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L'identification des chorèmes dans les cartes mentales pour mieux comprendre les représentations socio-spatiales

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Introduction

1 In a recent review of the literature, Gieseking (2013) shows that mental maps have been studied through a wide diversity of analytical methods (57 identified) over the course of the last sixty years. They stand at the intersection of disciplines that each accords them a slightly different meaning.

2 Mental maps are understood here as physical, hand-drawn maps on a blank sheet of paper where the subject expresses, graphically, a subjective reality of space using individual and social memory. These maps, which help us to organize spatial information, have a long history in geography (Gueben-Venière, 2011). Many authors have demonstrated their value from a primarily cognitive perspective (Gould and White, 1974; Kitchin, 1994; Gärling and Golledge, 2000). More recently, many studies have expressed a renewed interest in the use of mental maps, pointing to their relevance in a social approach to a variety of themes: the identification of key spaces in a city (Brennan-Horley, 2010), exploring collective memory of a city (Haas *et al.*, 2011), analyzing the influence of geographic cognition on foreign policy (Da Vinha, 2012), developing future

scenarios (Goodier and Soetanto, 2013), opposing views (Hervé *et al.*, 2014) or highlighting a conflict over land (Reuchamps *et al.,* 2014) represent a few examples of alternate perspectives.

3 This variety shows that it is necessary to overcome disciplinary divides to better understand mental maps, in particular, the divide between geography and social psychology. These two disciplines commonly use mental maps. Although their approaches are rarely directly linked, they generate rich theoretical frameworks that can be combined to provide support to an innovative understanding of mental maps. However, these methods have not fully explored one dimension of mental maps: the link between spatial organization principles (as studied by geographers), drawn by individuals, and their socio-spatial representations (as studied by environmental and social psychologists).

4 We address this dimension here in our methodological approach to mental maps, illustrated through our research on veterinary students' career choices for rural practices. This article describes an innovative analysis of mental maps to better understand how the expression of spatial organization (in this case of rural areas) may be a marker of students' socio-spatial representations. After a presentation of our theoretical approach, we will focus on the method developed to analyze mental maps, the results of that analysis, and its potential in the study of socio-spatial representations.

Theory

5 We want to understand how individuals apprehended space, especially as expressed on mental maps. It is important to make a difference between the "representation of space", as the interpretive filter of an individual, and a "spatial representation", as the graphical expression of that representation. We extend a spatial method to social space in order to explain socio-spatial representations from a wider perspective.

Socio-spatial representations

6 Over the last forty years, research on representations of space has advanced beyond traditional physicalist (Lynch, 1960) or cognitive (Downs and Stea, 1973, Cauvin, 1984) approaches. In the 1970s, francophone research on the subject developed into a school of thought based on the "geography of representations" as seen in the work of Bailly (1985) and earlier work in psychology by Milgram and Jodelet (1976). Studies began to underline the need to account for the construction of an individual's space representations in order to understand their geographical reality. In particular, authors highlighted the need to understand social influences on the way individuals perceive space (Bailly and Debarbieux, 1991). Moles and Rohmer (1998) refer to space as a metaphor for the social system, and maintained that research needs to adopt an approach that goes beyond separate perspectives of geography and psychology. The social environment gives structure to subjective experiences and the memory of space (Haas, 2002; 2004). Thus, representations are not a simple product of the treatment of mechanical information. They are socially constructed by a social subject according to his goals and his understanding of the meanings of space. Social issues can be addressed in two ways, where the environment becomes socio-physical, and the individual becomes a social subject (Jodelet, 1982). The socio-cultural dimension is integrated in the relationship

between the individual and the environment: the approach becomes transactional (Heft, 2013). Representations are not simply developed through the influence of space on the social environment but through the exchanges occurring between them (Depeau and Ramadier, 2011; Dias and Ramadier, 2015). As expressed by Jodelet (1982), space is an active construction by the subject that is mediated by the meanings conferred on a space, the subject's goals, and the social rules governing that space. It is the individuals who give meaning to this space, endowing it with their own personal experiences and events from their collective history.

7 Ramadier *et al.* (2008) present this view shared between geography and psychology by exposing the processes of internalizing and externalizing representations. Individuals encode the environment both through their direct experience with that environment and through the prism of their social groups. This internalization produces representations of space. Similarly, individuals transform their environment through an externalized spatial construction. The transformed space is thus the product of these two processes. All social practices and socio-spatial representations can be described by these internalization and externalization processes (Ramadier *et al.*, 2008).

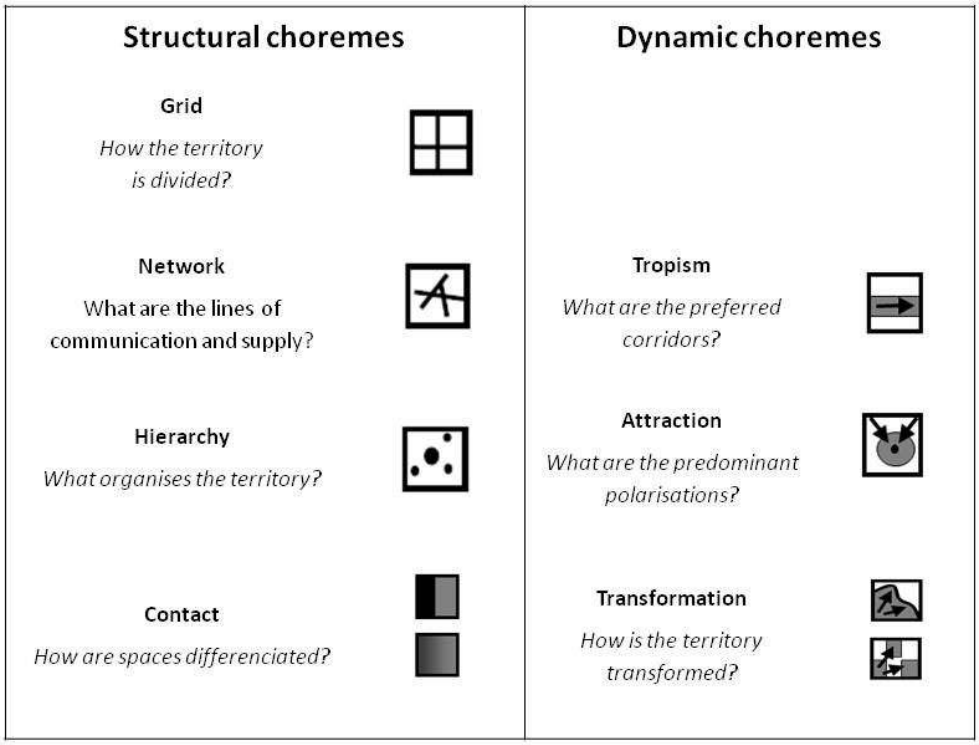
Space organization principles in choremes

8 This transactional perspective gives meaning to the space through the "inputs" and "outputs" in the social system as noted by Brunet (1980), who contends that societies need to organize space around their activities to ensure the reproduction of those activities. Thus, space acts not only as the environment but also as an element in the processes ensuring production and reproduction of society's activities. Spatial organization can be explained by linking places in networks where flows circulate. To understand this organization, Brunet (1986) proposes an analysis through the use of choremes, which he defines as basic structures of space represented in a graphical form (p. 2). Brunet used the term "abstractions". He created an alphabet of elementary choremes which are used in combinations to reflect spatial organizations (Brunet, 1986).

