

*Geography and Scales: The place of the concepts of cartographic scale, spatial scale and geographical scale*

*Geografia e Escalas: O lugar das escalas cartográfica, espacial e geográfica*

*Geografía y Escalas: El lugar de las escalas cartográfica, espacial y geográfica*

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**Abstract**

In order to demonstrate the place of the concepts of cartographic scale, spatial scale and geographic scale, and to understand their influence and the meanings they provide, contributions from a bibliometric research are presented. The methodology consisted of exploratory bibliographic research of articles and books, in digital databases available at Google Scholar and Scopus-Elsevier, whose selection privileged a qualitative and quantitative inventory of the published works. As a result, in addition to the spatial aspect, there is an understanding of the scale in terms of philosophical, political and social dimensions. Regarding the use of the concepts in publications, the spatial scale is absolutely the majority. And as for the reflection carried out on the concepts, the idea stands out that, while in Geography there is still some uncertainty regarding the concept of geographical scale, in areas such as Ecology, the adoption of the term “spatial scale” is evident, from the methodological point of view. And, finally, many of the criticisms of the cartographic analogy demonstrate the mistake of associating the map only to the restrictions imposed by its scale.

**Keywords:** scale, spatial scale, geographical scale, cartographic scale.

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**Resumo**

Para demonstrar o lugar dos conceitos das escalas cartográfica, espacial e geográfica, e entender sua influência e os sentidos que lhes são atribuídos, apresentam-se contribuições oriundas de uma pesquisa bibliométrica. A metodologia consistiu em pesquisa bibliográfica exploratória de artigos e livros, em bases digitais disponíveis no Google Scholar e no Scopus-Elsevier, cuja seleção das obras privilegiou um inventário

quali-quantitativo dos trabalhos publicados. Como resultado da análise, destaca-se um entendimento da escala a partir de dimensões filosóficas, políticas e sociais, além do aspecto espacial. Em relação ao uso dos conceitos nas publicações, a escala espacial é absolutamente majoritária. E quanto à reflexão realizada sobre os conceitos, sobressai a ideia de que, enquanto na Geografia há ainda certa indefinição quanto ao conceito de escala geográfica, em áreas como a Ecologia a adoção do termo “escala espacial” é pacífica, ao menos do ponto de vista metodológico. E, por fim, muitas das críticas à analogia cartográfica demonstram o equívoco de associar o mapa apenas às restrições impostas por sua escala de representação.

**Palavras-chave:** escala, escala espacial, escala geográfica, escala cartográfica.

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### Resumen

Para demostrar el lugar de los conceptos de las escalas cartográfica, espacial y geográfica, y para comprender su influencia y sus significados, se presentan aportes de una investigación bibliométrica. La metodología consistió en una búsqueda bibliográfica exploratoria de artículos y libros, en bases digitales disponibles en Google Scholar y Scopus-Elsevier, cuya selección privilegió un inventario cuali-cuantitativo de trabajos publicados. Como resultado del análisis, existe una comprensión de la escala desde las dimensiones filosófica, política y social, además del aspecto espacial. En cuanto al uso de conceptos en las publicaciones, la escala espacial es absolutamente mayoritaria. Y en cuanto a la reflexión realizada sobre los conceptos, se destaca la idea de que, si bien en Geografía aún existe cierta incertidumbre sobre el concepto de escala geográfica, en áreas como Ecología es evidente la adopción del término “escala espacial”, desde el punto de vista metodológico. Y, finalmente, muchas de las críticas a la analogía cartográfica demuestran el error de asociar el mapa solo a las restricciones impuestas por su escala.

**Palabras clave:** escala, escala espacial, escala geográfica, escala cartográfica.

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## Introduction

In many surveys from different areas of science, scale is one of the key concepts. It means an analytical piece of reality, according to its spatial and temporal dimension. According to Castro (1995, p. 127, our translation), “every phenomenon has a dimension of occurrence, and a more appropriate dimension of observation and analysis. Scale is also a measure, not necessarily of the phenomenon, but the one chosen to observe and measure it”.<sup>1</sup>

To Geography, however, this concept has a big relevance, due to its historical association between geographic knowledge and maps, which have scale as a basic element for the representation of the geographical space. Because of this connection, many times the cartographic scale was often assumed to be “the scale of Geography”, which was criticized by several authors, as Racine, Raffestin, and Ruffy (1980), Castro (1995), and Marques and Galo (2009).

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<sup>1</sup> “todo fenômeno tem uma dimensão de ocorrência, de observação e de análise mais apropriada. A escala também é uma medida, mas não necessariamente do fenômeno, mas aquela escolhida para melhor observá-lo, dimensioná-lo e mensurá-lo”.

Despite this, it is possible to consider that many of these disapprovals result from an incomprehension of Cartography's contributions to geographic analysis, which is not restricted to the scale of maps (Oliveira and Romão, 2021).

