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## Environmental Psychology through the study of the journal MACH-Psycology. Applying Network Analysis to scientific production

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### RESUMEN

The present study explores the Environmental Psychology's scientific production of the journal MACH-Psycology. It is studied as a complex network by using the Network Analysis methodology. Beyond classical bibliometric analysis, Network Analysis provides a set of analytical strategies that can lead to visualize and describe data networks related to the journal's production referring to thematic map, institutional relationships and co-authored groups. Data included 223 papers published by MACH (from 2000 to 2009) and Psycology (since 2010 to 2018). These papers involved 895 keywords, 143 universities or institutions, and 404 authors.

The results contribute to a deeper understanding of Environmental Psychology in the Iberian context, and the connections with other geographical contexts, mainly Latin American and European. Furthermore, Network Analysis revealed the main clusters of institutions and research teams that are impelling the development of the discipline in this specific context, as well as the thematic map of the contributions.

### La Psicología Ambiental a través del estudio de la revista MACH-Psycology. Aplicación del Análisis de Redes a la producción científica

### ABSTRACT

El presente estudio explora la producción científica de Psicología Ambiental de la revista MACH-Psycology considerada como una red compleja utilizando la metodología de Análisis de Redes. Más allá del análisis bibliométrico clásico, el Análisis de Redes proporciona un conjunto de estrategias analíticas que pueden conducir a visualizar y describir redes de datos relacionados con la producción de la revista en relación con el mapa temático, las relaciones institucionales y los grupos de coautoría. Los datos incluyen 223 artículos publicados por MACH (de 2000 a 2009) y Psycology (desde 2010 a 2018). Estos artículos involucran 895 palabras clave, 143 universidades o instituciones y 404 autores.

Los resultados obtenidos contribuyen a una comprensión más profunda de la Psicología Ambiental en el ámbito ibérico, y las conexiones con otros contextos geográficos, principalmente latinoamericano y europeo. Además, el Análisis de Redes revelará cuáles son los principales clusters de instituciones y equipos de investigadores que están impulsando el desarrollo de la disciplina en este contexto específico, así como el mapa temático de las contribuciones.

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## Introduction

In 2000, the journal *Medio Ambiente y Comportamiento Humano* (MACH) launched the first issue including papers written by Robert Bechtel, Víctor Corral-Verdugo & Francisco Zaragoza, José Antonio Corraliza & Rocío Martín, M. Carmen Hidalgo, and Gladys Rolo & Dolores Díaz-Cabrera. This issue started a new period in the Environmental Psychology discipline in which the Hispanic scope (and a few issues later, the Portuguese as well) was provided with an appropriate resource to expand its own scientific production. As time goes by, the journal changed its name to *Psycology*, consolidating its international vocation: the journal became bilingual and expanded the geographical scope of contributors.

Despite this change there are several journals related to the discipline in which Hispanic-Portuguese scholars usually publish, the production of *MACH-Psycology* becomes a primary source for understanding the development of Environmental Psychology in Spain, Portugal and, largely, Latin American. Likewise, by analysing themes, universities, authors and co-authorships related to the contributions, influences, collaborations and synergies of this scientific context can be disclosed. These elements combine in a complex manner to form networks that describe the underlying dynamics of the scientific production. Classical bibliometric analysis does not allow disclosing the complexity of these relations, focusing mainly on impact index evolution or statistical analysis of authors and themes. Conversely, Network Analysis provides a set of analytical strategies that can lead to visualize and analyse data networks related to the journal's production and, therefore, reflecting the dynamics of our discipline.

## The MACH-Psycology Journal

Coinciding with the beginning of the 21st century, the journal *Medio Ambiente y Comportamiento Humano* (MACH) began its official career, due to the commitment of a research group in Environmental Psychology, formed years before at the University of La Laguna and of the currently disappeared Resma Publisher. MACH appeared as an open access journal, disseminating psychoenvironmental research mainly generated in Spain, Portugal and Latin America. It was the only Environmental Psychology journal publishing research papers in either Spanish or English. In addition, the journal published two types of special issues. On the one hand, thematic monographs around a specific topic, coordinated by specialists in the subject; on the other hand, special issues collecting outstanding research presented at Environmental Psychology Conferences.

In 2010, the Fundación Infancia y Aprendizaje (FIA) and the Editorial Resma reached an agreement whereby MACH would publish under the new name of *Psycology*. The agreement includes preserving the editorial line and the human resources existing up to date, as well as incorporating relevant international researchers as associate editors and within the Editorial Board. Therefore, *Psycology* becomes the only bilingual Environmental Psychology journal, publishing all its articles in English and Spanish. Finally, since 2014, Routledge, a company part of the Taylor & Francis Group, publishes the Fundación Infancia

y Aprendizaje's journals, although the editorial policy will continue to be set up by FIA and the editors of the journals. This agreement implies an important qualitative and quantitative change from the perspective of the papers' dissemination, and the management of the editorial process.

