 1).

Table 1. Top 10 most cited articles within the framework phase 1 keywords

Article Title	Year	Citation	Source	Author
Construal-level theory of psychological distance	2010	2888	Psychological Review	Trope, Yaacov Liberman, Nira
Defining place attachment: A tripartite organizing framework	2010	1074	Journal of Environmental Psychology	Scannell, Leila Gifford, Robert
Gaze cueing of attention: Visual attention, social cognition, and individual differences	2007	895	Psychological Bulletin	Frischen, Alexandra Bayliss, Andrew P. Tipper, Steven P.
The location of trait emotional intelligence in personality factor space	2007	759	British Journal Of Psychology	Petrides, K. V. Pita, Ria Kokkinaki, Flora
A taxonomy of external and internal attention	2011	700	Annual Review Of Psychology	Chun, Marvin M. Golomb, Julie D. Turk-Browne, Nicholas B.
Why are small and large numbers enumerated differently - A limited-capacity preattentive stage in vision	1994	668	Psychological Review	Trick, Lana M. Pylyshyn, Zenon W.
How to build a baby: 2. Conceptual primitives	1992	610	Psychological Review	Mandler, Jean M.
Remembering the past and imagining the future: A neural model of spatial memory and imagery	2007	593	Psychological Review	Byrne, Patrick Becker, Suzanna Burgess, Neil
Emotion facilitates perception and potentiates the perceptual benefits of attention	2006	535	Psychological Science	Phelps, Elizabeth A. Ling, Sam Carrasco, Marisa
Primacy of wholistic processing and global/ local paradigm: A critical-review	1992	498	Psychological Bulletin	Kimchi, Ruth

In this table, 2 studies that are considered to have a relatively intense relationship with the discipline of architecture are colored in blue. This can be interpreted as the fact that among the most cited studies in the relevant field, the proportion of studies that can be considered related to the discipline of design within the discipline of psychology is quite low. When the 10 most cited articles were evaluated, it was found that there was no significant relationship network between them in terms of citation.

3.1.3.Source analysis

Regardless of citations, there are 283 sources with at least one publication on spatial perception. When we look at the sources with at least 1 citation, this number decreases to 222. The citation relationship network between 111 of these 222 sources consists of 22 clusters and 255 links. It is clearly seen that the journal ‘‘Frontiers In Pschology’’ is the dominant journal in this relationship network where many clusters form dense connections among them (Figure 4). However, another noteworthy point in this network of relationships is the situation of sources for environmental psychology related to architecture. Journal Of Environmental Psychology and Environment And Behavior journals are among the journals that cover research on the scientific examination of the mutual relations between humans and the physical environment. It was observed that these sources were dominant in the clusters they formed within themselves. However, it is possible to say that although the journals related to architecture are visible in terms of citation link, they remain in the background compared to the psychology discipline.

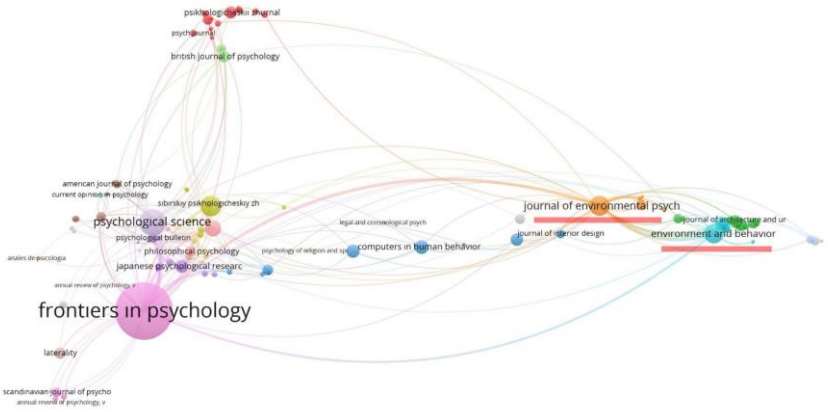

Figure 4. Citation link network of cited sources within the framework of phase 1 keywords

There are 17 journals that contain at least 25 studies on the subject and have at least 1 citation (Table 2). All these journals, although in a sense interdisciplinary, were evaluated in three ways according to their relative density in terms of content. In this table, journals related to design disciplines that have a relatively intense relationship with the discipline of architecture are colored in blue, while journals related to the discipline of psychology are colored in black. Journals that focus on research in the field of environmental psychology, which is located at the intersection of architecture and psychology, are also colored blue due to their relationship with design. Journals that contain research that is specialized in different fields are shown in red, even if they are related to the discipline of psychology. While determining this aspect of the journals; the descriptions on the online home page of each journal were taken as reference.