In addition to the cartographic and geographic scales, another concept permeates this discussion: the **spatial scale**. This word is often confused as synonym of geographic scale, although it is more used in the specific sense of the spatial dimension or extension of a phenomenon.

Finally, it is also important to mention the **time scale**. As stated earlier, all geographic phenomenon has a spatial and a temporal occurrence, therefore, it is possible (and necessary) to understand the phenomenon based on its spatial-temporal dynamics.

With a bibliometric research, this paper aims to use these arguments to demonstrate the place of each concept (cartographic, spatial and geographic scale) in academic publications, and to understand its scope and the meanings attributed by works that adopted such concepts. Since there is no controversy about time scale, assumed as a specific cut of the research temporality (or about the phenomenon manifestation), this concept will be not included in the analysis.

### **Methodological procedures**

An exploratory bibliographical research was made to identify works published as academic articles or books. The selection was based on a line of reasoning that privileged the quali-quantitative inventory of works published and accessible in digital databases. However, it is not a 'state of the art' on the subject, because this choice implies omitting certain publications that are no available in the databases selected or just in printed or even inaccessible versions.

A bibliometric research technique was used exclusively in free access databases on Internet, or those accessible by subscription, at the Federal University of Goiás network. This option is a result of both the large bibliographic production available on digital media, and because of the moment when this article is written, with the social isolation because of the COVID-19 pandemic, which restricted mobility and the access to library collections.

The sources of access were chosen by their coverage and importance as academic search engines and bibliographic databases. The first one was Google Scholar (<https://scholar.google.com/>), recognized as user-friendly platform with a large scope of publications.

According to Noruzi (2005, p. 170), "Google Scholar provides a new method of locating potentially relevant articles on a given subject by identifying subsequent articles that cite a previously published article". The author considers that "In comparison to commercial databases, it complements the researcher's needs by providing access to resources not covered by traditional citation indexes" (Noruzi 2005, p. 180).

The second source used was Scopus Elsevier (<https://www.scopus.com/>), one of the world's largest databases providing abstracts and peer-reviewed literature (SANTOS 2011), but with restricted access to subscribers.

To ensure that all articles were focused on theory, methods or applications of the concept of scale, the search was made only by the titles, with these keywords, in Portuguese, Spanish, French, and English: geographic scale, cartographic scale, spatial scale, spatial scale analysis, and geographic scale analysis. First, the search was made to recognize the number of papers related to each keyword separately. Then, they were combined when searching the databases to select the papers exclusively associated with a theoretical scope.

Due to linguistic similarity, the results for identical words in Portuguese and Spanish were grouped. And it was necessary to do research in English with two correlated words, 'geographic scale' and 'geographical scale', both used in publications. Even though the adjective 'geographical' is the oldest, according to Online Etymology Dictionary (OED, 2020), it has been passed over by the shortest form, 'geographic'. On the other hand, it was not necessary to conduct research in English for the keywords 'spatial scale analysis' or 'geographic/geographical scale analysis', because the results would be the same for 'spatial scale' and 'geographic/geographical scale', respectively.

### **The concepts in the academic production**

The quantitative results were surprising, due to the number of papers with the keywords 'spatial scale' ("*échelle spatiale*", in French, or "*escala espacial*", in Portuguese and Spanish), much higher than the results by 'cartographic scale' and 'geographic/geographical scale', especially in English and French.

#### ***Google Scholar***

Some failures happened with Google Scholar results (Table 1), such as the repetition of an article with two different weblinks, or the inclusion of a publication in another language (e.g.: Portuguese and Spanish), despite the specification made for each search tool. This required a more accurate review of the data, some of them with thousands of results.

However, Google Scholar's results included relevant publications, such as book chapters published only in print, but scanned and posted on a website – although not everyone has the full reading available. It is important to note that no articles were found with the following keywords: 'spatial scale analysis', in Portuguese, Spanish and French, and 'geographic/geographical scale analysis', in Spanish and French.

**Table 1:** Google Scholar search results

<b>Keywords in English</b>	<b>Number of Papers</b>
geographical scale	189
geographic scale	227
cartographic scale	8
map scale	704
spatial scale	3,820
<b>Keywords in Portuguese and Spanish</b>	<b>Number of Papers</b>
<i>escala geográfica (POR and ESP)</i>	51
<i>escala cartográfica (POR and ESP)</i>	21
<i>escala espacial (POR and ESP)</i>	87
<i>escala de análise geográfica (POR)</i>	2
<b>Keywords in French</b>	<b>Number of Papers</b>
<i>échelle géographique</i>	7
<i>échelle cartographique</i>	1
<i>échelle spatiale</i>	56

Source: Google Scholar, in English: <https://scholar.google.com/>, in Portuguese (POR): <https://scholar.google.com.br>, in Spanish (ESP): <https://scholar.google.es/>, and in French: <https://scholar.google.fr/><sup>2</sup>

The number of articles found in Portuguese and Spanish was considerably lower than in English, in all searched terms, but bigger than those in French. The use of English as a *lingua franca* and its dominance in scientific communication (Van Weijen, 2012), or the lack of publications in a particular language when issues are considered overcome, can be hypothetical explanations for these results.