9 Brunet, Ferras, and Théry (1992) apply this concept to the notion of cognitive space which is shown as a function of personal knowledge or practices. It is a living space where physical arrangements or accommodations of space, and related practices impact mental representations. For the authors (p. 428), these representations are individual but more or less determined by cultures, information and even myths and collective representations. A number of authors have used choremes to analyse spatial organization of a territory and the diversity of representations of the territory. They use the term territory as the appropriation (economic, ideological, political and social) of a space by groups in a representation of themselves and their history (Di Meo, 1996). This sense of territory includes the material and symbolic resources capable of structuring the practical existence of individuals and can be considered as a creator of identity (Debarbieux, 2003). Deffontaines et al. (1990) have used choremes to analyse spatial organization of a territory and to understand the individuals' spatial strategy and the diversity of their representations of the territory. Benoit et al. (2006) have combined chorems with others methods (such as landscape analysis, farm typologies) to make a territorial diagnosis. In territory management, Lardon and Piveteau (2005) proposed a grid of choremes that distinguishes structures (considered space objects) and dynamics

(spatial processes in which these objects are identified) as seven principles of space organization (figure 1).

Figure 1: Table of choremes[1] adapted from Lardon and Piveteau (2005).



10 These principles and various combinations of them are used to construct forms of spatial organization (Mérenne-Choumaker, 1999) and to interpret representations of space (Grataloup, 1993).This grid of space organization principles can be used to analyze the spatial representations of individuals, as seen in earlier analytical work. Brau (2002) examined representations of the concerns of individuals involved in land management institutions. Warrot (2003) uses these principles to study elected officials' visions for future intermunicipal changes. Le Ber and Brassac (2008) coordinated a multi-disciplinary and longitudinal experiment using a spatial tool based on the chorematic method (Le Ber et al., 2005) to model and compare the spatial organization of farms. The work of Brassac (2004) formalized both the steps of the modeling process, and the filming procedures that were set up by psychologists and linguists in order to reveal and analyze the underlying knowledge-building process. Based on this theoretical research, we used the grid of principles of space organization to describe and better understand socio-spatial representations in students' mental maps.

Choremes to mark socio-spatial representations

11 We place choremes in a psychosocial approach to space. Reimer and Fohringer (2010) have shown the multiplicity of ways in which choremes can be used through a variety of supports, and especially mental maps. As Depeau (2006) noted, mental maps can help us to understand practices at the individual level, but above all, to apprehend the spatial issues between social groups. The use of principles of space organization reflects the processes of internalizing and externalizing space as described by Ramadier *et al.* (2008).

There are simple mechanisms of social space that social individuals externalize in mental maps, reflecting their representation of space. Indeed, during their lives, individuals incorporate references to space that are anchored socially. These elements are structural. For example, they could be representations of varying distances between remote locations, the density of transport networks, or the organization of space (farming areas, suburbs, urban centers, etc.). These elements are also dynamic. For example, individuals might represent the attractiveness of one city as compared to another or the effect of population displacement (suburbanization, rural desertification, etc.). The choremes are thus markers of these different elements that make up the socio-spatial representations of individuals.

12 We test the hypothesis that the organization of spatial elements can be identified in mental maps as a marker of socio-spatial representations built by social individuals. To this end, we submit mental maps to these space organization principles in a socio-cognitive approach. With this analysis, the theory of social representations can provide a reliable and effective framework to interpret mental maps using choremes.

Materials and Methods

Population and sample

13 We used research on the shortage of health care professionals in rural areas affecting veterinarians as the basis for testing our hypothesis. The purpose of this research is to understand how socio-spatial representations in rural areas may influence students' professional projects in veterinary education. Our sample consisted of students with similar and paired profiles in the parent population of 672 students (as shown in Table 1) from the VetAgro Sup veterinary school and preparatory classes near Lyon, France. The sample is composed of 72 participants (54 women and 18 men) recruited on a voluntary basis. This gender distribution is reflective of the veterinary school. The average age is 22.3 years and the students represent a complete range of the French veterinary curriculum (9 students in preparatory classes, 15 first-year students, 12 second-year students, 16 third-year students, 11 fourth-year students, and 9 fifth-year students). To account for the socio-spatial influence, we have collected three additional criteria: their childhood environment (equilibrated between rural and urban or semi-urban areas), the competitive exams to enter a veterinary curriculum[2] (the distribution respects national statistics) and the sector of practice desired after completing the veterinary curriculum[3] (to avoid the bias of only having students who aspire for rural practices).

Table 1: Sample (n=72) characteristics and original population (n= 672)

Year in curriculum		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**	**%**	**Parent population**	**%**
Gender	Female	6	9	7	15	9	8	54	75 %	504	75 %
	Male	3	6	5	1	2	1	18	25 %	168	25 %
Average age		19.4	21.3	22.5	22.7	23.8	24.2	22.3			

Childhood environment	Rural	5	4	6	7	3	5	30	42 %	207	31 %
	Semi-urban	4	9	4	7	4	4	32	44 %	298	44 %
	Urban	0	2	2	2	4	0	10	14 %	167	25 %
Successful completion of National exam	A	5	9	7	13	10	8	52	72 %	566	84 %
	B	4	2	1	2	0	1	10	14 %	66	10 %
	C	0	3	4	1	1	0	9	13 %	36	5 %
	D	0	1	0	0	0	0	1	1 %	4	1 %
Sector desired. (dominant)	Pets	2	4	2	7	3	3	21	29 %	271	40 %
	Rural	4	7	6	7	4	2	30	42 %	150	22 %
	Equine	2	1	2	2	2	3	12	17 %	140	21 %
	Others	1	3	2	0	2	1	9	13 %	111	17 %
Total		9	15	12	16	11	9	72		672	

Implementation

14 The research was conducted between March and June 2013. The participants were recruited by email on their campus. They were told that our research team was investigating veterinary students' representation of veterinary activities.

15 The use of mental maps was focused on understanding how students consider veterinary activity in rural areas. We used a single statement directing students to make a drawing: " *Draw your representation of the territory of a rural veterinarian's practice*"[4]. Each drawing was made individually in the presence of a researcher. The student was given a white A4 sheet of paper and a mono-color pen. He could orient the paper however he wanted and there was no time limit for drawing (average time: 3.8 minutes, σ: 1.32 minute). We chose a quiet, familiar environment in a campus office. The students were asked to comment during their drawing, and this discourse was recorded. At the end of the exercise, we assembled each drawing with the linked audio recording and anonymized them with a code. The discourses on the drawings were transcribed and encoded with an anonymous code and the socio-demographic variables (gender, age, year of study, entrance test admission, desired field of study and family neighborhood). We consider the mental map to be the entire collection of data - drawing, sound recording and transcription.