Seven of these 17 sources include studies directly related to the discipline of psychology. Six of them are related to at least one of the disciplines of architecture and environmental psychology. In addition 4 journals are specialized in different fields, albeit interdisciplinary. Accordingly, in percentage terms, studies related to the discipline of psychology ranked first with 41.17%. Studies related to the discipline of architecture have a rate of 35.29%, while other journals have a rate of 23.52%. This situation shows that journals related to architecture and design can find a place in the discipline of psychology among the sources that stand out with the high number of documents in terms of space perception research. However, it is also seen from the relevant table that some psychology journals are relatively prominent in terms of the number of citations and documents (Table 2).

Table 2. Journals with at least 25 studies and at least 1 citation within the framework of phase 1 keywords

Journal	Documents	Citations	Related fields
Frontiers In Psychology	667	9110	**psychology**
Psychological Science	149	9636	**psychology**
Spatial Vision	86	1986	computation, perception, attention and action
Journal Of Environmental Psychology	85	4660	**environmental psychology**
Environment And Behavior	80	2916	**environmental psychology**
Psychological Review	53	8103	**psychology**
Computers In Human Behavior	40	1043	use of computers&psychology
Megaron	38	29	**architecture**, planning
International Journal Of Human-Computer Studies	37	788	design and use of interactive computer technology
Japanese Psychological Research	36	259	**psychology**
Archnet-Ijar International Journal Of Architectural Research	32	113	**architecture,** urban design and planning, built environment
Journal Of Asian Architecture And Building Engineering	32	97	**architecture** and building engineering
British Journal Of Psychology	30	1573	**psychology**
Psikhologicheskii Zhurnal	30	42	**psychology**
Laterality	26	297	lateralisation
Open House International	26	68	**architecture,** building technology, housing, urban design and planning
Annee Psychologique	25	94	**psychology**

3.1.4. Keyword analysis/Co-occurrences of keywords

When the related studies were evaluated in terms of the co-occurrence of keywords, it was found that there were 290 keywords repeated at least 5 times (Figure 5).

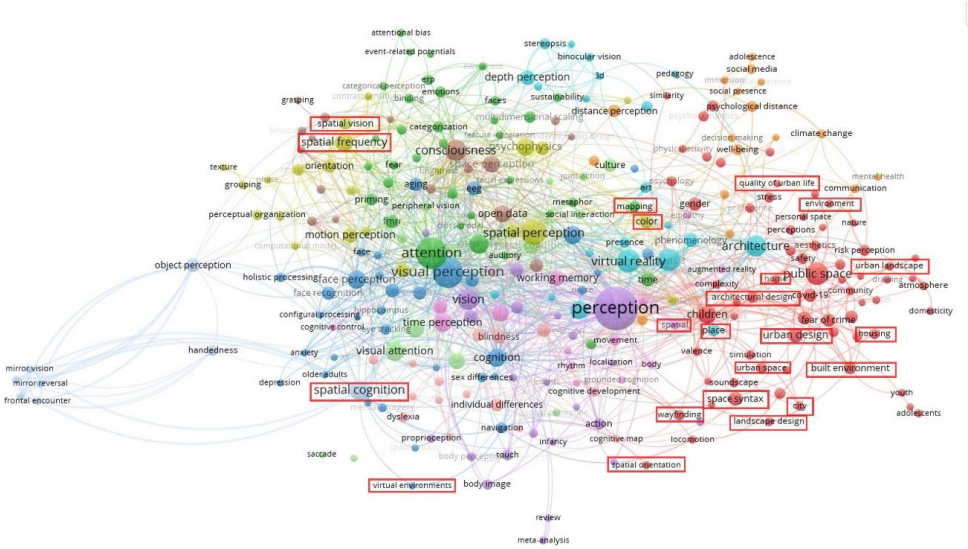

Figure 5. Co-occurences of keywords repeated at least 5 times within the framework of phase 1 keywords

Among these words, perception, attention, visual perception, spatial perception, virtual reality, public space, space, architecture, vision, consciousness were found to be the most frequently used keywords. Words that have a relatively intense relationship with the concept of space are highlighted on the

relationship network. When this visual is analyzed, it is found that most of the studies associated with the concept of space were carried out by associating with public spaces at the urban scale. When this relationship network visualization is evaluated, it is clearly seen that there are quite a lot of concepts related to psychology, but architectural terms can also find a place within this concepts.