Google Scholar sorts the sequence of results using a relevance factor that considers the citation count, the publication in which the article appears, how often the piece has been cited in other scholarly literature, and the relation between the search term and the complete content of the study (Carvalho, 2019). This explains why the order of articles are not the same as the order of citations count displayed by Google Scholar itself.

Because of the great number of results for some keywords, only the first ten papers associated with a theoretical scope were collected and analyzed. Repeated titles or

<sup>2</sup> Made by the authors with advanced search, realized on April 20<sup>th</sup> and 21<sup>st</sup>, 2020, with the options: “with **all** of the words” and “in the **title** of the article”; “*Encontrar artigos com todas as palavras*” and “*No título do artigo*”; “*tous les mots suivants*” and “*dans le titre de l'article*”.

articles with an applied focus were not considered. **Table 2** presents the articles selected in Portuguese and Spanish, and **Table 3**, the results in English.

**Table 2.** Google Scholar ranking for keywords searched in Portuguese and Spanish

Pos.	Title	Author/Authors	Year
1 <sup>st</sup>	Escala geográfica: da ação ao império?	María Laura Silveira	2004
2 <sup>nd</sup>	A escala geográfica: noção, conceito ou teoria?	Everaldo Santos Melazzo, Cloves Alexandre Castro	2007
3 <sup>rd</sup>	O conceito de escala geográfica nos estudos de mídia regional	Sônia Aguiar	2015
4 <sup>th</sup>	Escala geográfica e escala cartográfica: distinção necessária	Américo José Marques, Maria de Lourdes Bueno Trindade Galo	2009
5 <sup>th</sup>	La escala geográfica como concepto integrador en la comprensión de problemas socio-ambientales	Naxhelli Ruiz Rivera, Leopoldo Galicia	2016
6 <sup>th</sup>	O uso da escala geográfica na saúde pública: as escalas da leishmaniose visceral	Patrícia Sayuri Silvestre Matsumoto, Lourdes Aparecida Zampieri D'Andrea	2019
7 <sup>th</sup>	Escala geográfica e transnacionalização: análise sobre movimentos sociais e de mulheres	Dominique Masson	2006
8 <sup>th</sup>	Escala geográfica, "construção social da escala" e "política de escalas" <sup>1</sup>	Marcelo Lopes de Souza	2013
9 <sup>th</sup>	A escala cartográfica na ponta dos dedos: contribuição das maquetes táteis na construção da noção de proporção no espaço vivido	Flávia Gabriela Domingos Silva	2015
10 <sup>th</sup>	O conceito de escala geográfica e a formação inicial de professores de geografia	Francisco Tomaz de Moura Júnior	2020

<sup>1</sup> Book chapter of Souza (2013), "Os conceitos fundamentais da pesquisa sócio-espacial". Not available for free Internet access. Source: Google Scholar, in Portuguese [<https://scholar.google.com.br>] and Spanish [<https://scholar.google.es/>].<sup>3</sup>

This ranking highlights two things: 1) the absence of references in Portuguese and Spanish literature, such as Castro's (1995) article and Lacoste's (1976) book; and 2) the small number of papers which discuss the cartographic scale concept. The first condition may be because the texts of Castro (1995) and Lacoste (1976) were published only in print and may have a low position in the relevance factor of Google Scholar, compared to the articles presented in Table 2.

<sup>3</sup> Made by the authors with advanced search, realized on April 25<sup>th</sup>, 2020, with the options: "with **all** of the words" and "in the **title** of the article".

In turn, the lack of articles on the cartographic scale can demonstrate the consolidation of the concept, which is used in comparison to the geographic scale, as in Silveira (2004), Melazzo and Castro (2007), and Marques and Galo (2009), or in adapted conditions to other senses, as touch, as proposed by Silva (2015).

**Table 3:** Google Scholar ranking for keywords searched in English

Pos.	Title	Author/Authors	Year
1 <sup>st</sup>	Scale as relation: musical metaphors of geographical scale	Richard Howitt	1998
2 <sup>nd</sup>	Beyond state centrism: space, territoriality, and geograhical scale in globalization studies	Neil Brenner	1999
3 <sup>rd</sup>	Spatial scale problems and geostatistical solutions: a review*	Peter M. Atkinson, Nicholas J. Tate	2010
4 <sup>th</sup>	Ecological and geographical scale: parallels and potential for integration	Nathan F. Sayre	2005
5 <sup>th</sup>	Hierarchies and spatial scale in process geomorphology: a review	Dirk H. de Boer	1992
6 <sup>th</sup>	A world in a grain of sand: towards a reconceptualisation of geographical scale*	Richard Howitt	1993
7 <sup>th</sup>	Exploring Spatial Scale in Geography*	Christopher D. Lloyd	2014
8 <sup>th</sup>	Experienced and Novice Teachers' Concepts of Spatial Scale*	M. Gail Jones, Thomas Tretter, Amy Taylor, Tom Oppewal	2008
9 <sup>th</sup>	Exploring the Effects of Geographic Scale on Spatial Learning	Jiayan Zhao, Mark Simpson, Jan Oliver Wallgrün, Pejman Sajjadi, Alexander Klippel	2020
10 <sup>th</sup>	Basic Theory of Map Scale*	Chuanxin Zhang, Tigao Zhu, Shengwu Hu	2009

\* Not available for free Internet access.