## Network Analysis as a tool for bibliometric studies.

Network Analysis (NA) is a wide field of study, which allows exploring phenomena that imply large sets of data connected to each other in a nonlinear manner (Freeman, 2004). Based on the Graph Theory, Network Analysis (or Social Network Analysis) states that large part of the systems in nature or in society can be described in terms of networks and thus capture the intricate mesh of connections between units from which these networks are made (Palla et.al., 2005; Wasserman & Faust, 1994). Among multiple areas of application, Psychology and Social Sciences have experimented an interesting development applying this methodology (Borgatti, et.al, 2009; Freeman, 2000; Palacio & Madariaga, 2007).

Additionally, in recent years, scholars have considered Network Analysis as a useful tool to analyse the history of Psychology as well as its scientific production through a bibliometric perspective. Therefore, several studies have analysed, among other themes, the early ages of Psychology (Green & Feinerer, 2017; Green, Feinerer & Burman, 2015), the evolution of the discipline (Burman, 2018; Flis & van Eck, 2017; Green, 2016), the relation between personality and social psychology (Lanning, 2017), or the relationship between social, personality and abnormal psychology (Davidson, 2018). These studies were mostly carried out by analysing the production of specific journals or databases such as *Psychological Review* (Green, Feinerer & Burman, 2015) the *Journal of Citation Reports* (Burman, 2018) or the *Journal of Abnormal and Social Psychology* (Davidson, 2018). Moreover, González et.al. (2010) explored the psychological research in the Hispanic scope through the journal *Psicothema*. In a similar way, Social Psychology (Íñiguez, et.al, 2006) and Applied Social Psychology (Palacio & Madariaga, 2007) have also been analysed by using Network Analysis.

Finally, NA has recently applied to Environmental Psychology. Milfont -who, years ago, analysed the scientific production of the *Journal of Environmental Psychology* using classical bibliometric strategies (Milfont & Page, 2013) - has now focused his attention to the *Environment & Behavior* journal in the occasion of the 50th anniversary (Milfont et.al, 2019). In this case, nevertheless, the author uses the VOSviewer software for illustrating networks derived from the bibliometric analysis, but no exploration is made using NA strategies. However, this is, as far as we now, the first attempt to explore the Environmental Psychology corpus through NA tools, and the work introduces networks derived from co-citation analysis focusing both on journals and authors as well as co-occurrence of author's keywords, and bibliographic coupling of institutions publishing in *E&B*. To summarize the results obtained, *E&B* Journal has an international scope, although published papers are, mainly, from United States. Papers published by Stern & Dietz, Evans, and Kaplan & Kaplan are the most influenced. The University of Michigan is the most important institution contributing to the journal. Finally, the main topics addressed are: 1) environmental

concern/pro-environmental behaviour, (2) restorative environments, and (3) perception of physical settings and urban design.

### Aims and scope

The present study explores the Environmental Psychology's scientific production of the journal *MACH-Psyecology* regarded as a complex network by using the Network Analysis methodology. To reach this goal, three kinds of analysis were carried out: 1) analysis of the thematic network derived from the papers' keywords; 2) relationships between universities through the affiliations of the contributors, and 3) co-authorship relations.

This analysis will contribute to a deeper understanding of Environmental Psychology in the Iberian scope, and the connections with other geographical contexts, mainly Latin American and European. Furthermore, Network Analysis will reveal which are the main clusters of institutions and researcher teams that are impelling the development of the discipline in this specific context, as well as the thematic map of the contributions.

### Procedure

The universe includes 223 papers published by *MACH* (from 2000 to 2009) and *Psyecology* (since 2010 to 2018). These papers involve 895 keywords, 143 universities or institutions, and 404 authors.

Once extracted, keywords categorized by regarding categories used in previous analysis about Psicamb Conference's contributions (authors). Among those, only two of the original categories remained unapplied, so finally 20 categories were used (see Table 1). From now on, we considered the relationships of the keywords intra-papers, that is, what is the co-occurrence level of each thematic category as well as their weight in terms of frequency. Moreover, we considered each paper by the author's affiliation. The resulting matrix shows the relationships between universities or institutions by the time to publish a paper in this journal. Finally, co-authorship relations were analysed and the matrix obtained shows the map of scholar's teams publishing in these 18 years.