3.2. Analysis Results of the Studies on the Human Responses of Spatial Perception

After the first bibliometric analysis on spatial perception, a second bibliometric analysis with relatively narrow limitations was conducted as explained in the methodology section. For this second analysis, studies with the words ‘‘happiness’’, ‘‘comfort’’, ‘‘user satisfaction’’, ‘‘well-being/wellbeing’’ and ‘‘quality of life’’ were scanned together with the first group of words (‘‘spatial perception’’, ‘‘space perception’’, ‘‘perception of space’’, ‘‘perception of architectural space’’) scanned in the first phase through the Web of Science database.

At the point of determining the second keyword group, 1397 keywords that were repeated at least 2 times out of 7838 keywords identified within the framework of the common keyword analysis conducted in the first phase were analyzed. In order to determine those related to positive emotions/outcomes among the studies on the responses of users/perceivers, keywords that were related to the subject were examined. Accordingly, ‘‘happiness (2), comfort (3), user satisfaction (3)’’ were selected among the keywords that were used relatively few times, while ‘‘well-being (11)’’ and ‘‘quality of life (8)’’ were identified as the prominent concepts among the keywords that were repeated relatively many times. In this way, a second analysis was conducted using two keyword groups similar to the first phase.

In this framework, 276 studies were identified after a search on the Web Of Science. Since the year 2023 was ongoing during the study period, it is not included in the annual change graph visualization. When the distribution of these studies according to years is analyzed, it is possible to say that the studies related to the subject have relatively increased in recent years, although the increase and decrease in research continue to vary between years.

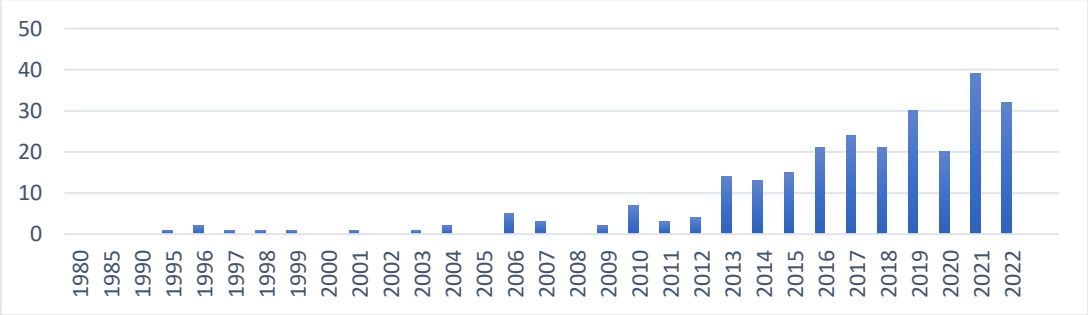

Figure 6. Distribution of publications by year in the architecture and multidisciplinary psychology categories within the framework of phase 2 keywords

In order to determine the boundaries of the research framework, ‘‘article’’ and ‘‘review article’’ were selected as document types to examine the articles within these studies. As a result, the data from 243 documents were extracted and analyzed in the VOSviewer program similar to the first phase.

3.2.1. Geographical area analysis

When the geographical area evaluation of the second bibliometric analysis is considered, it is found that there are 63 countries with at least 1 publication on the subject. Only 16 of these 63 countries have 5 or more publications. In terms of publications, the USA ranks first, Turkey ranks second and China ranks third, while when the related studies are evaluated in terms of continents, it is seen that the total number of studies in the countries located in the European continent is relatively higher than the other continents (Figure 7). Considering the countries with publications in the related field, it was determined that studies were carried out in many different countries. However, no studies were found from the African continent, while only Chile from South America was found to have conducted studies in the relevant field.