Source: Google Scholar, in English: <https://scholar.google.com/><sup>4</sup>

The Google Scholar results demonstrated the absolute dominance of applied research in the most relevant articles in English. Among the first 200 articles, the absolute majority of them in Ecology, 80% discuss the influence, effects or importance of the spatial scale for understanding a phenomenon. The 9<sup>th</sup> title in Table 3, for example, was just found in the 537<sup>th</sup> position. Unlike accessibility in Portuguese and Spanish, half of the titles in English are not available, either because they are printed books or chapters, or because they are published in journals accessible only by payment.

<sup>4</sup> Made by the authors with advanced search, realized on April 25<sup>th</sup>, 2020, with the options: “with **all** of the words” and “in the **title** of the article”.

Even among the first thousand results, no article using ‘cartographic scale’ in title was found. This confirms the idea of consolidation in the academic literature of the cartographic concept of scale.

Finally, only one article was found in the Google Scholar search in French: *Le choix de l'échelle géographique pour un diagnostic pertinent*, by Gérard-François Dumont, published as a book chapter<sup>5</sup> (Dumont, 2012), unfortunately with restricted access in Internet.

### Scopus-Elsevier

The number of articles found in Scopus databases (Table 4) was much lower than in Google Scholar. But it is important to say that Scopus has a high exigence level to accept indexing of journals, with a policy and selection criteria that must be accomplished. In addition, English is the language of most journals at Scopus, so it was not necessary to prepare tables for the few results in other languages.

**Table 4:** Scopus search results

Key words in English	Number of Papers
geographical scale	178
geographic scale	176
cartographic scale	1
map scale	91
spatial scale	3,126

Source: Scopus Elsevier (<https://www.scopus.com/search/form.uri?display=basic>).<sup>6</sup>

The search with the parameters in Portuguese and Spanish resulted in only 3 articles for the keywords “escala geográfica”. On the other hand, in French one article was found for “*échelle géographique*”, two for “*échelle cartographique*” e six for “*échelle spatiale*”. But just one of these twelve articles (RIVERA; GALÍCIA, 2016) refers to a conceptual discussion about ‘geographical scale’.

Similar to Google Scholar, the number of articles with ‘spatial scale’ was dominant in Scopus’ results, and the absolute majority of then in applied research. Just 10 articles with a theoretical-conceptual scope were found (Table 5). Among the more than 3,000 titles consulted, the first two selected articles (Brenner, 1999 and 1998) were found

<sup>5</sup> DUMONT, G.-F. *Diagnostic et gouvernance des territoires: concepts, méthode, application*. Paris: Armand Colin, 2012.

<sup>6</sup> Made by the authors, with advanced search realized on April 20<sup>th</sup> and 21<sup>st</sup>, 2020, with the options: TITLE (“key word”) AND (LIMIT-TO (LANGUAGE, “English”)).



in the 7<sup>th</sup> and 14<sup>th</sup> positions of Scopus results list. And the 3<sup>rd</sup> title (Howitt, 1998), just in the 51<sup>st</sup> position.

**Table 5:** Scopus ranking for keywords researched in English, Portuguese, Spanish and French

Seq.	Título	Autor(es)	Ano
1 <sup>st</sup>	Beyond state-centrism? Space, territoriality, and geographical scale in globalization studies	Neil Brenner	1999
2 <sup>nd</sup>	Between fixity and motion: accumulation, territorial organization and the historical geography of spatial scales	Neil Brenner	1998
3 <sup>rd</sup>	Scale as relation: musical metaphors of geographical scale	Richard Howitt	1998
4 <sup>th</sup>	Ecological and geographical scale: Parallels and potential for integration	Nathan F. Sayre	2005
5 <sup>th</sup>	Hierarchies and spatial scale in process geomorphology: a review	Dirk H. de Boer	1992
6 <sup>th</sup>	A world in a grain of sand: towards a reconceptualization of geographical scale*	Richard Howitt	1993
7 <sup>th</sup>	Understanding spatial concepts at the geographic scale without the use of vision	Robert M. Kitchin, Mark Blades, Reginald G. Golledge	1997
8 <sup>th</sup>	The paradox of geographical scale in Marx's politics*	Peter J. Taylor	1987
9 <sup>th</sup>	La escala geográfica como concepto integrador en la comprensión de problemas socio-ambientales	Naxhelli Ruiz Rivera, Leopoldo Galicia	2016
10 <sup>th</sup>	Exploring the Effects of Geographic Scale on Spatial Learning	Jiayan Zhao, Mark Simpson, Jan Oliver Wallgrün, Pejman Sajjadi, Alexander Klippel	2020

\* Not available for free Internet access.