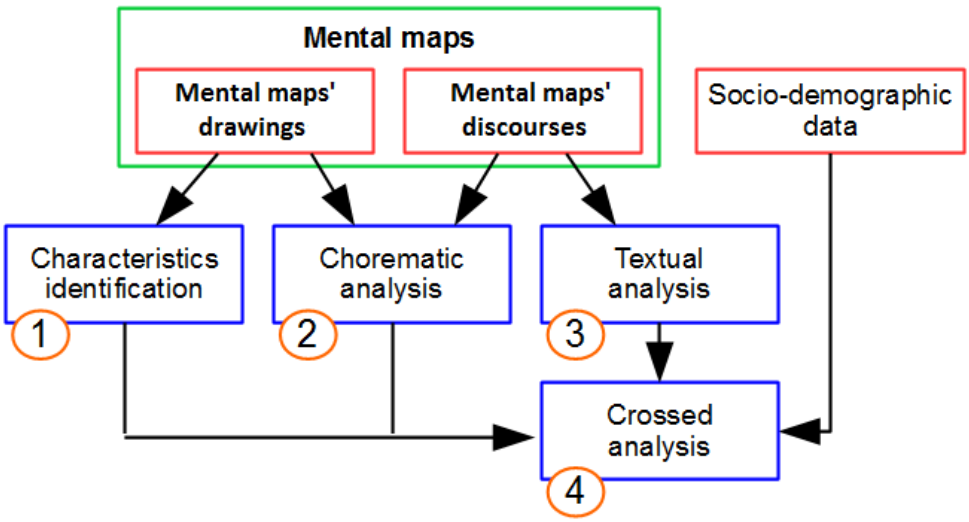
16 All stages of the exercise were pre-tested on a sample of seven students from the same population to ensure their understanding of instructions, the appropriateness of the induction statement, and their drawing capability.

Results

Data analysis

17 The analysis of mental maps is based on a combination of several methodological tools developed from our theoretical approach. We follow four steps, presented here in figure 2: an identification of drawing characteristics, a chorematic analysis of drawings and discourses, a textual analysis of the discourse, and a cross analysis of the data from the previous steps and the socio-demographic data.

Figure 2: Schematization of methodological treatments of mental maps.



18 Our objective was to identify the emergence of representational elements in the discourse, and to understand their relationships with choremes. We used these observations to explain the links between socio-spatial representations and space organization principles.

Identification of drawing characteristics

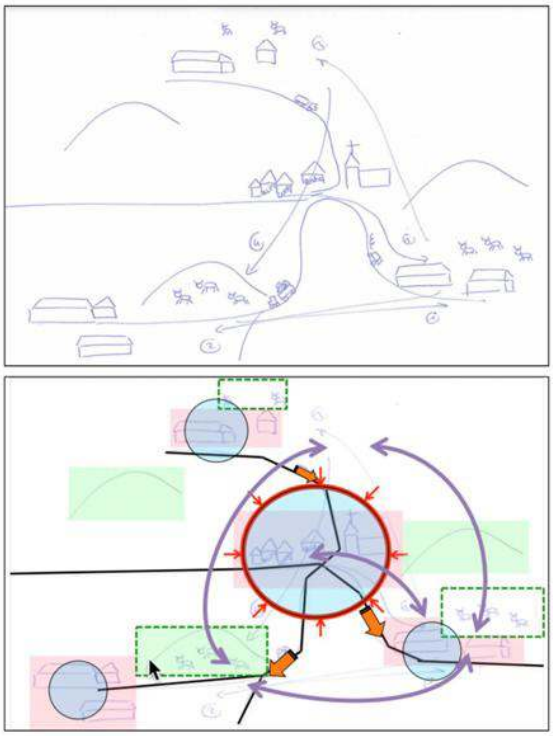
19 The drawing is initially analyzed by its characteristics. For each drawing we considered a number of elements which are conventionally used in mental maps (Gieseking, 2013). These elements give additional data in order to illustrate the choremetic analysis. We assigned a category to each drawing using Pierre Maurel (2001) classifications: cartographic (like a map), photographic (like a photo), schematic (without geographical feature), plan (as a way-finding drawing), and mixed (multiple categories). We also note the scale of the drawing: national (France), regional (a French administrative region or department), intermediate (an area with or without administrative boundaries but corresponding to social, technical or physical elements, such as a set of villages or towns), local (a city or a village), micro-local (a farm or a clinic), without scale, and multi-scale. We then note if the mental map includes human, symbol (such as a cow to represent cattle farming), temporal or textual elements. With these last elements, we also identify the type of text: nominative (to complement drawing elements), illustrative (to replace a non-drawn element), or legend (presented as in a traditional map).

Choromatic analysis of drawing and discourse

20 The choromatic analysis is systematic and based on the identification of the seven spatial organization principles (Lardon and Piveteau, 2005) in the mental maps.

21 Each drawing and discourse has been analyzed through a table indicating the presence or absence of certain spatial organization principles.

Figure 3: Example of choromatic treatments of drawings.



Choremes	Symbols	Meaning
Networks		Different roads
Hierarchy		Different sizes of urban centers
Contact		Urban areas
		Rural areas
		Agricultural areas
Tropism		Veterinary travel
Attraction		Centrality of the main urban center
Transformation		Dynamism of the territory

22 The research team analyzed drawings by noting the presence or absence of each choreme (spatial organization principle). Figure 3 shows how we have identified different choremes on a mental map. In this drawing at an intermediate level (a set of villages), we can recognize structural choremes such as network (the roads), hierarchy (the different urban centers, village, and farms), or contact (differentiation between urban and rural areas, specific agricultural areas). But the drawing also shows dynamic choremes such as tropism (the displacement of veterinarians as they travel between villages and other places to reach the farms), attraction (of the main urban center where the veterinarian lives) or transformation (interpreted by the arrows, linking the different places). This mental map integrates all the elements of structures and dynamics of rural territories, except the grid structure which is not used here.

23 The same choromatic analysis is made on the discourse. In the example in Figure 4, we note the presence or absence of each space organization principle in the students' discourses.

Figure 4: Example of choromatic treatment of discourse.

Rural veterinarian, in general, is associated with a clinic. After, I will, from what I've seen in placement, there is a client circle which is more or less wide. Clients like that. So, he goes everywhere there. So there is a first part of his job is here at the farm level with the breeder. So, he advises, there are interventions, there are prescriptions etc. Then at the clinic, with hospitals here. The breeder can come to the clinic too. He brought us a calf. There was a calf hospital. And then there is the pharmacy that is here, if he sells drugs. So there are many roads. In the farms there is a little bit of everything"

*Rural veterinarian, in general, is associated with a **clinic**. After, I will, from what I've seen in placement, there is a **client circle** which is more or less wide. Clients like that. So, **he goes everywhere** there. So there is a first part of his job is here at the farm level with the breeder. So, he advises, there are **interventions**, there are prescriptions etc. Then at the clinic, with hospitals here. The breeder **can come** to the clinic too. He **brought us** a calf. There was a calf hospital. And then there is the pharmacy that is here, if he sells drugs. So **there are many roads**. In the farms there is a little bit of everything"*

Choremes	Symbols	Meaning
Network	Abc	Different roads
Tropism	Abc	Clinic and client circle
Attraction	Abc	Moves of the vet and the customers

24 We analyze the complementary aspects of the two data channels (drawing and discourse) and their mutual enrichment. According to Mondada (2008), the visualizations are explained by the words that describe them, the verbal expression of how they are seen and interpreted.

25 By themselves, the images in these drawings can be vague and inherently disparate, and thus difficult to interpret. This difficulty highlights the need to understand the argumentation.

Textual analysis

26 The objective of the textual analysis was to analyze the socio-spatial representations and verbal practices in the subject's discourse during the drawing. In similar analyses, Denis *et al.* (1999) have shown the importance of spatial discourse. We used the method of Reinert (1983), processed with the IramuteQ software (Ratinaud and Dejean, 2009). The method is directed at studying the representations contained in the corpus by using the redundancy of word associations. The words are studied with those surrounding them. The corpus is cut into fragments of similar size. A Factor Analysis of Correspondence (FCA) is carried out on these fragments, followed by a Hierarchical Ascending Classification (HAC). The software statistically ranks words according to their similarity or dissimilarity. The classification begins by dividing the complete corpus into two groups according to vocabulary. The operation is repeated by dividing the largest opposing classes, maximizing khi2, and then repeating again if necessary. This ensures a distribution of opposing classes distinguished from each other by the contrast of their vocabulary. The software provides the list of words most significantly present (depending on khi2) in the "lexical world" of a class. The results are then projected onto the FCA (performed on the contingency table), which highlights the categories of discourses and the associated representations.