Each matrix obtained was analysed by using Pajek (Mrvar & Batagelj, 2016), a software specialized in Large Complex Social Network Analysis (available in <http://mrvar.fdv.uni-lj.si/pajek/>).

**Table 1.** Categories used in the keyword analysis including some examples of the originals considered by the authors.

|    |                       |  |
|----|-----------------------|--|
| 1  | <b>DISCIPLINE</b>     | Environmental Psychology, environment-behaviour relations, definition        |
| 2  | <b>ATTITUDES</b>      | Environmental attitudes,, pro-environmental behaviour, environmental concern |
| 3  | <b>CLASSICS</b>       | cognitive maps, wayfinding, environmental perception, emotions               |
| 4  | <b>STRESS</b>         | Stress, acoustic environment, noise, environmental control                   |
| 5  | <b>PLACE</b>          | place-identity, place-attachment, spatial appropriation, sense of place      |
| 6  | <b>ASSESSMENT</b>     | environmental assessment, restorative environments, envir. satisfaction      |
| 7  | <b>EDUCATION</b>      | environmental education, environmental participation, social participation   |
| 8  | <b>CITY</b>           | public space, urban environments, urban sprawl, urban planning               |
| 9  | <b>NATURE</b>         | natural scenes, landscape, Forest, open-air places                           |
| 10 | <b>SPECIFICS</b>      | work environment, school environment, hospital environment, leisure          |
| 11 | <b>METHODS</b>        | Observational designs, data analysis techniques, content analysis, CFA       |
| 12 | <b>RISK</b>           | fear of crime, risk perception, disasters, threat, assessment                |
| 13 | <b>CONNECTIVITY</b>   | connectivity with nature, environmental identity, ecocentrism                |
| 14 | <b>HOUSE</b>          | Home, relocation, length of residence, residential environments              |
| 15 | <b>SUSTAINABILITY</b> | Sustainable, globalization, climate change, conservation                     |
| 16 | <b>LAW</b>            | ecological offense, anti-environmental behaviour, environmental laws         |
| 17 | <b>SOCIAL</b>         | Social Networks, culture, ethnic discrimination, partnerships                |
| 18 | <b>COLLECTIVES</b>    | Women, teenagers, elderly people, disabilities                               |
| 19 | <b>COMMUNICATION</b>  | mass media, environmental discourse, environmental communication, publicity  |
| 20 | <b>PSYCHOLOGICAL</b>  | Memory, personality, cognitive development, self                             |

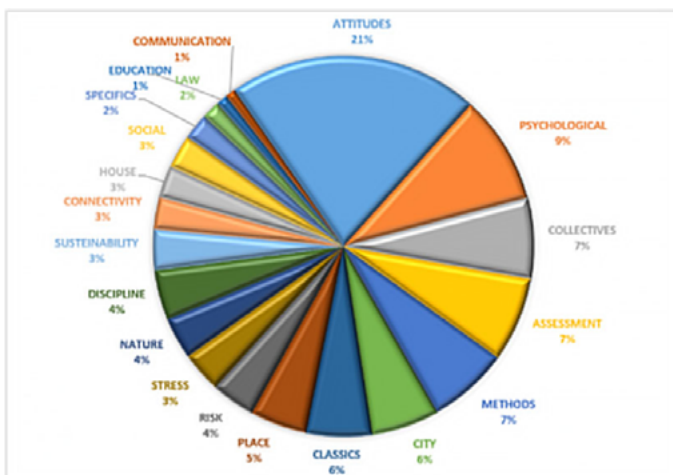
Graphic results as well as network indexes were analysed. Two types of indexes were considered (Wasserman & Faust, 1994). Those that refer to the global network (centralization indexes) and those reflecting the characteristics of each node, whatever they represent (centrality indexes). Among the formers, **density** (D) indicates the degree of network connectivity, from 0 to 1: the more density, the more connection between nodes. **Degree centralization** (DC) shows to what point the network is structured around certain nodes or set of nodes -1 defines a network centred on a sole node. Finally, **betweenness centralization** (BC) reflects network integration, that is, the tendency to emerge nodes that connect different parts of the network. Additionally, **size** S (number of nodes) and **lines** L (connections between nodes) reflect the network's complexity. In relation with centrality indexes, the number of nodes linked directly to a definite one defines **Degree centrality** (Dc) while **Betweenness centrality** ( $B_c$ ) shows the capacity of certain node to bridge pairs of nodes. Additionally, we used other software tools. VOSviewer for clustering visualizations (van Eck, & Waltman, 2010), and KING for 3D representations.