Source: Scopus Elsevier (<https://www.scopus.com/search/form.uri?display=basic>).<sup>7</sup>

Scopus results are almost the same as Google Scholar for English search, but with a different ranking. This demonstrate that relevance factor used by Google Scholar attenuates the weight of citation count, the only criterion used by Scopus to rank the articles. As previously mentioned, the Scopus database is mostly in English, which may explain the absence of titles in other languages among the most cited. The only exception is the article by Rivera and Galicia (2016), in Spanish, which also appears on the Google Scholar list.

<sup>7</sup> Made by the authors, with advanced search realized on April 20<sup>th</sup> and 21<sup>st</sup>, 2020.

## Contributions from the selected articles

In the analysis, the articles selected from Google Scholar and Scopus-Elsevier are presented in chronological order of publication, regardless of the language.

The oldest of the articles is by De Boer (1992), which presented a literature review of hierarchies and spatial scale in process geomorphology. The author assumes a dimensional conception of scale, as a space-time extension of a phenomenon, very similar to the proposition of Cailleux and Tricart (1996), even though De Boer (1992) never cites any French authors – in a selective exclusion that seems common in the Anglo-Saxon literature, as pointed out by Souza (2013).

Kitchin, Blades and Golledge (1997) also made a review of literature to determine the spatial understanding of people with visual impairments or blindness. The authors point out that most of the research has been conducted using small-scale spaces, and, because of that, “we are still unsure as to how people with visual impairments and blindness learn, store and process spatial information at the geographic scale” (Kitchin, Blades and Golledge, 1997, p. 225).

Howitt (1998), in a short and didactic article, presents three important metaphors about scale: 1) as ‘size’, that is, the map scale as a metaphor for geographic scale; 2) as ‘level’, or a pyramid metaphor for geographic scale, which refers to the idea of levels of complexity, or more simply to a level in a hierarchy; and 3) as a ‘relation’, in which the author draws an interesting parallel with music to demonstrate that the change of scale does not change the nature of notes (their tonality), but changes the relationship between the elements brought together ( the musical totality). Thus,

in a geographical totality, many elements will remain consistent in a geographical analysis that spans across different geographical scales. What changes in such analysis is not the elements themselves (the features on a landscape, the sites involved in a production process, the ecological processes affecting a social formation, the cultural practices performed by people), but the relationships that we perceive between them and the ways in which we might emphasize specific elements for analytical attention. What we emphasize at one scale may not be what we emphasize at another (Howitt, 1998, p. 55).

Howitt (1998) concludes his reasoning by informing that in the real world of geopolitics, scale is a foundational element, with scale politics of spatiality made by governments, corporations and non-government organizations – idea that refers to Lacoste (1976) –, which simultaneously construct different identities at different scales using precisely the same elements. Therefore, this should lead us to rethink the relationship between geographical research and social action, and “urgently tackle the crucial questions of how to act at multiple scales simultaneously; how to think globally and act locally, at the same time as thinking locally and acting globally (and at other scales simultaneously)” (Howitt, 1998, p. 56).

Brenner's (1998, 1999) articles are an exception to the francophobia of Anglo-Saxon authors. At the beginning of the article written in 1998, the author uses Lefebvre's texts to highlight the importance of scale. He also recognizes the increase of research about scale in 1990's, concerning the appropriate spatiotemporal unit of analysis and level of abstraction for empirical-historical research; processes of re-scaling as central dimensions of worldwide capitalist restructuring; the importance of scale for strategies of social and political transformation; the role in discursive-ideological struggles for hegemonic control over social and political space; and about the political construction of scale, that is, the scales on which political processes are organized and the concomitant struggles of social actors, movements, and institutions to influence their locational structure, territorial extension, and qualitative organization.

Brenner (1998) argues that scale structures both of cities and of territorial states have been molded ever more directly by the contradiction between fixity and motion in the circulation of capital. Supported in the production of Lefebvre and David Harvey, the author concludes that the current globalization can be interpreted as a multidimensional process of re-scaling, in which cities and states are being reterritorialized in the conflictual search for scalar fixes, at a level he called 'glocal'.

In the article by 1999, Brenner rescues the idea that the current round of globalization presents a reconfiguration of superimposed social spaces that unfolds simultaneously upon multiple geographical scales. According to the author, this process has decentered the national scale of social relations and intensified the importance of both sub- and supranational scales of territorial organization. Thus, the resultant methodological challenge is "to conceive configurations of geographical scales at once as the territorial scaffolding within which the dialectic of de- and reterritorialization unfolds and as the historically produced, incessantly changing medium of that dialectic" (Brenner, 1999, p. 69).