Cross-analysis

27 Our approach is based on a combination of existing methods that we have specifically used for identifying the links in combinations of space organization principles and socio-spatial representations. We introduce all the elements of drawing characteristics, the presence or absence of choremes in each drawing and discourse, and the socio-demographic variables that act as illustrative variables of the textual analysis. The IramuteQ software can also provide each discourse class with a list of significant variables associated with each discourse in the corpus (again depending on the khi2). We project these illustrative variables on the FCA to illustrate the classes of discourse.

Global analysis of the drawings' characteristics

28 Two-thirds of the drawings are categorized as cartographic, showing a geographic approach. The analysis of the scale reveals similar results: more than half of the drawings are at an intermediate scale. However, we do note that more than a third of the students have used a local or micro-local scale, indicating a very restrictive view of the territory of a rural veterinary practice that is often centered on a single farm or veterinary clinic (table 2).

29 Furthermore, it is noteworthy that the majority of the drawings express only a few representations of human beings, temporal elements and symbols. In this sense they remain closer to a cartographic style. Nevertheless, three-quarters of the drawings have textual elements. In almost all cases, these are nominative and used to explain what is represented on the drawing. This marks the limit of a purely "mapping" process. There appears to be a desire to draw a closely detailed map, but this desire is surpassed by an effort to describe as much as possible in order to improve the understanding and because they don't know to draw spatially some things.

Table 2: Characteristics of drawings (n=72).

Characteristics		**Number**	**Rate**	**Characteristics**		**Number**	**Rate**
Category of drawing	Cartographic	48	**0.66**	Human presence in drawing	Yes	7	0,10
	Photographic	7	0.09		No	65	**0,90**
	Schematic	13	0.18	Symbols in drawing	Yes	27	0,37
	Plan	1	0.01		No	45	**0,63**
	Mixed	3	0.04	Temporal elements in drawing	Yes	5	0,07
Scale	Without	1	0.01		No	67	**0,93**
	Multi-scales	4	0.06	Text in drawing	Yes	54	**0,75**
	National	3	0.04		No	18	0,25
	Regional	2	0.03	Types of text	Nominative	51	**0,71**

	Intermediate	38	**0.53**	Illustrative	2	0,03
	Local	18	**0.25**	Legend	1	0,01
	Micro-local	6	0.08			

Chorematic analysis of drawings and discourse

30 Identifying the choremes in drawings and discourses shows their transversal presence (table 3). Each mental map is composed of 3.5 choremes on average (δ 1.5), and each choreme can be found in at least a quarter of the students' mental maps. Contact, Attraction, and Tropism appear in at least half of the mental maps; however, their distribution is uneven. The most frequently found choreme (f=0.56) in drawings is Attraction, particularly the representation of the village where the veterinarian lives or the clinic where he works. The Contact choreme, distinguishing different uses of space, is also well represented (f=0.47).

31 The less represented choremes are the Transformation (f=0.08), the Hierarchy (f=0.25) and the Tropism (f=0.31). In some maps, this appears to relate to the difficulty of representing spatial dynamics on a drawing. Effectively, while Attraction, Contact, and Hierarchy remain quite stable, the number of dynamic choremes more than doubles in the discourse: Transformation (f=0.24), and Tropism (f=0.67).

32 Our results suggest a mutual enrichment between discourse and drawing. We can see an interest in the discourse beyond a simple element of explanation for the drawing. In at least a quarter of the mental maps, four of the seven choremes are present in either the drawing only or the discourse only: Grid, Contact, Attraction and Tropism. This trend is even more pronounced in the Transformation choreme in the discourse.

Table 3: Chorematic analysis

Choremes	**Drawing**		**Discourse**		**Enrichment**			
	Number	**Rate**	**Number**	**Rate**	**Choreme just in the drawing**	**Choreme just in the discourse**	**Rate**[5]	
Grid	29	0.40	26	0.36	10	7	0.24	
Network	31	0.43	32	0.44	0	1	0.01	
Hierarchy	18	**0.25**	16	0.22	7	5	0.17	
Contact	34	**0.47**	39	0.54	6	11	**0.24**	
Attraction	40	**0.56**	39	0.54	10	9	**0.26**	
Tropism	22	**0.31**	48	**0.67**	2	28	**0.42**	

Transformation	6	**0.08**	17	**0.24**	**0**	**11**	0.15

33 The discourse is a source of additional data and should be exploited. An analysis of the drawings alone would be too elementary to understand the mechanisms of socio-spatial representations.

34 In table 4, we calculated two indexes[6] depending on the presence or absence of choremes on mental maps (drawing and discourse) and organized them in a contingency table. We observed two strong interdependencies[7] between choremes when at least one of the others is present. This identifies two significantly different meanings of space, according to two combinations: one is structural (with the Grid, Network, Contact and Tropism choremes) based on the location of places, their differentiation, and their networks. The other is more dynamic (with the Contact, Attraction, and Tropism choremes) based on the specialization of places and their interactions. This idea is reinforced according to the distribution of the absence of choremes on mental maps[8]. The choremes related to structure are absent together (except for the Contact choreme). We also noted that the choreme that emphasizes the principle of transformation is also absent in this case. But this is less true with the other dynamic choremes (Attraction and Tropism).

35 This reinforces the idea of two different approaches, one based on the structure of the space, and one on the circulation and polarization within the territory.

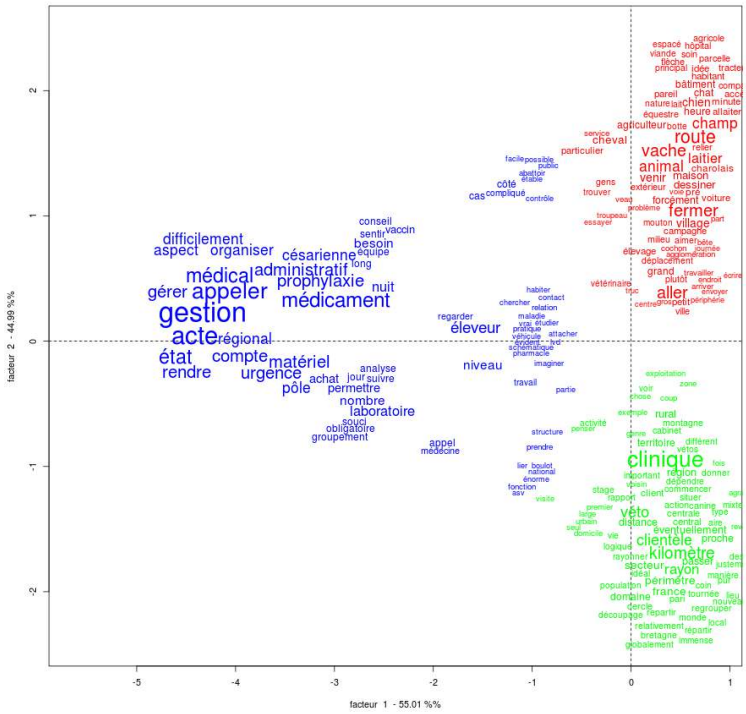
Table 4: Table of interdependence of choremes

	Grid	**Network**	**Hierarchy**	**Contact**	**Attraction**	**Tropism**
Grid		**0.361**	**0.319**	0.250	0.111	0.125
Network	**0.306**		**0.375**	0.264	0.153	0.208
Hierarchy	0.139	0.139		0.264	0.250	0.181
Contact	**0.375**	**0.333**	0.208		0.097	0.125
Attraction	0.292	0.278	0.250	**0.403**		0.181
Tropism	**0.319**	**0.347**	0.194	**0.444**	**0.556**	
Transformation	0.181	0.083	0.097	0.194	0.181	0.167
			Presence			

Textual analysis focused on discourse of drawings

36 Textual analysis of students' discourse throughout their drawing exercise has analyzed 99.75% of the corpus, i.e. 395 segments. It shows the emergence of a distribution around two inertia factors in the FCA (figure 5).

