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Research article

Naive geography: geoconceptology and topology of geomental maps

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ABSTRACT

The article presents the study of the geospace mental representations and their variability depending on the regional point of view. The research material comprises about 500 naive maps of Russia, created by informants of seven Russian regions: Moscow, St. Petersburg (capitals), Siberia (Barnaul, Biysk), Southern, Mid- and Northern Ural (Orenburg, Ufa, Perm) and Kaliningrad. A geoconcept, as a set of collective ideas about a geographic object, synthesizes images of a geographic location (topos), its name (toponym), ideas about it and its spatial parameters (length, coordinates, location relative to other geolocations). The paper raises the problem of the topology of the mental space, and describes the method and results of constructing computable metric models of geomental spaces. The use of modern means of processing and analyzing naive maps allowed to detect spatial dependencies between geoconcepts, their probable localization zones, and position relative to each other on the geomental map space. Modeling of geoconcepts was carried out on the example of the analysis of the collective regional representations associated with the capital (Moscow). Noticeable differences were found in the regional geoconcepts of Moscow, which makes it relevant to conduct research on the regional variability of the geoconcept systems of the country's common space.

1. Introduction

Space coordinates dominate any human activity. Due to ontological potential of the space this influence affects both objective and subjective levels of perception, comprehension and "making oneself at home" in the spatial environment, since this influence possesses physical parameters, has psychophysiological nature and thus is a basis for perpetual semiotization within the social and cultural context of human life.

People have to comprehend spatial environment both in their professional activity and everyday life, that is why mental representations of the space (from sensitive and kinesthetic, related to the living space of a person to large-scale geography and abstract geometry) are integrated into other concepts relevant for one's lifestyle, existence and self-awareness as a self-identification factor setting ego boundary.

In this respect geographical spatial representations which can be conceptualized with different degree of personalization/objectification are of our main interest. Depending on the scale of scrutiny types of geospatial conceptualization, ways of its exteriorization represent versions of self-identification at different levels: those at the personal level, at the level of a region, nation and other socially significant communities in one way or other associated with a certain territory.

The problem of mental representations is much wider than constructing mental projections (maps, plans, models) of the immediately experienced spacious environment of the person, correlated, first of all, with the so-called egocentric representation of space (Wang, 2012). Mental representations of the geographical space may have a number of sources, reflecting both personal experience and that stated in academic and scientific discourses, popular TV and radio programs, news and other geocontent produced by a person's social environment (texts, photos, video materials). The influence of external sources on the mental maps is particularly noticeable in the course of a school or vocational training (Gillespie, 2010; Somdahl-Sands, 2014). While being "adopted",

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integrated into individual system of concepts, information received from such sources is being transformed into stereotypes, background knowledge received in a non-critical mode, and corresponding to the archetypes of the unconscious psychic level.

The peculiarity of geographical information that forms the basis of individual spatial representations is the semiotic complexity of the texts that represent it. All geo-content which is accessible to humans (from school textbooks on geography, geographical atlases and GIS applications to travel bloggers descriptions) are multimodal texts: semiotic systems that combine spatial, color, formative and linguistic signs. This feature is organic to the multimodal nature of perception.

In modern studies in the field of neurosciences and cognitive psychology a separate direction is being developed. Within the framework of Embodiment Theories, the connection between various multimodal sensory systems, motor skills and linguistic semantics was substantiated (Barsalou, 1999; Pulvermuller, 1999; Gallese and Lakoff, 2005; Meteyard et al., 2012).

L.W. Barsalou, one of the most prominent representatives of this direction, put forward the concept of a simulator – a distributed multimodal system that connects into a neural network many visual, auditory, tactile, motor, linguistic and other stable (that is, statistically correlated properties) neuronal patterns (Barsalou, 1999). These patterns are called simulations, they are specific instances of the simulator. Within the framework of the simulator as a multimodal system, they are combined into a neural network representing a category as a unit of the subject's mental world. Activation of a network node accompanies the simultaneous activation of nodes associated with them, which can differ in modality (visual/auditory/motor, etc.) and ontology (representation/concept/image, etc.). However, all the content of the simulator never becomes active at the same time. Only a small part of the simulations can reach consciousness as many patterns are embedded in the neural network unconsciously (Barsalou, 1999). The above fully refers to the perception, "appropriation" and translation of geospatial images, which is reflected in the geographical sketch maps created by ordinary people. This can manifest itself in the selection of geo objects, in their location, selection of sizes, color markers, nomination (official or unofficial version: for example, St. Petersburg/Peter/Petersburg/StP) and its associations-representations.

The hypernetwork principle of organizing mental representations is confirmed in studies of the mental vocabulary (Anderson, 1983; Elman, 2004; McClelland et al., 2010), associative memory modeling (Carpente, 1989; Lansner, 2009).