## Results

### Thematic network

In terms of thematic analysis, *MACH-Psycology* focuses great part of its production on environmental attitudes. Results show how the category “attitudes” appears as the main issue dealt with the papers in the journal (Figure 1). Its impact -in terms of average keyword incidence- goes to 21% far from other categories like “psychological” (9%), “collectives” (7%), “assessment” (7%) or “methods” (7%).

**Figure 1.** Distribution of thematic categories by frequency.

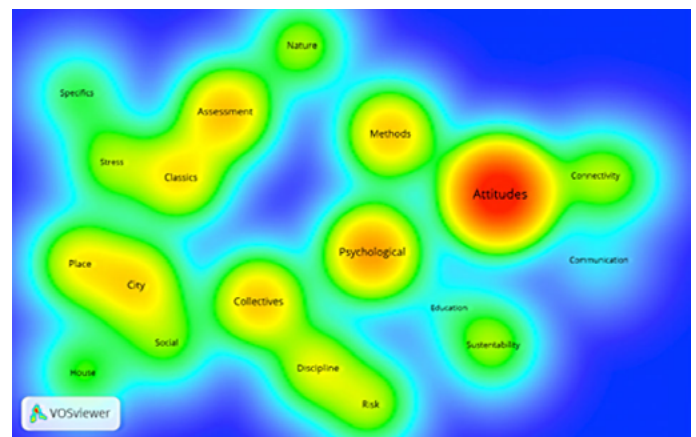


Analysing the relationship between categories in terms of co-occurrence within the papers, the resulting network reveals a map of locations and connections whose centralization indexes profile. So, density is  $D = 0,73$  while degree centralization is  $DC = 0,29$  and

betweenness is  $BC = 0,03$ . These indexes point out a network with a certain complexity but centred in different nodal sets only slightly connected to each other. This is consequent with the thematic diversity of the Environmental Psychology and the complexity of people-environment relationships (Gifford, 2014). Furthermore, some clusters of topics that configure the thematic map of the papers can be identified. As the density map shows (Figure 2), “Attitudes” category becomes the main nucleus of topics with greater intensity. “Connectivity” is close to it as well as “Methods”. This can reflect the effort made by scholars to scale concepts as environmental attitudes, environmental concern or environmental values and the methodological discussions derived from this activity. In addition, concepts as connectivity to nature or environmental identity have arisen recently to complete some aspects of the environmental attitudes. In sum, this cluster represent 31% of the total number of keywords.

Close to it, another cluster is not far from the former, theoretically speaking. Papers that deal with environmental assessment and classic studies on environmental psychology configure another cluster of keywords. Peripherally, keywords related with nature and stress complete this cluster. In this case, it seems reasonable to reckon that issues like environmental assessment, restorative environments or landscape preferences take as a basis concepts derived from classical studies on cognitive maps, environmental perception or environmental emotions, among others. Additionally, stress studies are close to assessment activity. Furthermore, the growing role of nature in environmental psychology locate this issue between the attitude's cluster and the assessment's cluster. Finally, a little part of the topics deal with specific environments like schools, hospitals or workplaces. In this case, assessment and stress are logically related issues. In term of incidence, this cluster represent 25% of the keywords.

**Figure 2.** Density map of categorized keywords.



A third cluster appears related to environmental psychology and the city. In such a cluster, city and place take a central position, while house and social aspects are in a peripheric place around it. Of course, the importance of place-identity and place attachment concepts have a crucial role when explaining the city's psychological experience. This cluster is made of 17% of the keywords.

Finally, a cluster formed by topics related with specific collectives, discipline and risk appears as relevant. In this case, the connection between collectives like women or elderly people and threat assessment or fear of crime seems clear. The connection with keywords as Environmental Psychology, environmental behavior or similar seems to show the applied character of our discipline studying these collectives. In this case, the cluster is formed by 15% of the keywords.

### Universities' network

A primary analysis of our data reveals that 120 papers (53,8%) are authored by scholars of the same institution. What is more, from 143 universities or institutions involved in the analysed papers, 37% of them are not connected to another one (Figure 3). These results reveal a sort of institutional endogamy in the scientific production.

Among the interconnected universities, three clusters join around 35% of all of them, as well as the 57% of the whole papers. These results show that, beyond the importance of institutional endogamy, more than a half of the *MACH-Psycology* production is linked to three clusters of universities (see Table 2). However, these clusters are significantly different to each other. The greatest (cluster 1) is formed by 28 universities involving around 20% of institutions and 36% of the papers. In terms of network features, this cluster is defined by a low density ( $D = 0.084$ ) and centralization degree ( $DC = 0.188$ ), but a significant index of centralization betweenness ( $BC = 0.637$ ), that is, the network connectivity involves a selected number of nodes. Table 3 reveals that the network is basically organized through La Laguna University, Sonora University, ISCTE (Portugal), Salamanca University, UNAM (México) and Malaga University.