Figure 5: FCA projection of textual analysis.



37 The first factor, which counts for approximately 55% of the variance, isolates the terms of work related to actions (such as ”management“, ”medicine“, ”act“) from the terms related to work place. We call this the “activity axis”. The other factor (about 45% of the variance) contrasts geographical terms (such as ”perimeter“, ”area“, “radius”) of the practice to terms used for the work environment (such as ”field“, ”cow“, ”village“). We call this the “space axis”. On these two axes, we observe an organization in the discourses delineating three classes (table 5). We see the presence of a Guttman effect in the results of the FCA that signals the presence of a subgroup of individuals in the analysis. This subgroup produced a singular discourse on veterinary activity (based on activity and not on territory) during the realization of the mental maps.

Table 5: Results of textual analysis

Discourse categories	Most significant terms	Rate in% for each terms	Chi 2	p<0,01
Activity (12.41 %)	Management	100.0	57.66	< 0.0001
	Act	100.0	50.32	< 0.0001
	Drug	72.73	37.89	< 0.0001
	State	100.0	35.76	< 0.0001
	Medical	100.0	35.76	< 0.0001
	Accountability	100.0	28.53	< 0.0001

	Prophylaxis	82.83	28.21	< 0.0001
	Equipment	82.83	28.21	< 0.0001
	Emergency	82.83	28.21	< 0.0001
	Administrative	82.83	28.21	< 0.0001
	Breeders	100.0	57.66	< 0.0001
Work Environment (41.77 %)	Road	92.59	30.77	< 0.0001
	Cow	86.67	26.9	< 0.0001
	Farm	77.08	28.01	< 0.0001
	Field	94.44	21.51	< 0.0001
	Dairy	93.75	18.52	< 0.0001
	Dog	100.0	12.84	0.00033
	Village	74.07	12.43	0.00042
	Horse	82.35	12.03	0.00052
	House	85.71	11.52	0.00068
	Building	100.0	8.49	0.000356
	Farmer	88.89	8.41	0.000374
Geographic Space (45.82 %)	Clinical	74.49	43.15	< 0.0001
	Kilometer	95.83	25.74	< 0.0001
	Clientele	92.0	22.92	< 0.0001
	Radius	100.0	19.72	< 0.0001
	Sector	100.0	12.13	0.00049
	Perimeter	100.0	12.13	0.00049
	France	100.0	12.13	0.00049
	Rural	64.29	11.68	0.00063
	Region	78.26	10.35	0.00129
	Close	90.91	9.27	0.00233
	Distance	90.91	9.27	0.00233

38 The first class, which we call ”Activity“, includes terms from the axis of the first inertia factor based on the action. It accounts for 12.41% of the discourse. This emphasis is seen primarily among beginning students who come from urban and semi-urban areas, and have little experience with rural areas in their daily life or in internships. The second class, which we call ”Work Environment“ (41.77% of the analysis), includes terms related to the work environment from the second inertia. Again, in this class we see more students that are new to the veterinary curriculum. Their image of rural territories underlines their lack of precise knowledge about rural areas. Representation in this class is fairly stereotypical and more based on landscape elements. The last class is called ”Geographic Space“ (45.82% of the analysis). It includes terms from the second inertia of the FCA, but only the ones that focus on spatial organization. This vocabulary refers to the way veterinarians organize their workspace, including activity perimeters, intervention areas and competition zones, and the way that they use distance in their organization forms. It is more characteristic of students nearing the end of the curriculum, who have more experience with veterinary practices in rural territories through various internship opportunities.

Cross-analysis

39 Combining data from our previous analyses with the socio-demographic data of students reveals a relationship between the classes of textual analysis and the characteristics and choremes in the drawings and discourses (table 6). We can reuse the FCA analysis to illustrate this.

40 The three classes of discourse are characterized by different elements. The class ”Activity“ is characterized by local or even micro-local schemes (the size of a farm or a veterinary office). No choreme showed a significant presence in this class. By contrast, the absence of some choremes is important: we saw no Grid, Attraction, or Hierarchy choremes. Their absence in a representation suggests a lack of knowledge or understanding about the territorial dimensions of veterinarian activity (how the activity is integrated in the territory). In these drawings, the veterinarian’s activity in a rural territory is summarized by a closed and narrowly defined space, without dynamics.

41 The class ”Work Environment“ is also at a local scale, but in a more photographic sense. It marks representations that include many symbols or humans in the drawing. In this class we observe several choremes of structure such as Contact and Grid. The socio-spatial representation is more spatial than in the Activity class. Here, students present an image of an organized and hierarchical space. Nevertheless, the absence of a significant dynamic choreme shows that this image remains fairly static without a vision of the dynamics involved in a rural veterinary territory of activity.

42 Finally, the class ”Geographic Space“ is characterized by an intermediate scale in a cartographic category. The lack of additional characteristics (humans, symbols, text) presents a less detailed image but one that is more global in its depiction of rural veterinary activity. This class is also the only one that highlights choremes that are dynamic (Attraction and Transformation). This shows that students perceive the veterinarian activity integrated with its territory. That is also a depiction that shows the rural veterinary practice as a more mobile and less sedentary form of veterinary activity and one where spatial proximity or distance (for example to urban center) is important to

the organization of these activities. In fact, in this population we find students who are more attracted by a ”rural“ practice.

43 We can see that, most of the time, it is not singular, independent choremes which dominate the discourse categories and the underlying socio-spatial representations, but combinations of these choremes. A combination of space organization principles reflects the existence of certain forms of students' representations. In this research we have identified micro-localized representations without organization principles, local representations from an integrated, static perspective (characterized by significant structural organization principles on a static map), and integrated, spatialized representations using a combination of dynamic choremes.

Table 6: Results of cross-analysis.