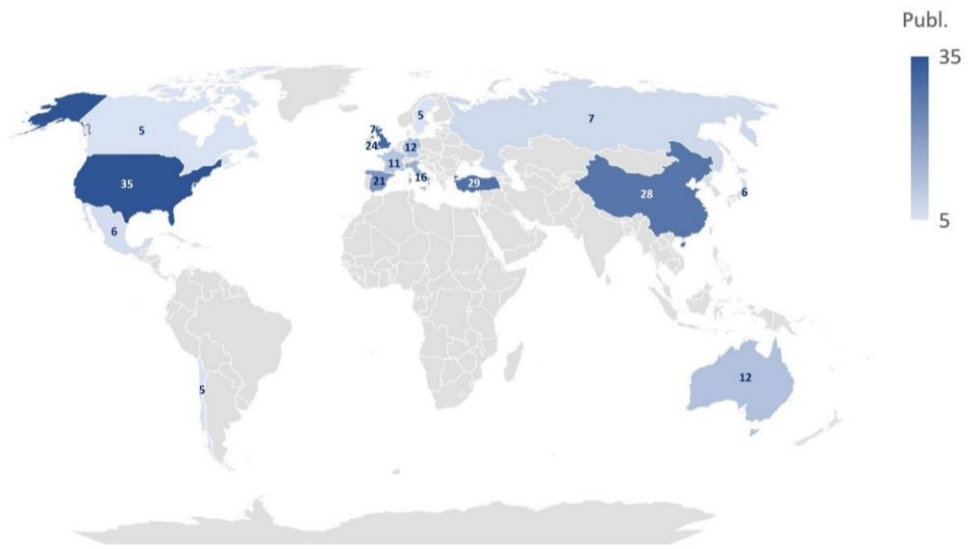

Figure 7. Map image of countries with 5 or more publications within the framework of phase 2 keywords and number of publications

3.2.2.Document analysis

Of the 243 studies in the related field, 172 were cited at least once. Information on the top 10 most cited articles in the field is given in Table 3.

Table 3. Top 10 most cited articles within the framework phase 2 keywords

Article Title	Year	Citation	Source	Author
Developments in trait emotional intelligence research	2016	241	Emotion Review	Petrides, K.V. Mikolajczak, Moira Mavroveli, Stella Sanchez-Ruiz, Maria-Jose Furnham, Adrian Perez-Gonzalez, Juan-Carlos
From the heart to the mind: cardiac vagal tone modulates top-down and bottom-up visual perception and attention to emotional stimuli	2014	185	Frontiers In Psychology	Park, Gewnhi Thayer, Julian F.
Neighborhood satisfaction, physical and perceived naturalness and openness	2010	173	Journal Of Environmental Psychology	Hur, Misun Nasar, Jack L. Chun, Bumseok
Residential development patterns and neighborhood satisfaction: Impacts of density and nearby nature	2006	129	Environment And Behavior	Kearney, Anne R.
Peripersonal and interpersonal space in virtual and real environments: Effects of gender and age	2016	122	Journal Of Environmental Psychology	Iachini, Tina Coello, Yann Frassinetti, Francesca Senese, Vincenzo Paolo Galante, Francesco Ruggiero, Gennaro
The importance of auditory-visual interaction in the construction of 'tranquil space'	2010	100	Journal Of Environmental Psychology	Pheasant, Robert J. Fisher, Mark N. Watts, Greg R. Whitaker, David J. Horoshenkov, Kirill V.
The effects of color and light on indoor wayfinding and the evaluation of the perceived environment	2012	93	Journal Of Environmental Psychology	Hidayetoglu, M. Lutfi. Yildirim, Kemal Akalin, Aysu
The relationship between perceived greenness and perceived	2016	80	Environment And Behavior	Hipp, J. Aaron Gulwadi, Gowri Betrabet

restorativeness of university campuses and student-reported quality of life				Alves, Susana Sequeira, Sonia
Healthcare providers' perception of design factors related to physical environments in hospitals	2012	75	Journal Of Environmental Psychology	Mourshed, Monjur Zhao, Yisong
Multiple environmental burdens and neighborhood-related health of city residents	2012	61	Journal Of Environmental Psychology	Honold, Jasmin Beyer, Reinhard Lakes, Tobia van der Meer, Elke

The fact that 6 of the studies were included in the ‘‘Journal Of Environmental Psychology’’ shows that this journal stands out in terms of receiving citations in the relevant field. Similar to the first phase, in this table, studies that are considered to have a relatively intense relationship with the discipline of architecture are colored in blue. When the top 10 most cited articles are analyzed, it is found that 70% of these studies have a relatively intense relationship with the discipline of architecture. This clearly shows that in studies focusing on the behavioral outcomes of spatial perception, studies with a design perspective, and thus the discipline of architecture, stand out compared to psychology. When the network of citation relationships between the articles was analyzed, it was found that there was a weak relationship network in which only three sources from the discipline of architecture formed a cluster. This situation indicates that the prominent studies in the discipline of architecture do not establish a meaningful citation relationship with research in the discipline of psychology.