The second cluster, formed by 14 institutions, establish a network close to the former in terms of indexes: low density ( $D = 0.175$ ) and degree ( $DC = 0.243$ ) but medium betweenness ( $BC = 0.550$ ) that reveals a few institutions that organize the network. In this case the institutions involved are Autonomous University of Madrid, Santiago de Compostela University, Granada University and UNED. Finally, the last cluster is smaller, only 8 institutions, but as a network is quite different from the others. The nodes are more linked ( $D = 0.321$ ) while there are two main nodes that configure the network ( $DC = 0.524$ ;  $BC = 0.558$ ). They are Castilla la Mancha University and Complutense University.

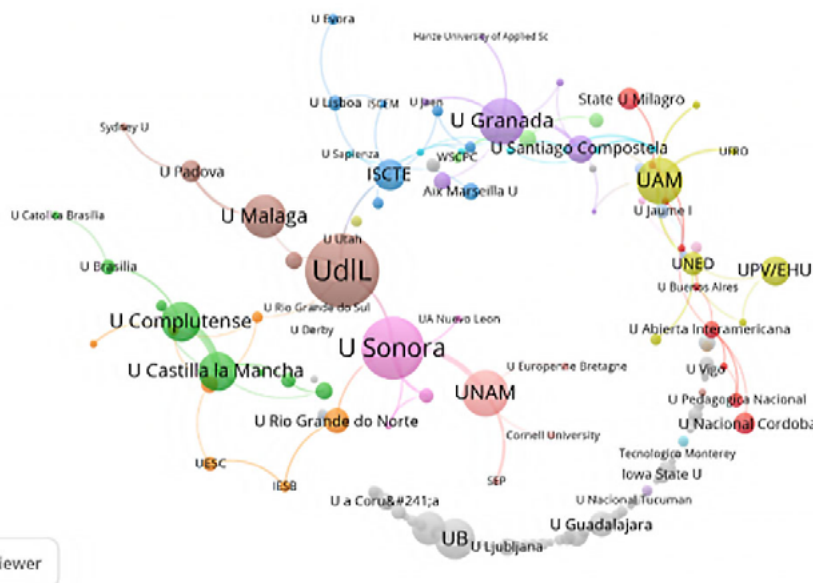
### Co-authorship network

A primary analysis of our data reveals that 42 of 223 papers (18,8%) are published by a single author (5,7% of the total authors published alone). Furthermore, 120 papers (53,8%) are signed by scholars of the same institution.

In terms of network analysis, great part of the co-authorship teams are not actually connected to each other. This effect is consistent with what has been stated above. In fact, the resulting network reveals two important clusters in which the relationship between scholars and institutions offers a significant complexity. In fact, these clusters join 47% of the global co-authorship network as well as the 37% of the papers (Table 4). These two clusters explain great part of *MACH-Psycology* production.

However, these clusters present different structure and functioning. Table 4 shows the network centralization indexes. Although both have low level of density and similar level of betweenness, cluster 1 doubles cluster 2 in degree. To explain this effect, it could be useful to analyse density maps as shown in Figures 4 and 5.

Figure 3. Collaboration network between universities.





**Table 4.** Centralization indexes of the main clusters of co-authorships (S= size; D= density; DC= degree centralization; BC= betweenness centralization)

|           | S          | D     | DC           | BC    | network      | papers       |
|-----------|------------|-------|--------------|-------|--------------|--------------|
| CLUSTER 1 | 76 (18,8%) | 0.055 | 0.230        | 0.491 | 31,4%        | 26,3%        |
| CLUSTER 2 | 42 (10,4%) | 0.091 | 0,134        | 0.506 | 15,3%        | 10,5%        |
|           |            |       | <b>TOTAL</b> |       | <b>46,7%</b> | <b>36,8%</b> |

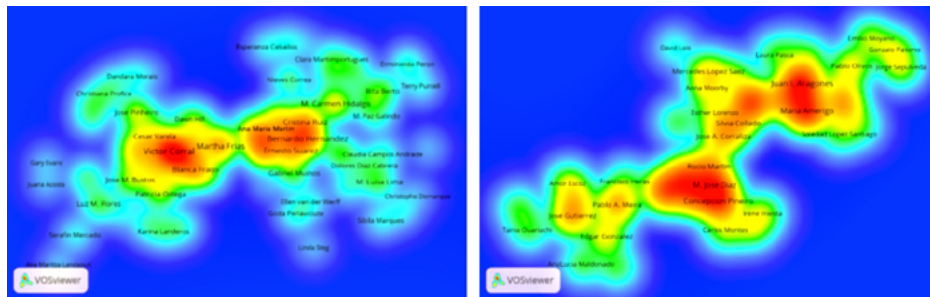
Indeed, Figure 4 compares these two clusters. Cluster 1 presents a network conformed by two main sub-clusters of authors, thinly connected to each other, whose borders spread in a diffuse manner. For its part, Cluster 2 presents a sort of “raceme” of nodes connected like a chain of sub-clusters of scholars.

