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Bibliometric analysis of empirical studies in Spanish on Working Memory (1999-2014).

Análisis bibliométrico de estudios empíricos en español sobre memoria de trabajo (1999-2014).

Análise bibliométrica de estudos empíricos em espanhol na memória de trabalho (1999-2014).

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Resumen

La memoria de trabajo es un constructo multicomponente que permite la mantención de la información y su manipulación. El objetivo de este estudio fue analizar, mediante indicadores bibliométricos, los trabajos científicos de corte empírico vinculados al constructo memoria de trabajo, publicados en español en el período comprendido entre 1999 y 2014. Para ello, se realizaron búsquedas mediante palabras clave en cuatro bases de datos que incorporan literatura científica hispana: Dialnet, Lilacs, Scielo y Redalyc. Los resultados sugieren la necesidad de potenciar la producción regional en este campo. Por último, se discute acerca del impacto que puede proporcionar el estudio de la memoria de trabajo en el ámbito laboral, educativo y clínico.

Palabras clave: estudio bibliométrico; memoria de trabajo; idioma español; investigaciones empíricas

Abstract

Working memory is a multicomponent construct that allows storage and manipulation of information. The aim of this study was to analyze, by bibliometric indicators, empirical studies related to working memory, published in Spanish in the period between 1999 and 2014. For this purpose, we searched by using keywords in four databases that include Hispanic scientific literature: Dialnet, Lilacs, SciELO and Redalyc. The results suggest the need to enhanced regional production in this field. Finally, we discuss about the impact that can provide the study of working memory in the labor, educational and clinical settings.

Key words: bibliometric study; Working Memory; Spanish language; empirical studies

Resumo

A memória de trabalho é um conceito multicomponente que permite a manutenção da informação e de sua manipulação. O objetivo deste estudo foi analisar, mediante indicadores bibliométricos, os trabalhos científicos de corte empírico vinculados ao conceito memória de trabalho, publicados em espanhol no período compreendido entre 1999 y 2014. Para tanto, se realizaram buscas mediante palavras-chave em quatro bases de dados que incorporam literatura científica espanhola: Dialnet, Lilacs, Scielo y Redalyc. Os resultados sugerem a necessidade de potencializar a produção regional neste campo. Por último, se discute a respeito do impacto que pode proporcionar o estudo da memória de trabalho no âmbito laboral, educativo e clínico.

Palavras chaves: restudo bibliométrico; memória de trabalho; idioma español; investigações empíricas.

In 1890, James presented the first and classical model about organization of memory's system. It distinguishes two essential types: short term memory and long term memory, depending on the amount of time the stored and recovered memories lasts (Ballesteros Jiménez & García Rodríguez, 1996). Despite the temporary earliness of these developments, it wasn't until 1960 with the works of Cognitive Psychology that the interest in superior psychological processes – including memory- was reborn; these processes had been left behind during the first half of the twentieth century. Cognitive Psychology tries to understand in which way the human's mind succeeds in processing information and learning, this is the reason why memory plays such an important role in its developments.

According to current knowledge, it is possible to conceptualize memory as a construct conformed by a complex net of sub-systems capable of working in parallel. In this sense, Carrillo Mora (2010) supports that memory cannot be understood as a static brain function but instead it behaves like a set of functions closely interrelated, orientated to reach a common objective. Because of these reasons, it will be more accurate to talk about "Memory Systems".

In the 70's, short term memory store was beginning to be considered as a multicomponent system thanks to Baddeley and Hitch's studies. They established that short term memory is active and it is used to perform other cognitive functions more complex than the merely storage of a small amount of elements; and in fact, it is considered essential for every task and cognitive activity. They proposed the model of Operative Memory (Ballesteros Jiménez & García Rodríguez, 1996). The authors introduce the notion of "operative memory" or "working memory" to designate a mental work space used to retain and manipulate information temporarily. This type of memory is the essential element in tasks of learning or remembrance. It is divided in three sub-systems of storage: Central Executive, which executes attention-control functions, the Phonological Loop, that is the phonological store and exercises the hallucinatory process control and the visual-spatial agenda, responsible for the registers and storage of essential spatial aspects of visual information (Darlington, Barceló, Fernández Frías & Rubia, 1999).