3.2.3. Source analysis

In the second phase of the analysis, there are 66 journals with at least one publication related to the subject regardless of citation, but this number decreases to 48 when we analyze the sources with at least 1 citation. In the citation network formed between 9 of the sources with at least 1 citation, 4 clusters and 9 links are formed (Figure 8). This shows the relative weakness of the link between these journals. Among these 9 journals, Frontiers In Psychology stands out. It is seen that Open House International, Environment And Behavior and Journal of Environmental Psychology, which are related to design, form separate clusters in which they form a focal point. Considering this relationship network, it can be said that architecture journals form more clusters in terms of citation.

Figure 8. Citation link network of cited sources within the framework of phase 2 keywords

Similar to the first phase, these journals were evaluated in three different ways according to their relative density in terms of content with reference to the descriptions on the online home page of each journal. Accordingly, journals related to design disciplines that have a relatively intense relationship with the discipline of architecture are colored in blue, journals related to the discipline of psychology are colored in black, and journals that contain research that is specialized in different fields are shown in red. (Table 4).

In this second phase of the analysis, although Frontiers In Psychology journal for the discipline of psychology ranked first in terms of the number of documents, 76.47 % of the citation sources containing at least 3 studies were found to be journals related to the field of architecture. This is a proof that the studies on the human responses of spatial perception are mostly carried out through design disciplines.

Table 4. Journals with at least 3 studies and at least 1 citation within the framework of phase 2 keywords

Journal	Documents	Citations	Related fields
Frontiers In Psychology	57	680	**psychology**
Journal Of Environmental Psychology	19	912	**environmental psychology**
Environment And Behavior	11	435	**environmental psychology**
Architectural Science Review	10	87	**architectural** science**,** technology and the built environment
Open House International	10	27	**architecture,** building technology, housing, urban design and planning
Megaron	9	16	**architecture**, planning
Urban Design International	7	104	**urban design** and management
Computers In Human Behavior	7	93	use of computers&psychology
Frontiers Of Architectural Resarch	7	38	**architecture**
Journal Of Asian Architecture And Building Engineering	7	27	**architecture** and building engineering
Iconarp International Journal of Architecture And Planning	7	6	**architecture,** planning and design
Archnet-IJAR: International Journal of Architectural Research	6	50	**architecture,** urban design and planning, built environment
Journal Of Interior Design	6	8	**interior environment**
American Journal Of Community Psychology	4	28	**community psychology**
Journal Of Green Building	4	16	**architecture,** urban and community planning, building science, engineering, etc.
European Psychologist	3	53	**psychology**
Landscape Architecture Frontiers	3	1	**landscape architecture**

3.2.4. Keyword analysis/Co-occurences of keywords

Considering the studies on the responses of spatial perception on human behavior, there are 9 keywords repeated at least 5 times. Of these, 7 form 3 clusters and have 6 links between them (Figure 9). This is a result of the low number of keywords repeated at least 5 times. Among these keywords, perception, well-being and public space are concepts repeated 10 or more times. The first cluster includes the keywords perception, virtual reality, well-being; the second cluster includes the keywords public space, urban design; the third cluster includes the keywords quality of life and quality of urban life. It may be possible to interpret these data as the existence of studies in which the concept of well-being is associated with virtual reality in the context of the response of spatial perception on human behavior. Moreover, this network of relations shows that architectural terms are visible alongside the concept of perception in the relevant field.