Discourse categories	**Variables**	**Rate in% for each variable**	**Chi 2**	**p<0,01**
Activity (12.41 %)	Micro-local scale	67.91	53.23	<0.0001
	Schema category	35.11	58.50	<0.0001
	Mixed category	83.33	28.21	<0.0001
	Semi-urban childhood area	22.62	28.07	<0.0001
	Absence of grid choreme	19.74	26.68	<0.0001
	Absence of attraction choreme	20.43	20.83	<0.0001
	Absence of hierarchy choreme	15.84	14.14	0.00016
	Presence of text	15.31	10.70	0.00107
	Year 1 in curriculum	21.98	9.97	0.00158
Work Environment (41.77 %)	Presence of contact choreme	56.85	36.75	<0.0001
	Presence of humans	85.37	35.74	<0.0001
	Year 0 in curriculum	82.61	35.70	<0.0001
	Presence of symbols	59.15	34.80	<0.0001
	Photographic category	82.35	25.19	<0.0001
	Presence of grid choreme	55.69	23.04	<0.0001
	Age = 19 years	92.86	15.57	<0.0001
	Contest “B” obtained	68.09	15.19	<0.0001
	Local scale	60.87	12.54	0.00039

	Absence of attraction choreme	50.00	9.78	0.00176
	Age = 20 years	63.04	9.69	0.00185
Geographic Space (45.82 %)	Presence of attraction choreme	60.29	37.40	<0.0001
	Cartographic category	58.80	32.32	<0.0001
	Absence of symbols	57.58	30.96	<0.0001
	Absence of contact choreme	59.60	30.34	<0.0001
	Intermediate scale	59.78	25.67	<0.0001
	Year 4 in the curriculum	76.36	24.01	<0.0001
	Absence of humans	50.00	23.97	<0.0001
	Absence of text	61.36	11.02	0.0009
	Contest “A” obtained	50.92	9.24	0.00237
	Age = 25 years	67.50	8.42	0.00370
	Presence of transformation choreme	66.67	6.30	0.00102

Discussion

44 In this experiment, we have tested the hypothesis that the organization of spatial elements can be identified in mental maps as a marker of socio-spatial representations built by social individuals. Cross-analysis of choromatic and textual data has led us to a dual evaluation of their contribution to the interpretation of mental maps: the impact of methodological contributions and theoretical contributions.

45 The methodological input comes from the use of choremes to identify the spatial organization principles in mental maps. They are markers of socio-spatial representations built by social individuals. Two points are to be distinguished: first, the complementary drawing and discourse to analyze the organizing principles of space, and second, the combination of the organizing principles for reporting on socio-spatial representations. The choromatic analysis highlights the enriched analysis by combining drawings and discourses. Consideration of the additional data provided by the discourse allows the identification of dynamic choremes that would be difficult to read in the drawing alone. We believe a holistic approach with a thorough reading of all collected data provides the best means of interpreting mental maps. In this way we refine the results of Cauvin (2002) that show the benefits of mixed methods (the textual analysis helps us understand the mechanisms of spatial cognition).

46 Most studies with mental maps attempt to interpret the meaning of the collected drawings, but our objective was to mark the characteristics and choremes that

correspond to each spatial object in the drawings and discourse, and then process them statistically. This approach allows us to analyze all aspects of mental maps and compare them in a holistic fashion. The mental maps of each individual are not analyzed and compared with each other. The whole corpus is analyzed statistically to account for the major classes of representations identified. The socio-demographic characteristics of individuals (or other elements such as level in the curriculum or biographical elements) are used as illustrative variables in the results. They explain the identified classes. We view this process as ”social“ marking because we link the expressed organization principles with the main items of the discourse analysis and characterize them by elements from social individuals.

47 This methodological approach provides an operational and rigorous analysis, which helps minimize subjectivity in the interpretation of mental mapping:

- The table of the organizing principles of space reflects aspects of proven geographical models (e.g., polarization process, Pumain, 2014; process of transformations of space, Voiron, 2012).
- The grid of the organizing principles has been used for over 25 years in the field of agronomy and land use, and tested in numerous situations (Deffontaines et al., 1990; Benoit et al., 2006).
- In our approach, the grid of spatial organization principles is used consistently on all drawings and discourses, following the methodology formalized in Le Ber and Brassac (2008). The transcripts were prepared by three researchers, separately and collectively, to ensure an accurate depiction of the body of discourse.
- The enumeration of data from drawings and discourses (using the grid of spatial organization principles) was conducted without prior knowledge of the results from the socio-spatial analysis based on interviews. This precaution, excluded potential bias from the interpretation of the researchers. As Laurini *et al.* (2006, cited by De Chiara *et al.,* 2011) suggest, it is impossible to automatically extract choremes from mental maps, but the functionality is possible to identify in a supervised mapping exercise.
- The cross-analysis of data is performed quantitatively and statistically, thus precluding criticisms generally directed at qualitative methods. Our approach reflects modeling methods recognized by geographers (Dastès Durand, 1992), this methodological approach uses the observations and the models as an analytical instrument as advocated by Legay (1973).

48 Nevertheless, we cannot ignore one methodological limit in our case study. In one sense our study differs from the experiments that Gieseking (2013) described. Our analysis is based on the elicitation of subjective space and not on a precise location. In geography, mental maps are generally used with delimited urban areas, which do not correspond to our analytical framework. The elicitation here is based on the use of the term ”territory“ which may result in some student bias with respect to the category or scale of the drawing. This requires further investigation in order to assess the relevance of our method.

49 The theoretical contribution comes from applying these space organization principles to a socio-cognitive approach. The theory of social representations can provide a reliable and effective framework using choremes to interpret mental maps.

50 Our analysis proves that we can highlight groups that have common socio-spatial representations in our sample through the expression of similar combinations (or absence) of space organization principles. Brunet (1980) has noted this basic property of

choreme combinations. He sees them as elaborate and complex constructions that join, juxtapose, and mutually interact. In different combinations with different drawing scales, we can see the results by combined analyses. The combinations of space organization principles can be the marking tools of socio-spatial representations. They may be an indispensable intermediary in the process of understanding the expression of space on mental maps. The use of these combinations in an analytical grid of the mental maps of individuals should reveal how they appropriate space in a socio-cognitive way.

51 The different combinations of space organization principles expressed by social individuals should show the differences in the spatial capital they hold (Lussault and Stock, 2010). These different levels of spatial capital (the knowledge and skills to read space) are then reflected in different representations of that space. These differences notably reflect different socio-cognitive internalizations (in the sense of Ramadier *et al.* (2008)) marked by the organization principles. Thus, we see differences between the identified classes. Students from the "Work Environment" class perceived space as images of static, landscape elements. The "Geographic Space" class exhibits a higher level of spatial capital and their perception of rural space is more integrated. Students identify some dynamics in their representations. Improving these socio-cognitive skills could encourage a diversification of practices and a better appropriation of space (Ramadier and Moser, 1998). But in the "Activity" class, the students' level of spatial capital with respect to rural areas is poor and limited to a micro-local scale. This group shows that there is no complete equivalence between social and spatial structures, a deduction similar to the results of Dias and Ramadier (2015).

52 Moreover, our analysis also shows that the relationship between socio-spatial representations and students' career choices should be considered as dialectical and likely to evolve over time. As in the studies of Mexico and Paris by De Alba (2004; 2011), the social practices of rural territory reflect the prevailing practices of individuals and groups. But as Portugali (2011) proposes in his work with urban populations, we can also hypothesize that students project their future plans (career choices) on rural territories. The progress in the curriculum marks a change in the combinations of the space organization principles. The "Geographic Space" approach is more pronounced among students nearing their completion of the curriculum. Conversely, representations remain centered on the activity or the environment among students at the beginning of their studies. Therefore, we see a change in their proficiency in space reading and the decoding / encoding process that is revealed by the combination of choremes. This allows us to take account of the diachronic dimension. There is no innate ability to read space (Ramadier, 2003), it is a social construction.

Conclusion

53 The socio-spatial approach to mental maps through space organization principles seems to enrich our understanding of how individuals perceive their life spatially. It helps to see the meaning these individuals attribute to space through the use of specific combinations of space organization principles. The chorematic method helps to mark the socio-spatial representations in the mental maps. Moreover, this approach raises the subject of how individuals construct the spatial capital that they use in acquiring the socio-cognitive skills to read space, which in turn can become a lever for action. Our reading of space organization principles questions the educational levers that facilitate the insertion of

students into a professional veterinarian practice. It broadens the ways we have of understanding rural territory.