One of the high-level units of hypernetwork is geoconcept, which synthetizes the image of a certain geographic location with ideas about it, with its name (toponym) and spacious parameters (its extention, its relative location in respect to other geolocations) which is important for studying the images of the objects together with spacious modus generating them (Zelyanskaya, 2014; Zelyanskaya et al., 2017).

The image of the territory arises in the process of conceptualization, "the conscious, constructive forming of its new meanings and geographical images" (Kalutskov, 2012: 28). The result of the conceptualization of the territory, "carried out under the influence of science, art, politics, the media, is geoconcepts that are significant for a particular human community" (Kalutskov, 2015: 8).

Of course, the role of conscious constructing in the process of geoconcepts formation is important, however, the image of the territory, functioning in the representations of social groups, "is a composite" of different sources. One of its most important components is the meanings and images that are created in the process of everyday unprofessional reflection of everyday consciousness, the most important source of information for which is the firsthand experience of a person and his close environment. Another aspect of our understanding of geoconcept is its regional variability, diffuseness, non-constancy. The result of the conceptualization of one and the same territory (locus) will depend on the proximity/remoteness of people living in a given territory from the conceptualized area, the presence/absence of borders between regions, and, possibly, others factors. We can assume the existence of a "zero" geoconcept of a given locus for some territories (people living there have no idea about this locus). Another important aspect of our understanding of geoconcepts is their consideration both as neurocognitive units of an individual mental space and as sociocognitive constructs obtained as a result of the generalization of diverse mental representations of the same geoobjects in a group of people united by one or another attribute.

Geoconcepts are connected with each other in a hypernetwork both paradigmatically (systems of geoconcepts variably correlated with different regional points of view) and syntagmatically (transition from one geoconcept to another in the process of thinking).

Movement inside hypernetwork can be exercised within the frames of scenario (a standard one or an ad-hoc scenario created to cope with a new task). As a result of scenario realization there appears a layout of high-level hypernetwork knots, forming an entity we call a mental map. "Mental maps provide a schemata that organizes knowledge of the physical world in to some type of understandable structure" (Chiodo, 2007: 154). The value of mental maps is that they "serve as a singular data source to capture the spatial cognition or place perception of the subject who is drawing the map" (Boschmann and Cubbon, 2014: 237). In due turn geomental maps (mental maps that structure the geographical representations of the subject) are layouts of geoconcepts, that are correlated a) by their presence/absence (in individual mental maps) or by frequency principle (in generalized mental maps of social groups), and b) – spatial arrangement/proximity in the hypernetwork, bringing its topology into being.

The notion "mental map" was inherited from E. Tolman's "cognitive map" (Tolman, 1948). In spite of the fact that geographical mental maps are criticized (namely by (da Vinha, 2012)) their significance has many aspects: mental maps are a form to fulfill cognitive processes – "continually adapting structure of the mind" (Henrikson, 1980: 498), they are a way to organize human experience and knowledge and at the same time perceptible diagrams of this organization (Chiodo, 2007); they are also mental structures representing peculiar features of "how an individual grasps his own geographic environment" (Criekemans and Duran, 2011). Thus, mental map is at the same time a phenomenon, i.e. current forms/formats to process, store and spread information (or at least its meaningful part) and a construct, a way to simulate the phenomenon under study.

Semiotic potential of the mental map, its ability to reflect spatial relations and its proximity to the cartographic terminology made the construct of geographic mental maps highly demanded, e.g. in human geography. Geomental maps are mental structures and they reflect the specific features of understanding and adapting oneself to the spatial macro-, meso- and microenvironment and behavioral patterns of different social groups identified based on gender, age, religion and other criteria (Self et al., 1992; Kaplan and Herb, 2011).

In our work we study geomental maps as an object reflecting ways of regional self-identification on a national scale, providing insights into system of interconnections between geographical objects, relevant to its representatives. When reflecting geospace in the consciousness a person actualizes geoconcepts, the system of which can be considered an alternative space of the country, different from the objective geography, captured by maps. Mental geospace representing georeflection of vast population groups implicitly has answers to the questions on the roots of problems or keys to success in the development of certain economic, political and cultural strategies of the state.

In this paper we'll reconstruct generalized mental maps of Russia, reflecting spatial representations of the inhabitants of seven regions of Russia: capital cities (Moscow, Saint-Petersburg), Siberia (Barnaul, Biysk), Southern, Mid- and Northern Ural (Orenburg, Ufa, Perm) and Kaliningrad. For scientific generalization on mental representations of the geospace we used naive maps representing subjective visualizations of personal ideas on geospace.