Countless investigations show that working memory could reach its adult level of performance during adolescence (Huizinga, Dolan & Van der Molen,

2006; Van Leijenhorst, Crone & Van der Molen, 2007). Talking about this point, we must take into consideration that the ability to maintain the information would mature before the ability to manipulate it (Conklin, Luciana, Hooper & Yarger, 2007; Gathercole, 2004).

At an anatomical-functional level, some studies with healthy adult subjects have associated working memory with fronto-parietals activities. Among which it is possible to mention the prefrontal cortex and the superior parietal cortex (Owen, McMillan, Laird, & Bullmore, 2005; Wager & Smith, 2003). However, there are differences in the observed activation of the different areas in function according to the type of information that it is involved (verbal vs. spatial) and the kind of process that it is considered (maintenance vs. manipulation). Currently there is no agreement between the different authors about whether the functions of maintenance and manipulation of information would depend on the activity of different neuronal regions (Crone, Wendelken, Donohue, Van Leijenhorst & Bunge, 2006; Narayanan et al., 2005).

Taking into account the significant interest and distribution that the Baddeley & Hitch's model has generated since its origins, it was proposed to carry out

a quantitative survey and an analyses of the scientific production that is disseminate in connection with the working memory construct (Duarte Masi, 2006). A bibliometric study, is in this sense, is very useful because it can provide important data to analyze, making possible to measure and compare the development and results of scientific activity and it can also help to discover which vacancy areas exist in the field.

Bibliometrics.

The word “bibliometry”, as it is currently known, was defined in 1969 by Alan Pritchard as the application of the statistical and mathematical models for the definition of the written communication processes and the development of the different scientific disciplines (Camps, Recuero, Avila & Samar, 2006).

In tune with this definition, it is possible to claim that the bibliometry is the body of methodological knowledge for the application of quantitative techniques, meant to study processes of production, communication and usage of scientific information, with the purpose of

contributing to the analyses and evaluation of science and investigation (Carrizo Saneiro, 2000).

In view of the above mentioned, it is important to highlight the great benefits of the bibliometric studies. They allow a better organized search based on a specific topic, they also permit an approach to other similar areas investigation-groups and orientate the author towards the reach of better options to publish his work.

In addition to that, it can be appreciated the huge relevance that the evaluation of scientific production gains in the current context, specially having in mind that scientific society demands that the new findings, the verification of previous theories, the inclusion in other fields of study or any other scientific approach must be divulgated as condition for being considered part of science. As a consequence of the exposed situation, it has been produced not only the increase but also the reinforcement of the bibliometric studies. One of the main factors that have contributed to the existence of this phenomenon is the interest in the scientific production as a quality index and a guideline

to compare the growth and development of a discipline or area of knowledge.

Lastly, it is important to highlight that the bibliometric studies mainly inform about the productivity as regards quantitative data. While these elements cannot be considered as the only quality index, it is logical to admit that with an accurate use and in the light of an appropriate interpretation, they may constitute an index to estimate at least, the diffusion level (Agudelo, Bretón-López & Buela-Casal, 2003).

Objectives

The main purpose of this study was to analyze by using bibliometrics indicators the empirical scientific works associated to the working memory construct, that were published in Spanish in the period between 1999 y 2014.

The aim is to promote the progress of the knowledge related to this construct, as well as to provide relevant evidence about local levels of productions associated to the topic¹.

[1] The present study has been conducted in the context of the investigation proyect called "Comparative Study in Spatial and Semantic Memory among a population of architects and psychologists", accredited for the years 2013 y 2014 by the Science and Technology Department of the Nacional University of Rosario (Argentina).

Methodology

For the compilation of the corpus of analysis, there have been systematic searches in four databases of Spanish scientific literature: Dialnet, Lilacs, Scielo and Redalyc. These databases were selected because of the studie’s objective: to analyze scientific works published in Spanish.

The search was made using preselected key words. The search categories were: “working memory”, “operative memory”, “Baddeley model”, “Baddeley and Hitch” “central executive”, “phonological loop”, “visual-spatial agenda”.