The best positioned article in the Google Scholar ranking for the search in Portuguese was Silveira (2004). Based in Grataloup (1979), Racine, Raffestin and Ruffi (1980), and Castro (1995), the author also highlighted the "inconvenience of the analogy between cartographic scale and geographic scale", because this reiterates the existence of "a geometric conception of space". Even though she recognizes the importance of the cartographic scale as a "technical and methodological foundation" (Silveira, 2009, p. 88, our translation<sup>8</sup>).

In turn, according to Melazzo and Castro (2007), the cartographic scale consists of a mathematical measure that is capable of a dual purpose: on the one hand, to establish the proportion between things; on the other hand, a relationship between the map and the true dimension in the place, whose notion would be equivalent to "a strategy for

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<sup>8</sup> "inconveniência da analogia escala cartográfica - escala geográfica"; "uma concepção geométrica do espaço"; "fundamento técnico e metodológico".

reproducing of a previous and already given reality”<sup>9</sup> (Melazzo and Castro, 2007, p. 136, our translation).

The words “given reality” are suggested as “a notion that reality would be immutable [in the maps]”<sup>10</sup> (Melazzo and Castro, 2007, p. 136, our translation). In this case, the word ‘immutable’ demonstrates an incomprehension about the maps’ ability to reveal the temporal and spatial dynamics of a phenomenon.

In addition, the use of the word ‘reproduction’ by Melazzo and Castro (2007) gives the idea that reality can be duplicated on the map, with the scale being the only reference considered. However, on the contrary, the cartography does not wish to duplicate reality, since it is necessary to choose what should be represented or should be hidden on a map.

By contrast, according to Marques and Galo (2009, p. 48, our translation), “there is no lecture on a map without determining the scale, just as there is no analysis of a phenomenon if the geographic scale is not clearly known”<sup>11</sup>. Discussing research carried out in Landscape Ecology, the authors highlight the fact that “it is necessary to consider the area of occurrence of a phenomenon”, indicating a clear conception of the geographical scale related to the extension of that area.

As a result, Marques and Galo (2009, p. 49, our translation) assume the idea that there is an inverse relationship between cartographic scale and geographic scale, since “the larger the area of a phenomenon, the smaller the cartographic scale used to its representation”<sup>12</sup>, and vice versa. However, the authors treat the time scale as a concept separate from geographic scale, although they discuss levels of hierarchy, comparing the spatial dimension with the time of occurrence of the phenomena.

The next article, by Sayre (2005), intends to establish a bridge between the discussions about scale in Ecology and Human Geography. Analyzing the ontological and epistemological characteristics of scale, the author states that scale, in a more technical sense, however, is an attribute of how one observes something rather than of the thing observed.

Arguing in favor the dialogue between Ecology and Human Geography concerning the definition of scale and level, Sayre (2005, p. 286) says that

the epistemological basis for distinguishing among biological levels is processes that can be identified and studied: the growth of a plant, for example, or competition among neighboring plants for limited

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<sup>9</sup> “uma estratégia de reprodução de uma realidade anterior e já dada”.

<sup>10</sup> “a noção de que a realidade seria também imutável”.

<sup>11</sup> “não há leitura em um mapa sem determinação da escala, assim como não há análise de fenômenos sem que seja esclarecida a escala geográfica adotada”; “é necessário considerar a área de ocorrência de determinado fenômeno”.

<sup>12</sup> “quanto maior for a área compreendida por um fenômeno, menor deverá ser a escala cartográfica adequada para a sua representação”.

resources. In the same way, geographers delimit levels of social organization in terms of processes such as capital circulation, governance, social reproduction, consumption and so forth.

Sayre (2005) also criticizes the fact that in most of the literature on the subject, the words 'scale' and 'level' are used indistinctly – as, indeed, was done by Souza (2013). He cites the texts by Sallie Marston, Neil Smith, Neil Brenner, and others, to demonstrate some conceptual errors about discussions of politics of scale, urban scale, re-scaling, and other subjects.

Finally, the author recognizes that we cannot postulate hierarchical relationships among the levels, especially for social processes, because “political and economic institutions can be created, modified or suspended, for example, in ways that biologic processes generally cannot” (Sayre, 2005, p. 286).

Another author, Masson (2006, p. 445, our translation), intend “to explore the potential of the new contributions of Political and Human Geography that place the issue of scale in the foreground, as a central spatial dimension of the processes by which the transnationalization of collective action takes place”<sup>13</sup>. Therefore, the author understands the scale as spatial property of social relations: the scale would be the spread of the scope of diverse economic and political processes that organize the social relations and social life, through different (and variable) extensions of space.

In the next article, Souza (2013), like other authors, adopts a critical discussion in relation to the cartographic scale, emphasizing the need for “emancipation of the scalar reasoning beyond the narrow limits of Cartography [...] in the socio-spatial research” (Souza, 2013, p. 183). Regarding the geographic scale, the author proposes that it must be subdivided into the scale of phenomenon (the physical extent or the related processes to the phenomenon), scale of analysis (the analytical level of apprehension of the phenomenon) and scale of action (the reasoning on the spatial reach of the practices of social agents).