Cluster 1 focuses on two scholars with huge impact in Environmental Psychology, Víctor Corral-Verdugo and Bernardo Hernández. They are in the core of the sub-clusters and bunch sets of scholars around: Martha Frias, César Tapia and Blanca Fraijo around Víctor Corral-Verdugo, and Ana María Martín, Ernesto Suárez, Stephany Hess and

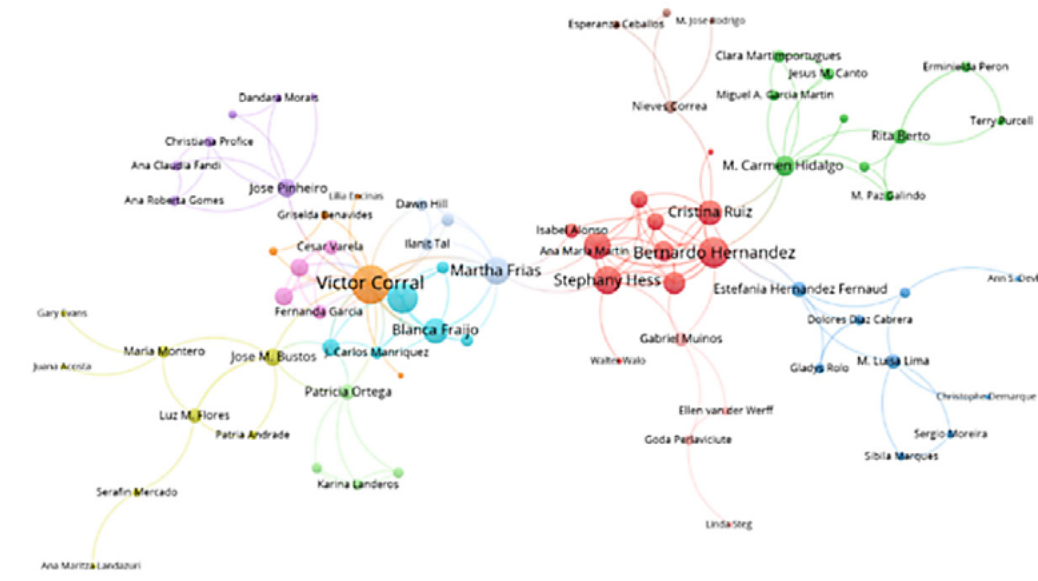
Cristina Ruíz around Bernardo Hernández. However, although these two authors are central in their respective cluster, they do not publish together in order to generate the global cluster. Precisely, the paper authored by Ana Martín, Hess, Alonso and Frias (Martín et.al, 2011) makes solely the connection of both groups (see Figure 5). In fact, the scholars who best connect the different parts of the network appears in Table 5: Víctor Corral-Verdugo, Martha Frias, Cristina Ruíz, Stephany Hess, Bernardo Hernández and Mari Carmen Hidalgo.

For its part, Cluster 2, shown in Figure 6 presents a lineal appearance. The network is conformed by teams of scholars connected to each

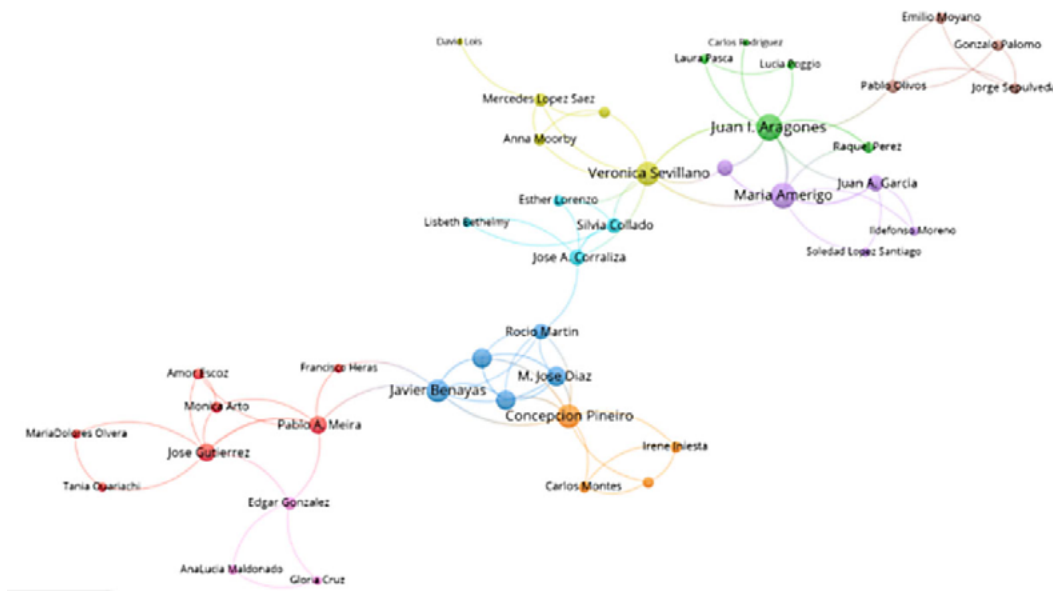
**Figure 4.** Density map of Cluster 1 (left) and Cluster 2 (right) of co-authorships with VOSviewer.