As an inclusion criteria for the selection of the articles, it was considered that they must have a reference to empirical studies (not necessarily experimental studies), and that they must be published in indexed scientific magazines and in Spanish. Finally,

Tabla 1. Amount of scientific articles according to production country.

PROVENANCE	N	%
Spain	13	28,3
Argentina	11	23,9
Colombia	10	21,7
Chile	6	13,0
México	4	8,7
Cuba	1	2,2
Costa Rica	1	2,2
<i>Total</i>	<i>46</i>	<i>100,0</i>

Table 2. Amount of articles published according to institution and affiliation country.

INSTITUTION	COUNTRY	N	%
Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)	Argentina	9	19,6
Universidad de Oviedo	Spain	4	8,7
Universidad de la Frontera	Chile	3	6,5
Pontificia Universidad Javeriana	Colombia	2	4,3
Fondo Nacional para el estudio Científico y tecnológico. (FONDECYT)	Chile	2	4,3
Asociación Colombiana de Psiquiatría	Colombia	2	4,3
Universidad Complutense de Madrid	Spain	2	4,3
Universidad Nacional Autónoma de México	México	2	4,3
Universidad de Buenos Aires (UBA)	Argentina	1	2,2
Centro Interamericano de Investigaciones Psicológicas y Cs. Afines	Argentina	1	2,2
Universidad de La Laguna	Spain	1	2,2
Universidad Autónoma de Baja California	México	1	2,2
Universidad de Almería	Spain	1	2,2
Sociedad Mexicana de Análisis de la Conducta	México	1	2,2
Universidad del Rosario	Colombia	1	2,2
Universidad del Norte	Colombia	1	2,2
Universidad Católica de Colombia	Colombia	1	2,2
Universidad de Costa Rica	Costa Rica	1	2,2
Universitat de Girona	Spain	1	2,2
Ministerio de Educación y Ciencia de España	Spain	1	2,2
Universidad de Antioquia	Colombia	1	2,2
Centro Internacional de Restauración Neurológica	Cuba-México	1	2,2
Universidad Nacional de Colombia	Colombia	1	2,2
Universidad de San Buenaventura	Colombia	1	2,2
Universitat de Vic	Spain	1	2,2
Comité para el Desarrollo de la Investigación (CODI)	Colombia	1	2,2
Universitat de Barcelona	Spain	1	2,2
Unspecified	-	1	2,2
<i>Total</i>		<i>46</i>	<i>100,0</i>

Table 3. Amount of articles according to publication magazine and affiliation country.

MAGAZINE	PROVENANCE	N	%
Psicothema	Spain	6	13,0
Revista Chilena de Neuropsicología	Chile	4	8,7
Revista Argentina de Ciencias del Comportamiento	Argentina	3	6,5
European Journal of Education and Psychology	Portugal	2	4,3
Revista Colombiana de Psiquiatría	Colombia	2	4,3
Electronic Journal of Research in Educational Psychology	Spain	2	4,3
Actualidades en investigación	Costa Rica	2	4,3
Psicológica	Spain	2	4,3
Avances en psicología Latinoamericana (Colombia)	Colombia	1	2,2
Interdisciplinaria	Argentina	1	2,2
Anales de Psicología	Spain	1	2,2
Revista Latinoamericana de Psicología	Colombia	1	2,2
Acta Colombiana de Psicología	Colombia	1	2,2
Psicología desde el Caribe	Colombia	1	2,2
Universitas Médica	Colombia	1	2,2
Revista Electrónica de Investigación Educativa	México	1	2,2
Revista Mexicana de Análisis de la Conducta	México	1	2,2
Anuario de Investigaciones	Argentina	1	2,2
Literatura y Lingüística	Colombia	1	2,2
Estudios Filológicos	Chile	1	2,2
Rev. Lat. de Investigación en Matemática Educativa	México	1	2,2
Cuadernos de Neuropsicología	Chile	1	2,2
Acta Neurológica Colombiana	Colombia	1	2,2
Revista Cubana de Investigaciones Biomedicas	Cuba	1	2,2
Acta Biológica Colombiana	Colombia	1	2,2
Psicología: Avances en la disciplina	Colombia	1	2,2
Acta de Investigación Psicológica	México	1	2,2
Salud Mental	México	1	2,2
Liberabit	Perú	1	2,2
Anuario de Psicología	Spain	1	2,2
Universitas Psychologica	Colombia	1	2,2
<i>Total</i>		46	100,0

those works which its full text could not be found in the databases were excluded.