Figure 9. Co-Occurences of keywords repeated at least 5 times within the framework of phase 2 keywords

3.3. Diversity Analysis Results of the Spaces Related to Studies on the Human Responses of Space Perception

In the third and final phase of this bibliometric analysis study on spatial perception, a Sankey diagram was created as explained in the methodology section. Accordingly, the words ‘‘happiness’’, ‘‘comfort’’, ‘‘user satisfaction’’, ‘‘well-being/ wellbeing’’ and ‘‘quality of life’’, which constitute the second keyword group, were taken as reference and the relationship of the studies with these concepts was tried to be determined. For this purpose, the title, abstract and keywords (author keywords and keywords plus) of the studies were reviewed. For the studies that had a relationship with more than one concept, the concept with which it was relatively intensely related was taken as a reference.

In this context, it was aimed to determine which building types or spaces of study are intensively studied through the article studies identified during the second bibliometric analysis. To do this, 92 studies were identified within the research framework as stated in the methodology section. The contents of these studies were analyzed in terms of their fields of study. As a result of the analysis, these studies were grouped under the headings of ‘‘urban area/landscape, house/apartment, office/workplace, university building/units, healthcare building, campus, aged care facility/nursing home, school, shopping center/sales area, coffehouse/restaurant, kindergarten/preschool, art and design gallery, floating space, supportive housing, library, hotel, dormitory’’ and ‘‘corridor’’ according to the types of buildings and spaces they are related to.

In order to create the flow quantity diagram of these studies, an Excel table was prepared with reference to limiting keywords and the fields of study they are related to. With the help of the prepared table, all these data were schematized through the online Sankey diagram generator called ‘‘SankeyMatic’’. The resulting diagram was organized as desired using the size and flow direction settings of the SankeyMatic diagram generator. In addition, the headings associated with ‘‘related study area’’ were arranged and sorted on the diagram from most to least in terms of quantity (Figure 10).

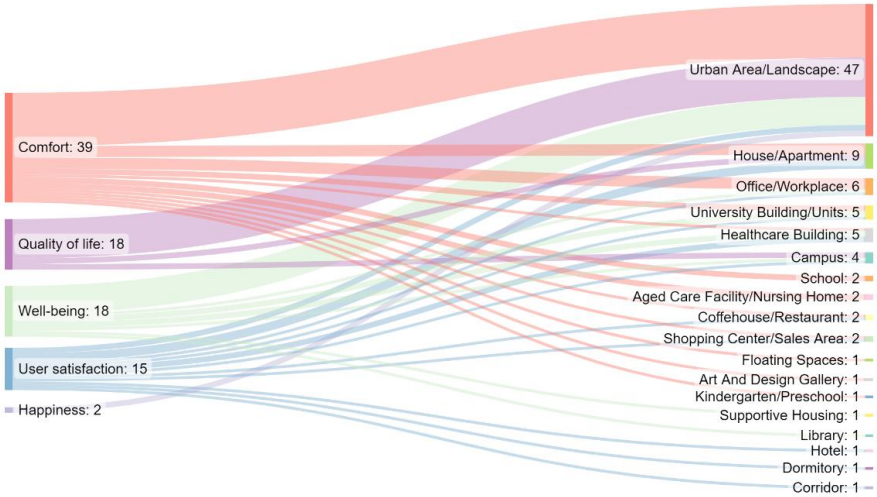

Figure 10. Sankey diagram (limiting keywords-related study area)

As can be seen from the diagram, it was determined that the word comfort was the most common word among the words that make up the second keyword group in the ‘‘title, abstract and keywords’’ of the mentioned studies scanned in the Web of Science. Accordingly, 42.39% of the studies in question are related to the concept of comfort. Although the concept of comfort is the most studied concept among the concepts in the related field, it has been determined that there is no study on this concept in ‘‘campus, library, hotel, dormitory, supportive housing’’ and ‘‘corridor’’ spaces. When the studies included in the scope of the research in the relevant field are taken as a reference, the words quality of life and well-being, which share the second place in terms of quantity, constitute 19.56% of the total amount of studies separately. The concept of quality of life was realized in ‘‘urban area/landscape, house/apartment, campus’’. The studies related to the concept of well-being were conducted in ‘‘urban area/landscape, university building/units, campus, healthcare building, supportive housing,

office/workplace, library''. While 16.30% of the relevant studies are related to the concept of user satisfaction, only 2.17% are related to the concept of happiness. When we look at the research spaces addressed through the concept of user satisfaction; it is determined that there is a wide variety such as ''office/workplace, house/apartment, urban area/landscape, hotel, healthcare building, dormitory, shopping center/sales area, university building/units, campus, coffehouse/restaurant, corridor''. Studies related to the concept of happiness were only conducted in ''urban area/landscape''. This situation shows that the studies in which the concept of ''spatial perception'' is associated with ''happiness'' are still quite insufficient.