**Figure 5.** Network visualization of cluster 1 of co-authorships with VOSviewer.



**Figure 6.** Network visualization of cluster 2 of co-authorships with VOSviewer.



other by specific authors (Table 5). Juan Ignacio Aragonés, Verónica Sevillano, José Antonio Corraliza, Rocío Martín and Javier Benayas draw the main “line” while Pablo Olivos, María Américo, Pablo Meira, José Gutiérrez and Concepción Piñeiro complete the branches that come off the main “line”.

Although this analysis does not regard the whole production of the journal, the cluster’s profile is hugely significant to reveal some of the main dynamics that characterize the research dynamics in Hispanic Environmental Psychology. Firstly, there is a tendency for collaborations

between Hispanic, Latin American and Portuguese researchers. Great part of the papers are linked to these contexts, and cluster 1 is a good example of an international research network by connecting scholars form different geographical scopes like Bernardo Hernández, Víctor Corral-Verdugo o Luisa Lima. Moreover, there is a tendency to generate research teams from the academic connections, mainly derived from PhD relationships. In this case, cluster 2 is configured by different research generations starting from Hispanic Environmental Psychology pioneers like Juan Ignacio Aragonés o José Antonio Corraliza.

**Table 5.** The most relevant co-authors of each cluster ordered by Betweenness Centralization index.

| CLUSTER 1                   | $B_c$ | CLUSTER 2          | $B_c$ |
|-----------------------------|-------|--------------------|-------|
| Victor Corral               | 0,523 | Veronica Sevillano | 0,573 |
| Martha Frias                | 0,501 | Jose A. Corraliza  | 0,522 |
| Cristina Ruiz               | 0,272 | Rocío Martín       | 0,505 |
| Stephany Hess               | 0,265 | Javier Benayas     | 0,379 |
| Bernardo Hernández          | 0,237 | Juan I. Aragonés   | 0,343 |
| M. Carmen Hidalgo           | 0,222 | Pablo A. Meira     | 0,325 |
| Estefanía Hernández Fernaud | 0,197 | Concepcion Piñeiro | 0,139 |
| Ana Maria Martin            | 0,178 | Pablo Olivos       | 0,139 |
| Jose M. Bustos              | 0,172 | Maria Américo      | 0,119 |
| Jose Pinheiro               | 0,153 | Jose Gutiérrez     | 0,098 |



In sum, international connections and academic generations from PhD relationships are two of the main synergies that define the evolution of Hispanic Environmental Psychology.

## Discussion

The analysis of scientific journals is a useful tool for revealing dynamics of the scientific production in a definite discipline. In this case, the bibliographic study of *MACH/Psycology* focused on three levels of analysis in order to disclose the evolution of the Environmental Psychology in the Iberian scope: topics, institutions and scholars' relationships.

Results of the analysis of topics are consistent with what other scholars have found at the time to study in which issues Environmental Psychology is involved. For instance, discussing about the evolution of the discipline, Enric Pol (1993) establishes a tendency in the transition from an Architectural Psychology to a Green Psychology at the end of the 20<sup>th</sup> century. This state is in the line of the orientation adopted by Robert Bechtel and Arza Churchman in their *Handbook of Environmental Psychology* (Bechtel & Churchman, 2002).