The time range covered the last 16 years: there were included articles published between 1999 and 2014, either year inclusive.

The categories analyzed were: country of origin, financing institute, scientific magazine in which it has been published, country of origin of the magazine, methodology (quantitative, qualitative, triangulation quali-quantitative); design (quasi-experimental, experimental, no experimental); temporary cut (longitudinal, transversal), publication year, amount of bibliography quoted in different languages (English, in Spanish, other languages).

Results

The search carried out in the four databases showed an amount of 46 scientific articles which study the working memory construct and also complimented the previously specified criteria.

In Table 1 it is presented the information related to the country of origin of the articles.

According to what can be appreciated on the table, the country that presents the biggest production in the last 16 years is Spain, with an amount of 13 published articles. In second place, we find Argentina, with 11 published articles associated with the subject

Table 4. Amount of scientific articles according to used methodology.

METHODOLOGY	N	%
Quantitative	41	89,1
Triangulation Quali-Quantitative	4	8,7
Qualitative	1	2,2
<i>Total</i>	<i>46</i>	<i>100,0</i>

Table 5. Amount of articles according to used design.

DESIGN	N	%
Quasi experimental	22	47,8
Experimental	17	37,0
No experimental	7	15,2
<i>Total</i>	<i>46</i>	<i>100,0</i>

Table 6. Amount of articles according to the time period.

Temporary Cut	N	%
Longitudinal	11	23,9
Transversal	35	76,1
<i>Total</i>	<i>46</i>	<i>100,0</i>

and finally Colombia with 10 articles. Altogether, this three countries, focus the 73,9% of the scientific production on working memory published in indexed Spanish magazines in the last 16 years.

Concerning the financing institutions, Table 2 shows that CONICET (Argentina) is the one that has financed the biggest amount of studies (9 articles). In second place we find the Oviedo University with 4 articles, and the Universidad de la Frontera with 3.

Furthermore, it is possible to observe that besides CONICET, in Argentina there are only two institutions that have conducted studies connected with the subject. In contrast, the articles carried out in Spain and Colombia have been funded by a large number of institutions (8 and 9 institutions respectively).

In Table 3, it is easy to observe the great heterogeneity regarding the magazines from where the analyzed articles come. In spite of that, the more productive has been the magazine “Psicothema” from Spain, with 6 articles, followed by the “Revista Chilena de Neuropsicología” with 4 articles, and the “Revista Argentina de Ciencias del Comportamiento”, with 3 articles.

It is also possible to see the Colombian predominance in terms of quantity of scientific

magazines which have published articles related to the subject: 10 Colombian magazines, compared with an amount of 5 Spanish magazines and only 3 magazines from Argentina, just as Chile also with 3 magazines.

As regards the employed methodology in the analyzed articles (Table 4), it is noted that the largest amount of them used a quantitative methodology (41 articles), while only four articles used methodology triangulation as a strategy, and only one of them used qualitative methodology.

On the other hand, as regards the design (Table 5), it can be seen that the largest amount of the studies were carried out with quasi-experimental designs (22 articles). Other 17 works employed an experimental designed, and finally 7 articles were carried out with no experimental designs.

Table 6 shows a majority of crosscutting works since at least a quarter of the conducted studies have implemented a longitudinal follow up.

In relation to the publication years, it is possible to observe in Table 7 that 2009 and 2012 were the more productive years (with night published articles during the course of each one)².

The most relevant outcome in connection with this index lies in the wide gap between the amount of articles published among the first and the second half

Table 7. Amount of scientific articles according to the publication year.

Publication Year	N	%
1999	1	2,2
2003	2	4,3
2006	4	8,7
2007	1	2,2
2008	1	2,2
2009	9	19,6
2010	7	15,2
2011	4	8,7
2012	9	19,6
2013	7	15,2
2014	1	2,2
Total	46	100,0

Table 8. Amount of bibliographic references in the articles, according to languages.