Souza (2013) also recovers the contribution of Lacoste and other authors by Castro (1995). In addition, he highlights Bahiana's master's dissertation (1986) and presents an extensive production of Anglo-Saxon origin on the theme 'scale'. Although initially considering an error “the identification of a fixed and constant number of levels”<sup>14</sup> for the scale in the socio-spatial scope (Souza, 2013, p. 187-188, our translation), the author presents at the end his proposition of typology, but not as “a rigid framework of references”. This typology, in his words, “is subject to several improvements” (p. 199), and adopts an indistinction between 'scale' or 'level'. It starts with the scale (or level) of the body; then the scale (or level) of nanoterritories; the local scale (or level), subdivided in micro, meso and macro-local; the regional scale (or level);

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<sup>13</sup> “explorar o potencial de novas contribuições da geografia política e humana que coloquem a questão da escala em primeiro plano, como uma dimensão espacial central dos processos pelos quais se realiza a transnacionalização da ação coletiva”.

<sup>14</sup> “a identificação de um número fixo e constante de níveis”.

the national scale (or level); and finally, the international scale (or level), also subdivided in “group of countries” or “global”.

The article by Aguiar (2015) mainly combines the reflections of Castro (1995) and Souza (2013), resulting in the idea that scale typologies are only able to guide the choice of levels of analysis. The author considers the scale as “a two-way methodological instrument, that can start from both the local (city, village, neighborhood, block, street, etc.) or the global totality (world, nation, region, place)”<sup>15</sup> (Aguiar, 2015, p. 6, our translation).

Silva’s master’s dissertation (2015) was the only work selected in the research that deals with the concept of cartographic scale. One of the ideas presented by the author is that the restrictions of mathematical proportions are at the origins of the students’ difficulties with the understanding of cartographic scale. However, she highlights that the understanding of proportionality is built, first, in non-quantified terms, from first-order relationships (comparisons among parties and, subsequently, between parties and the totality) and second relationships order (comparisons of the first-order relationships with each other).

The article by Rivera and Galicia (2016) also presents an important contribution from the Anglo-Saxon literature on scale. They begin the text by pointing out that scale “is defined more than as an attribute of the scientific observation of the object, than as an intrinsic dimension of the observed object”<sup>16</sup> (Rivera and Galicia, 2016, p. 138, our translation). Based mainly on the articles by Gibson, Ostrom and Ahn (2000) and McMaster and Sheppard (2004), the authors synthesize that

the scale represents a set of spatial relationships between elements organized in different types of hierarchical relationships, which are observed through an extension and a specific resolution. The scale is an epistemological instrument for identifying, observing and interpreting the emergent properties of the phenomena to be studied<sup>17</sup> (Rivera and Galicia, 2016, p. 142, our translation).

Matsumoto and D’Andrea (2019, p. 3826) present an important review of literature on the concept of scale, in which they state that “there is still little discussion on geographic scale in health, in a conception that goes beyond the material notion”. The article discusses the concept of scale based on authors already cited, as Racine, Raffestin and Ruff (1983), Bahiana (1986), Castro (1995), Melazzo and Castro (2007) and Souza (2013), and adds the work of Smith (2000). Matsumoto and D’Andrea (2019, p. 3827)

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<sup>15</sup> “um instrumento metodológico de mão dupla, que pode partir dos desdobramentos do lugar (cidade, aldeia, bairro, quarteirão, rua etc.) ou da totalidade global (mundo, nação, região, lugar)”.

<sup>16</sup> “la escala es definida como un atributo de la observación científica del objeto, más que como una dimensión intrínseca al objeto observado”.

<sup>17</sup> “la escala representa un conjunto de relaciones espaciales entre elementos organizados en diferentes tipos de relaciones jerárquicas, los cuales son observados a través de una extensión y una resolución específicas. La escala es el instrumento epistemológico para identificar, observar e interpretar las propiedades emergentes de los fenómenos a estudiar”.

believe in an inseparability between cartographic and geographic scales, stating that “the geographic scale brings subjectivity and other meanings in addition to materiality, but there will always be a material representation, which is formalized in the cartographic scale”<sup>18</sup>.

Moura Júnior’s master’s dissertation (2020) was the last text found in the research in Portuguese and Spanish, and it also makes use of contrast between cartographic and geographic scales, anchored in Castro (1995), Marques and Galo (2009) and other authors. He states that “while the cartographic scale is a fixed, momentary and punctual representation, the geographic scale is historically produced, changing over time, being procedural and contradictory” (Moura Júnior, 2020, p. 51, our translation).