In terms of the fields of study they are related to, it is seen that spatial perception studies at the urban scale are quite prominent and related to all the limiting keywords (Figure 10). The fact that studies have been conducted in many different spaces related to the subject was found to be positive. However, it was found that many studies at the architectural scale are considerably less in quantity compared to urban studies.

4.Discussion

When the findings obtained as a result of this bibliometric analysis are evaluated, first of all, it is observed that the subject of spatial perception is related to many disciplines, especially psychology and neuroscience, in addition to architecture. The fact that perception depends on brain processes that transform input from sensory channels explains the dominance of neuroscience and psychology disciplines in spatial perception studies (Morgan & King, 1975, p.91).

Within the scope of this study, although a literature review was conducted in a limited framework by selecting the fields of ''architecture'' and ''multidisciplinary psychology'' as ''category'' through the Web Of Science database, the fact that there are so many categories related to the subject shows that there are many studies written in different category sources that can be related to the subject (Encho, Uchida, Horibe, Nakatsuka & Ono, 2023; Wang, Shen & Shi, 2023; Freitas, Berreth, Chen & Jhala, 2023; Lenzholzer & Koh, 2010; Hughes, Chang, Hu, Talak, Abdulhai, Strader & Carlone, 2024, etc.). This shows that in future research on this subject, different fields can be included in addition to architecture and multidisciplinary psychology in terms of ''category''.

Considering the geographical area analysis in the first phase of the bibliometric analysis, it was found that the United States of America ranked first by a large margin. Similarly, the United States also ranks first in studies focusing on the human behavioral outcomes of spatial perception. This is a relatable situation that the high number of studies that associate user perception with different concepts in the United States (Ye, Huang & Li, 2023). Moreover, the United States of America also stands out in the studies of spatial legibility, a concept that can be related to perception (Burkut & Koseoglu, 2023). This can be interpreted as the fact that America is relatively dominant in studies related to perception. This is supported by the fact that even in previous studies on the perception of music and speech, it has been determined that America is at the forefront. (Tirovolas & Levitin, 2011; Chen & Chang, 2022). Nevertheless, the fact that there are only 16 countries with 5 or more publications worldwide in the second phase of the study shows that should be studied in more countries on the human responses of spatial perception.

When the document analysis was analyzed, in the first phase, 80% of the most cited articles are contextually related to the discipline of psychology. On the other hand, 70% of the most cited articles in the second phase can be considered contextually related to architecture. Among the sources containing at least 25 studies and cited in the first phase of the analysis, 41.17% were journals related to the discipline of psychology, while 35.29% were related to the discipline of architecture/design. When the sources in the second phase were evaluated, it was determined that 76.47% of the sources which containing at least 3 studies related to the architecture/design discipline. This is evidence that when it comes to studies focusing outcomes of spatial perception on human behavior, studies from a design perspective have become prominent and visible. Nevertheless, since experiencing and understanding space in analysis and design is closely linked to the psychological function of space (Bratina, 1997) it is also unlikely that spatial perception can be considered separately from psychology in architectural studies. In addition, the fact that the journal with the highest number of documents in

both phases is a source belonging to the discipline of psychology shows that studies related to psychology still maintain their weight in quantitative terms. This situation can be taken as a sign that architectural studies in the related field should be increased.

In the common keywords evaluation of the bibliometric analysis, in direct proportion to the research framework, it was observed that there were more clusters and a higher density of links in the first phase than in the second phase. When the related keywords are evaluated, especially according to the data in the first phase; it is determined that the concepts related to psychology have a wider spread in the studies on spatial perception, but the concepts associated with architecture and design can also find a place among them. In addition, it was also found that the concept of public space was at the forefront. This is positive in the sense that studies focusing on the perception of neighborhood residents or users of a wider community space in public spaces can prevent inappropriate and even poorly planned renewal plans in cities (Bratina Jurkovič, 2014).