QUOTED BIBLIOGRAPHY	Total	Mean	%
In English	1412	31	81,4
In Spanish	318	7	18,3
Other Languages	5	0	0,3
Total	1735	38	100,0

of the considered period. Whereas between 1999 and 2006 there were found 7 articles, between 2007 and 2014, it had been registered an amount of 39. This fact could indicate that the productivity has been having a tendency to grow up in the last years, although the result can also have been influenced by the relevance that have gain in the last year the digital media of scientific dissemination.

Finally we can observe, in Table 8, the great impact of English bibliography for the production of studies and articles referred to working memory.

Even though the only articles analyzed were published in Spanish, the references in this language were 318, while the references in English were 1412. Merely 5 references correspond to other languages.

Discussion

The bibliometrics indicators analyzed in this paper, reflect the scientific production connected with the working memory construct, written in Spanish between the years 1999 and 2014. On the basis of the results obtained, it is important to highlight the supremacy of quasi experimental, quantitative and transversal studies. This is in part the result of the

construct's characteristics and its available evaluation instruments. However, in some areas the application of longitudinal monitoring, would encourage an evolutionary understanding of the populations being studied and its results could be more objective than the ones in the transversal studies.

We must also note that the search carried out in the selected databases have shown an amount of 46 articles associated to this topic, reason why it is considered necessary to potentiate the local production in this field. The said potentiation finds meaning when it is consider the importance of the working memory construct study. In this sense, since its operation is conected to the temporary preservance and the information handling, (Hitch, 2002; Baddeley, 1986, 2003), we can anticipate that the performance of this cognitive function, would have an impact direct or indirict, on every process with cognitive request –of medium or hight complexity- realized by a person. For this reason, its study is highly crucial for the following fields: (a) Education: because of its importance in some key processes such as reading and calculation (Baqués & Sáiz, 1999) and its connection with general intelligence measures (Colom & Flores-Mendoza, 2001); (b) Clinical: because of the existence of studies about

the impact of normal aging over the central executive (Burín & Duarte, 2005), of Parkinson's disease over the visual spatial ability (Morris et al., 1988) and of the decline of the working memory in the Alzheimer dementia (Baddeley, Bressi, Della Sala, Logie & Spinnler, 1991); (c) Labour: because of the interest that covers to determinate in which way the professional work models the structure of the nervous system and the cognitive performance. This study field was initiated by the pioneer work which identified that London's taxi drivers –who have to memorize a big number of streets and places of interest in order to obtain their licenses – experiment morphological changes in the hippocampus (Maguire, Frackowiak & Frith, 1997).

Finally, it is in our interest to emphasize that to potentiate the production in this field, it will be crucial to rely on promotion policies from the financing institutions. Those become even more significant given the scientific and intellectual contributions that could be reach and use to create and implement in efficient forms more inclusive social policies. This can only

happen in a satisfactory manner if the people who are responsible for making the decisions consider that science has something to offer for this purpose. If yes, it will be logical and healthy for every country genuinely interested in the human development, to constitute a feedback process in which the social policies would create new investigation questions, new motivations to the scientific development and, in the same sense, that science generates investigations targeted to inform the executive sector, nurturing the scientific and political agenda with new priorities. That is why, the major role of scientific policies is to guide new investigations, generate and orientate them to provide solutions associated to the priorities of each society (Lipina & Álvarez González, 2011).

It is not only desirable to look for an increscent of the scientific production, but also we must try that the new contents will take part in the disciplines training plans. This includes the ones that present a direct link with neuroscience (psychology, neurology and psychiatry) and the ones that, even though having

different areas, can be benefited by their contributions (education science, pedagogy, general medicine, etc). As an example, years ago have been pointed the neuro scientific formation vacancy in the teaching career (Francis Salazar, 2011). In this sense, we consider that the present article contributes to present a general access panorama not only for the investigators in the area, but also to educators and students that are interested in a formation that includes the more recent and relevant improvements of neuroscience. Only in that way, the publications could transcend the specialist ground and promote the social welfare. We invite all the interested actors to reflex on epistemological and disciplinary aspects, but also on the philosophical positioning that contributes to generate a major integration or cohesion between the different knowledge areas.

Received: 10/11/2014

Accepted: 13/04/2015

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