In the analysis of the concept of geographic scale, Moura Júnior (2020, p. 53, our translation) relies on the reflections of Neil Smith, one of the great references of the theoretical reflection on scale as a social and political product. He uses the Vieira’s (2012) article to list what would be the central points of Smith’s theory:

- 1) the scale is produced socially; 2) socio-spatial phenomena are always multiscale; 3) the geographic scales are different from each other and hierarchically ordered, even this hierarchy is not so rigid ; 4) the differences provide different meanings for the scales: local, regional, national, and global; 5) the different meanings can be coincident, but never identical; 6) the factor that guides the production of scale is the capital/labor ratio, although without disregarding the socio-cultural dimension of social relations; 7) the production of scale, from the relationship between capital and labor, is contradictory and non-linear.<sup>19</sup>

Finally, the last text analyzed, from the research carried out on Google Scholar and Scopus-Elsevier, is the article by Zhao et al. (2020), which also refers to a discussion on the concept of geographical scale in the teaching-learning area. However, despite the authors citing the article by Sayre (2005), which has a refined definition of scale, the concept they adopt is the same as that of spatial scale, that is, “which refers to the spatial extent of a phenomenon or a study” (Zhao et. al., 2020).

Based on a notion of scale as a “spatial extent visually accessible from a single viewpoint”, the authors carried out experiments with people with high and low spatial ability, to compare how the visual accessibility of an environment affects spatial learning.

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<sup>18</sup> “a escala geográfica traz subjetividade e outras acepções além da materialidade, mas sempre terá uma representação material, que se traduz na escala cartográfica”.

<sup>19</sup> 1) a escala geográfica é produzida socialmente; 2) os fenômenos socioespaciais são sempre multiescalares; 3) as escalas geográficas são diferentes em si e estão ordenadas hierarquicamente, ainda que essa hierarquia não seja totalmente rígida; 4) as diferenças proporcionam diferentes significados às escalas: local, regional, nacional e global; 5) os significados diferentes podem ser coincidentes, mas nunca idênticos; 6) o fator direcionador da produção da escala é a relação capital/trabalho sem, contudo, desconsiderar a dimensão sociocultural das relações sociais; 7) a produção da escala, a partir da relação capital/trabalho, é contraditória e não-linear

They conclude that an increased scale of the environment (visible from an elevated perspective) can assist in spatial learning, especially for people with low spatial ability.

## Conclusions

The selected texts pointed out that there is still a lack of definition in Geography about the concept of geographic scale, in contrast to other areas, such as Ecology, where the theoretical-conceptual problem about the scale is already solved with the adoption of the 'spatial scale', which has a dimensional sense, of extension of a phenomenon – although the 'ecologic scale' does not have only a dimensional aspect, as demonstrated by Sayre (2005).

The results of the bibliometric research provided many other references on the discussions of scale in the political and social sphere, as Bahiana (1986), Smith (1992, 2002), Delaney and Leitner (1997), Marston (2000), Marston et al. (2005), and Moore (2008). Interesting texts were also found discussing the relationship between scale, space and time, as Meentemeyer (1989), Fresco and Kroonenberg (1992), and Grataloup (2003). Or approaches to scale in various aspects, such as the article by Gibson, Ostrom and Ahn (2000), and the collection organized by Sheppard and McMaster (2004). But unfortunately, it will be impossible to discuss such texts here.

In other article (Oliveira and Romão, 2021), we presented our contribution to this subject, making a comparison between cartographic and geographic scales, as well as their relationships with the spatial scale. We conclude that the 'scale' construct contains the geographical scale, and this, in turn, integrates the spatial and cartographic scales.

[...] the spatial and cartographic scales do not combine to form the geographic scale, since they respond only to the dimensional aspect, due to the extension of the phenomenon or its representation, respectively. As shown in the bibliographic production in the field of Cartography, maps are representations that contemplate only a part of reality: the one which interests the cartographer-geographer, and of which the scale (of the mapping) indicates only one of the clippings. For this reason, the cartographic scale is not totally juxtaposed to the spatial scale – and even less to the geographical scale.<sup>20</sup>

The texts highlighted in the databases demonstrate the interest in understanding the scale from the ontological point of view. In this regard, qualifying the type of the scale is even more necessary when trying to understand the scope of the reference used. And it

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<sup>20</sup> [...] as escalas espacial e cartográfica não se combinam para formar a escala geográfica, pois elas respondem tão somente ao aspecto dimensional, em função da extensão do fenômeno ou de sua representação, respectivamente. E conforme já bem demonstrado na produção bibliográfica no campo da Cartografia, os mapas são representações que contemplam apenas uma parte da realidade: aquela que interessa ao cartógrafo-geógrafo, e da qual a escala (do mapeamento) indica apenas um dos recortes. Por isso mesmo, a escala cartográfica não se juxtapõe totalmente à escala espacial – e menos ainda à escala geográfica.



is important to say that the contrast between geographic scale and cartographic scale is almost nonexistent in the articles in English.

Last but not least, it is necessary to emphasize the fact that geographic analysis using maps is not limited to the restrictions imposed by the cartographic scale. From the processing of data and information, the cartographic language has great capacity for analysis or synthesis, when creating images that reveal the geography of the phenomena. In fact, the cartographic scale influences the level of representation, but does not determine the scope of information on a map.

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