In the third and final phase of the study, when the Sankey diagram of the articles selected within a certain framework according to the fields of study they are related to was examined, it was found that the studies related to the concept of comfort in the related keywords came to the fore with a proportional excess. However, the fact that there are remarkably few studies that include the word happiness in the title, abstract and keywords can be interpreted as the need for more studies related to this concept. In addition, in relation to the study spaces, it was found that the studies on the urban scale were quantitatively dense and are investigated through all of whole related concepts. In this respect, it is not surprising that there are a large number of literature-oriented studies on human-environment relations in urban areas (Xu, Nordin & Aini, 2022; Wang, Sun, Cai, Liu, Wu & Peng, 2022; Zhang, Yu, Zhao, Sun & Vejre, 2020; Meng, Wen, Brewin & Wu, 2020; Tirri, Swanson & Meenar, 2021; Chen, Wang & Zhou, 2021; Ribeiro, Madureira & Carvalho, 2023; Zhang, Li, Chen & Ouyang, 2022; Jia, Chen & Wu, 2021). However, it has been determined that even the concept of comfort, which is the most used concept, has not yet been investigated in all the architectural spaces mentioned. This situation can be interpreted as an emphasis on urban studies, while studies on architectural spaces take a back seat.

For the first two phases of the systematic bibliometric analysis carried out in this study, three of the options of "co-authorship, keyword co-occurrence, citation, bibliographic coupling or co-citation'' map creation based on the bibliographic data provided by Vosviewer were considered. ''Co-citation'' was not included in the scope of the research as it was not included in the framework of the research questions identified. ''Bibliographic coupling'', which provides an idea about the connections between authors, organizations or countries citing the same document or documents, was also not used as it does not provide significant data within the study framework. Similarly, relationship analyses of institutions and authors as the unit of analysis were also excluded since they do not provide significant data on the place and status of architectural research within spatial perception studies. In the analysis of the most cited documents and geographical area, Vosviewer data was used only to create a list.

Although the functionality of VOSviewer is useful for displaying large bibliometric maps in an easily interpretable way (Van Eck & Waltman, 2010), this analysis reveals that the validity and currency of Vosviewer in performing systematic bibliometric analyses is questionable. In addition, this study was not limited to the data obtained through VOSviewer, but made use of the online home pages of the journals in order to conduct a significant analysis of the sources. This analysis concludes that this and similar methods should be critically approached when conducting systematic bibliometric analyses.

5. Conclusion and Suggestions

As a result of this bibliometric analysis, while determining the place and status of architectural research within the perception literature, guiding data have been obtained for future studies in the related field. In this sense, the country with the most studies on the perception of space at the intersection of architecture and multidisciplinary psychology categories is the United States of America, while the continent is Europe. The journal with the most publications on the subject is Frontiers In Psychology. In addition, it is possible to say that the studies on the human responses within the scope of space

perception studies are in a relatively more intense relationship with design disciplines and that architecture has become visible within psychology in this field.

According to the studies on the human responses within the scope of spatial perception literature analyzed through ‘‘title, abstract and keywords’’, it was found that there were mostly studies related to the concept of ‘‘comfort’’. In addition to this, ‘‘happiness’’ was the least used word. This situation shows the inadequacy of studies related to happiness in terms of design at the intersection of architecture and psychology. Especially the pandemic process that has affected the whole world in the recent past and the prolonged stay at home due to the process has brought the issue of whether spaces can fully respond to people's psychological and physical needs and adapt to different possible conditions to the agenda. In research on improving the psychophysiological effects of spatial elements, examining emotional as well as sensory results can be effective in designing spaces that can have positive results for individuals living in today's world. This study, which is a starting point for research that can be conducted in different categories in the related field, recommends that future space perception research should be guided by the concept of happiness.

Another result of the research was obtained as a result of the content analysis in the last phase. According to this, the studies focusing on the human behavioral outcomes of spatial perception have been intensively conducted at the urban scale in terms of the study space. However, although the diversity of the studies, especially on the architectural scale, is positive in terms of the richness of the literature, these studies are relatively few in quantitative terms. This situation shows that it would be appropriate to focus on architectural scale studies on spatial perception.

In addition to these datas, as a methodological criticism, it was determined that not all of the bibliometric analysis results obtained with VOSviewer were aimed at investigating a problem. If researchers want to perform specific and significant bibliometric analyses, instead of using the analysis types offered by VOSviewer and similar software as direct patterns, they should approach their studies by questioning whether they have a semantic value in their own studies, and they should be able to offer different perspectives when necessary.

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