54 Our results allow us to consider how we might change the socio-spatial representations of students by improving the knowledge they have of the dynamics of rural territory. This might be used in an educational mechanism oriented towards removing obstacles to employment of veterinarians in rural territories (Dernat *et al*., 2015).

BIBLIOGRAPHY

Bailly A., 1985, "Distances et espaces : vingt ans de géographie des représentations", *Espace géographique*, (3), 197-205.

Bailly A., Debarbieux B., 1991, "Géographie et représentations spatiales", *Les Concepts de la géographie humaine* (p.153-160), Paris, Masson.

Benoit M., Deffontaines J-P., Lardon S., 2006, "Acteurs et territoires locaux. Vers une géoagronomie de l'aménagement", Paris, INRA QUAE Edition savoir-faire.

Brassac C., 2004. "Action située et distribuée et analyse du discours : quelques interrogations", *Cahiers de Linguistique Française*, 26, 251-268.

Brennan-Horley C., 2010, "Mental mapping the "creative city" ", *Journal of Maps*, 6(1), 250-259. doi:10.4113/jom.2010.1082

Brunet R., Ferras R., Théry H, 1992, *Les mots de la géographie, dictionnaire critique*, Paris, La Documentation française.

Brunet R., 1986, "La carte-modèle et les chorèmes", *Mappemonde*, 86(4), 2-6.

Brunet R., 1980, "La composition des modèles dans l'analyse spatiale", *Espace Géographique*, 9(4), 253–265. doi :10.3406/spgeo.1980.3572

Camargo B., Justo A.M., 2013, "IRAMUTEQ: um software gratuito para análisede dados textuais", *Temas em Psicologia*, 21(2), 513-518.

Cauvin C., 2002, "Cognitive and cartographic representations: towards a comprehensive approach", *Cybergeo: European Journal of Geography*, 206. doi: 10.4000/cybergeo.194.

Cauvin C., 1984, "La perception des distances en milieu intra-urbain : une première approche". Editions du CDSH (CNRS), Synthèse et documentation, 284 p.

Da Silva Martinuci O., 2010, "Da Cartografia a Corematica : Representações espaciais para uama espacialidade mutante (from cartography to chorematic : spatial representations for a mutant spatiality)", *Revista Mercator*, 8(17), 193-a.

Da Vinha L., 2012, "Charting geographic mental maps in foreign policy analysis: A literature review", *Human Geographies-Journal of Studies & Research in Human Geography*, 6(1), 6-17. doi: 10.5719/hgeo.2012.61.5

De Alba M., 2011, "Social representations of urban spaces : A comment on mental maps of Paris", *Papers on Social Representations*, 20, 29-1.

De Alba M., 2004, “Mapas mentales de la Ciudad de México : una aproximación psicosocial al estudio de las representaciones espaciales”, *Estudios demográficos y Urbanos*, 115-143.

Debarbieux B., 2003, “Territoire”, in Lévy J. et Lussault M. (dir.), *Dictionnaire de la géographie et de l’espace des sociétés* (pp 910-912), Paris, Belin.

De Chiara D., Del Fatto V., Laurini R., Sebillo M., Vitiello G., 2011, “A chorem-based approach for visually analyzing spatial data”, *Journal of Visual Languages & Computing*, 22(3), 173-193.

Deffontaines J-P., Cheylan J-P., Lardon S., 1990, “Gestion de l’espace, des pratiques aux modèles”, *Mappemonde*, 1990/4.

Denis M., Pazzaglia F., Cornoldi C., Bertolo L., 1999, “Spatial discourse and navigation: An analysis of route directions in the city of Venice”, *Applied cognitive psychology*, 13(2), 145-174.

Depeau S., Ramadier T., 2011, “L’espace en représentation ou comment comprendre la dimension sociale du rapport des individus à l’environnement”, *Pratiques psychologiques*, 17(1), 65-79.

Depeau S., 2006, “De la représentation sociale à la cognition spatiale et environnementale : La notion de ”représentation“ en psychologie sociale et environnementale”, *Travaux et documents de l’UMR ESO*, 25, 7-17.

Dernat, S., Johany, F., Lardon, S., & Siméone, A. (2015, April). *The Territory Game: an experiment in veterinary education of an innovative educational tool to help students career choices*. Communication presented in the 22e European Seminar on Extension and Education (ESEE), Wageningen, Netherlands.

Dias P., Ramadier T., 2015, “Social Trajectory and Socio-spatial Representation of Urban Space: The Relation Between Social and Cognitive Structures”, *Journal of Environmental Psychology*, In press. doi: 10.1016/j.jenvp.2014.12.002.

Di Méo G., 1996, *Les territoires du quotidien*, Paris, L’Harmattan.

Downs R., Stea D. (dir.), 1973, *Image and Environment. Cognitive mapping and spatial behavior*, Chicago, Aldin Publishers Co.

Durand-Dastés, F., 1992, “Les modèles en géographie”, In : Bailly A., Ferras R et Pumain D. (eds.), Encyclopédie de la géographie (p. 311-325), Paris, Economica.

Gärling T., Golledge R, G., 2000, “Cognitive mapping and spatial decision-making”, in Kitchin R. and Freundschuh S., *Cognitive mapping: Past, present, and future*, Psychology Press, 4, 44.

Gieseking J.J., 2013, “Where We Go From Here The Mental Sketch Mapping Method and Its Analytic Components”, *Qualitative Inquiry*, 19(9), 712–724. doi:10.1177/1077800413500926

Goodier C.I., Soetanto R., 2013, “Building future scenarios using cognitive mapping”, *Journal of Maps*, 9(2), 203-217. doi:10.1080/17445647.2013.770997

Gould P.R., White R., 1974, *Mental Maps*, Harmondsworth, Middlesex, Penguin books.

Grataloup C., 1993, “Le même et l’autre : renouvellement de la chorématique”. *Espaces Temps*, 51 (1), 143-196.

Gueben-Venière S., 2011, “How can mental maps, applied to the coast environment, help in collecting and analyzing spatial representations?”, *EchoGéo*, 17. doi: 10.4000/echogeo.12625

Haas V., Levasseur E., Béal A., Charrier L., Demoures A., Kalampalikis N., ..., Rampon J.M., 2011, *Villeurbanne, à la croisée des mémoires* (Rapport final de recherche), Université Lumière de Lyon.

Haas V., 2004, “Les cartes cognitives : un outil pour étudier la ville sous ses dimensions socio-historiques et affectives”, *Bulletin de Psychologie*, 474, 621-633.

Haas V., 2002, “Approche psychosociale d’une reconstruction historique. Le cas vichyssois”, *Cahiers Internationaux de Psychologie Sociale*, 53, 32-45.

Heft H., 2013, “Environment, cognition, and culture : Reconsidering the cognitive map”, *Journal of Environmental Psychology*, 33, 14-25.

Hervé D., Ramaroson J.H., Randrianarison A., Le Ber F., 2014, “Comment les paysans du corridor forestier de Fianarantsoa (Madagascar) dessinent-ils leur territoire ? Des cartes individuelles pour confronter les points de vue”, *Cybergeo : European Journal of Geography*, 681. doi : 10.4000/cybergeo.26387

Jodelet D., 1982, “Les représentations socio-spatiales de la ville”, in Derycke P.H. (dir.), *Conceptions de l’espace* (pp. 145-177), Paris, Université de Paris X.