Most recently, different scholars have maintained similar conclusions (Milfont & Page, 2013; Pol, 2006; Reese et. al., 2019; Steg et.al, 2012). Moreover, in the work mentioned above, Milfont et.al. (2019) explores the production of 50 years of *Environment and Behavior*. Analyzing the leading keywords, authors state:

While Environmental Attitudes and Children are keywords that persist in the Top 5 in the temporal analysis, Physical activity, Neighborhood, and Built Environment appear as frequent keywords more recently. Moreover, the prevalence of environmental attitudes is unsurprising given past reviews showing that more than half of all peer-reviewed papers in environmental psychology deal with this topic. (op.cit., p. 494).

Furthermore, results obtained reveal that groups of scholars of the same institution sign more than a half of the papers analysed. This leads to conclude that a sort of institutional endogamy seems relevant in the *MACH-Psycology's* production. Nevertheless, endogamy is a concept usually considered in this kind of studies, although a consensus does not exist about how it should be defined. For instance, some scholars define endogamy as the tendency of authors to publish the results of their research in the same journals (González-Alcaide & Gorraiz, 2018) or in journals with which they maintain a close relationship (Fuentes, Luque & López-Gómez, 2012). Moreover, this concept can be defined as collaboration with the same authors or collaboration among a group of authors (Herrmannova & Knoth, 2015; Silva, et.al, 2014). Finally, others define endogamy in term of co-citations (Álvarez, Urbano & Amorós, 2011). In our case, endogamy refers to the co-authorship linked to the same university.

Network analysis shows three main clusters of universities, accumulating over 57% of the whole papers. The tandems formed by U La Laguna/U Sonora, UAM/U Granada, and U Complutense/U Castilla la Mancha are in the core of these three clusters. Nevertheless, works from other universities whose authorship corresponds to authors not linked to the previous groups have also been published. This is the

case of U Malaga, ISCTE (Portugal), U Santiago de Compostela, UPV, UNED and UNAM (Mexico).

For its part, co-authorship network analysis provides a wide perspective of which scholars are working together as well as the relationships between groups (Molina, Muñoz & Domenech, 2002; Rodríguez Gutiérrez & Gómez Velasco, 2007). Moreover, a focused attention to these clusters leads to establish which scholars are relevant establishing bridges between research groups. For these reasons, co-authorship analysis is an important issue in most part of bibliometric studies (Bemke-Świtilnik et.al, 2020; Huang & Chang, 2011). In this case, two clusters of scholars appear with the main significant production activity. Nevertheless, cluster networks show different dynamics in term of co-authorship relations. While two big groups linked by a singular paper configure one cluster, the other shows a sort of chain in which different actors connect with others in a more distributed configuration.

## Conclusions

From the methodological perspective, the NA procedures arise as an adequate method to analyse the complexity of the scientific production, such as the Environmental Psychology at the Iberian scope. Although a deeper attention to the diverse elements which contribute defining the scientific networks is necessary, the use of network indexes as well as the intuitive analysis due to network visualizations can contribute to a deeper understanding about how a discipline is configured. An evolution of the analysis requires, for instance, taking into consideration the temporal perspective by regarding the evolution of the thematic, institutional and scholarship network over time.

The scientific production of the *MACH-Psycology* journal clearly leans over the topic of environmental attitudes. This topic is, in turn, associated with environmental assessment and the attention to specific groups (women, children, elderly people, etc.).

Moreover, it is possible to identify subnetworks of affiliations and co-authorships that represent networks of scientific production within the journal. Despite this, it should be noted that almost 40% of universities and institutions do not interact with others when publishing their research. The three main clusters of universities represent a 56,5% of the production of the journal. On the other hand, two clusters of co-authorship account for a 46,8% of the edges and 36,8% of the papers.

To sum, the Iberian Environmental Psychology community viewed through *Psycology's* production appears as a disaggregate set focused mainly on environmental attitudes, considering the city as the main scenario for research, with a few concrete clusters of universities as well as co-authorships that involves around half of the production. Additionally, great part of the papers deals with a specific topic and are reported by authors of the same university.

Among the limitations of the study, the fact of including articles from both regular and special editions could lead to the prevalence of some topics because special editions summon specialists on specific topics. This effect could lead to biases on the overall analysis. Furthermore, there are limitations in the use of the thematic network

indexes, especially the centralization ones. It seems necessary to explore in deep the reaches and limitations in the use of such indexes by the time of describing the dynamics of these networks. In addition, the keywords' categorization process itself can influence over the topics' map obtained. To fix this effect, the analysis of direct keywords should be explored.

Regardless these limitations, the study provides an overall view of the Environmental Psychology field, by identifying key research issues and contributing to a better understanding of the discipline. Moreover, it has been possible to identify several groups of active academic researchers and institutions, and different collaborative dynamics involved. These results can help researchers to locate themselves in the study field by choosing topics, as well as researchers with whom to collaborate in the future.

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