Kitchin R. M., 1994, “Cognitive maps: What are they and why study them?”, *Journal of environmental psychology*, 14(1), 1-19.

Klippel A., 2003, *Wayfinding Choremes – Conceptualizing Wayfinding and Route Direction Elements*, Bremen, Universität Bremen.

Lardon S., Piveteau V., 2005. “Méthodologie de diagnostic pour le projet de territoire : une approche par les modèles spatiaux”, *Géocarrefour*, vol. 80/2 | 2005, 75-90.

Le Ber F., Brassac C., 2008. “Étude longitudinale d’une procédure de modélisation de connaissances en matière d’organisation du territoire agricole”, Revue d’anthropologie des connaissances, 2(2), 151-168.

Legay J-M., 1973. “La méthode des modèles, état actuel de la méthode expérimentale”, *Informatique et Biosphère*, 1, 5-73.

Lussault M., Stock M., 2010, “Doing with space”: towards a pragmatics of space”, *Social Geography*, 5(1), 11-19.

Lynch K., 1960, *The image of the city*, Cambridge, Mass., The MIT Press.

Maurel P., 2001, “Les représentations spatiales : concepts de base et éléments de typologie”. In Lardon S., Maurel P., Piveteau V., *Représentations spatiales et développement territorial* (pp 75-108), Paris, Hermès Editions.

Mérenne-Schoumaker B., 1999, *Didactique de la géographie, tome 1. Organiser les apprentissages*, Paris, Nathan pédagogie.

Milgram S., Jodelet D., 1976, “Psychological maps of Paris”, in Proshansky H., Ittelson W., Rivlin L. (dir.), *Environmental psychology: people and their physical settings* (pp. 104-124), New York, Holt, Rinehart and Winston.

Moles A. A., Rohmer E., 1998, *Psychosociologie de l’espace*, Paris, Editions L’Harmattan.

Mondada L., 2008, “Production du savoir et interactions multimodales”, *Revue d’anthropologie des connaissances*, 2(2), 219-266.

Portugali J., 2011, *Complexity, Cognition and the City* (pp. 113-138), Berlin, Springer Science and Business Media.

Ramadier T., Petropoulou C., Bronner A-C., Borja S., 2008, “Les usages paysagers de la ville : le paysage urbain comme régulateur des mobilités quotidiennes”, in Wieber J-C., Brossard T. (eds.), *Paysage et information géographique* (pp. 287-312), Paris, Édition Lavoisier-Hermès Science.

Ramadier T., 2003, “Les représentations cognitives de l’espace : modèles, méthodes et utilité”, in Moser G., Weiss K. (dir.), *Espaces de vie : aspects de la relation homme-environnement* (pp. 177-200), Paris, Armand Colin.

Ramadier T., Moser G., 1998, “Social legibility, the cognitive map and urban behaviour”, *Journal of Environmental Psychology*, 18(3), 307-319.

Ratinaud P., Déjean S., 2009, “IRaMuTeQ : implémentation de la méthode ALCESTE d’analyse de texte dans un logiciel libre”, *Modélisation Appliquée aux Sciences Humaines et Sociales MASHS*, 8-9.

Reimer A., Fohringer J., 2010, “Towards constraint formulation for chorematic schematisation tasks-work in progress”, in *Proceedings of the 13th Workshop of the ICA commission on Generalisation and Multiple Representation*, Zürich, 12-13 September 2010.

Reinert A., 1983, “Une méthode de classification descendante hiérarchique : application à l’analyse lexicale par contexte”, *Cahiers de l’Analyse des Données*, 8(2), 187-198.

Reuchamps M., Kavadias D., Deschouwer K., 2014, “Drawing Belgium: using mental maps to measure territorial conflict”, *Territory, Politics, Governance*, 2(1), 30-51.

Pumain D., Saint-Julien T., 2010, *L’analyse spatiale. Tomes 1 et 2*, Paris, Armand Colin.

Voiron-Canicio C, 2012, “L’anticipation du changement en prospective et des changements spatiaux en géoprospective”, *l’Espace géographique*, 2, 99-110.

Warrot G., 2003, “L’utilisation des tableaux chorématiques à dires d’acteurs”. In Debarbieux B. et Lardon S., *Les figures du projet territorial* (pp 193-202), Paris, Editions de l’Aube.

NOTES

1. In French, the Transformation choreme is called “Dynamique territoriale”.
2. Four modes (identified with letters) of access to veterinary schools are possible by national competitive exams: the "A" exam at the end of two years of preparatory classes following secondary school, the "B" exam after two years of university degree in life sciences, the "C" contest after a two year associate degree and a specific preparatory class year, and the "D" exam after a diploma in medicine or pharmacy or a master degree.
3. In the fifth year of the veterinary curriculum, students can choose between several specializations: pets, rural, equine, and industry/research. They can also choose to mix two specializations.
4. In French: “Dessinez votre représentation du territoire d'activité d'un vétérinaire rural.” The term “territory” is used to elicit a representation of the rural veterinary practice’s surrounding area.
5. The enrichment rates in the analysis are obtained by a calculation: (number of choremes only in the drawing + choremes only in speech) / number of mental maps.
6. Each index corresponds to the total number of mental maps where the two choremes (intersection of abscissa and ordinate) are present respectively or absent divided by the number of mental maps in the study (n=72). At the bottom of the table, the data obtained are for the presence of the choremes; the data at the top are for the absence.
7. An interdependence is identified when the presence of a choreme causes the presence of other choremes in over 30% of the cases (index higher than 0.3). This threshold has been empirically established because there is no value defined in the scientific literature about choremes. We consider that the presence of groups of choremes in over a third of mental maps shows a significant interdependence.

8. We took the same value of 0.3 for the index and applied it to the absence of choremes in mental maps.

ABSTRACTS

There is a large body of scientific literature examining mental maps from a variety of disciplinary approaches. In this article we propose a specific method combining geography and social psychology to elicit and analyze socio-spatial representations in mental maps. To illustrate this method, we chose a case study of rural career choices envisioned by veterinary students. We combined textual analysis of student discourses with choremes analysis of both graphical representations and discourse to reveal how students represent socio-spatial aspects of a rural veterinary profession in mental maps. The results show that students' representations reflect various combinations of spatial organization principles. This method provides a means of better understanding socio-spatial representations.

La littérature scientifique sur les cartes mentales est riche et reflète différentes approches disciplinaires. Dans cet article, nous proposons une méthode spécifique d'analyse qui réunit la géographie et la psychologie sociale pour favoriser la compréhension des représentations socio-spatiales. Pour illustrer notre approche, nous avons choisi l'étude du choix de carrière des étudiants vétérinaires vers les zones rurales. Nous avons associé la modélisation graphique par les chorèmes des dessins et du discours des étudiants, avec l'analyse textuelle de ce discours, pour mieux comprendre les représentations socio-spatiales des étudiants vétérinaires sur la profession en milieu rural. Nos résultats montrent que leurs représentations renvoient à des combinaisons de principes d'organisation de l'espace. Ainsi, la méthode fournit un moyen d'extraire les représentations socio-spatiales exprimées dans les cartes mentales.

INDEX

Mots-clés: chorématique, modélisation graphique, comportement spatial, représentations sociales
Keywords: chorematic, graphic modeling, spatial behavior, social representations

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