2. Research methodology

2.1. Cognitive geomapping

Our study is based on the results of unprofessional reflection on the geographical space of Russia. The assumption of the multimodal nature of geoconcepts determined the choice of the optimal method of collecting material for the research: it is an experiment involving the testees into visualization and verbalization of their own spatial images, i.e. actualizing representations based on different modalities. Objectification spatial representations may be carried out by a conventional drawing which allows representing spatial objects, based on their spatial properties (length, composition, aspect ratio, simultaneous existence) that a natural language, operating signs disposed one after another in the time circuit, is unable to make (see also (Rakhilina, 2010)).

One of the methods of studying geographic representations (geographic mental maps) is sketch mapping (Didelon et al., 2011; Saarinen, 1988; Troffa et al., 2009). Sketch maps we also call naive maps to indicate that they are the result of reflection of everyday consciousness of the geographical space, i.e. space significantly exceeding the living space of the subject.

Naive maps are a source for studying cognitive processes of handling spatial information. In particular, the researchers are interested in experimental investigation of the relations between “drawingability, spatialability, spatial memory, and geographic and spatial knowledge” (Bell and Archibald, 2011); in the study of psychosocial patterns of human interaction and its social-physical environment (Troffa et al., 2009; Pinheiro, 1998) and etc.

The experiment of “cognitive geomapping” was carried out as follows:

The respondents were given sheets of size A3 paper and offered the task:

1) on the basis of their own knowledge and representations to draw a map of Russia, on which they were asked to mark the most important geographical features (any objects marked on the maps) of Russia; and to define countries bordering with Russia;
2) to write down near all marked geographical features his or her own associations/ideas connected with these objects (examples of the maps received in the course of the experiment on cognitive geomapping are presented in Figure 1).

For the experiment on cognitive geomapping we invited full-time and part-time students, specialists from various professional fields and qualifications, and retirees. These were people from 18 to 65 years. All in all, we analyzed about 500 naive maps of Russia from capital cities (Moscow, Saint-Petersburg), Siberia (Barnaul, Biysk), Southern, Mid- and Northern Ural (Orenburg, Ufa, Perm) and Kaliningrad.

It should be noted that experiment combined opportunities of information transfer by means of graphic and verbal codes and being aimed at subjective reproduction of the country map it turned into a playful activity, providing the testees with maximum degree of freedom in stating their ideas about objects of our interest. Playful activities minimize experiment artificiality and neutralize its seriousness, while combination of two types of sign systems allows to reveal information that is difficult to encode by means of natural language alone.

Creation of the mental geospace by the interviewed, first of all, is possible thanks to their course of school geography. But the importance of school education should not be either underestimated or overestimated. School knowledge constitutes the initial base of geographical representations, together with stereotypes broadcast by the media, literature and culture as a whole (*Russia is the largest country*; *Baikal is the deepest lake*, etc.), and then reproduced into a “sketch map” by a wide range of informers. This can be proved by the trend of marking geoconcepts discussed in the media: thus, on the maps drawn in 2008–2009, it was Georgia, the military conflict with which was a key issue, while on the maps of 2014 the dominating theme was that of Crimea. We would like to emphasize that temporal remoteness or proximity to the period of schooling is not a significant variable. On the other hand, the factor of a great life experience, which older age groups undoubtedly possess, plays no noticeable part, either. The empirical material shows that the variation in the age parameter (18–20 years old; 30–40 years old; 50–60 years old) reveals the absence of differences between the mental representations of the geospaceby representatives of these age groups.

Unlike directed experiment (Troffa et al., 2009), with the task of drawing a map of the region, the instructions of our experiment did not mention the region of the testee, which implied freedom in choosing geographical objects on the maps created. The wording of the task (to depict a map of Russia) led to a multi-stage spatial identity of the interviewed as it required “fitting” themselves into multi-scale coordinate systems: the world, the country and their region.

Analysis and interpretation were carried out within the framework of the semiotic tradition. Due to the fact that naive maps have multicode nature, semiotic analysis used conceptual apparatus of map semiotics (Bertin, 1983; Neytchev, 2008; Schlichtmann, 2002; Wolodtschenko, 2003).

2.2. Geoconceptology of naive maps. Semiotic codes

We understand geoconceptology as an interdisciplinary field of research, within which geoconcept systems are studied using the tools of naive geography, semiotics, cognitive linguistics, as well as modern computer technology for processing, analyzing and visualizing data. Geoconcept as a set of collective representations of a geographic object is reconstructed on the basis of data combining information presented in graphic and verbal forms of naive maps.

In map semiotics there is a certain language for describing geographical maps. Thus, J. Bertinsingled out eight variables: TWO DIMENSIONS OF THE PLANE, as well as SIZE, VALUE, TEXTURE, COLOR, ORIENTATION, and SHAPE, used to represent “point (a position without area), a line (a linear position without area), or an area” (Bertin, 1983). In the case of the sketch map, we deal with two types of variables: dependent (all the variables listed above) and independent (socio-demographic and territorial characteristics of the participants).

The graphic code on the geo-mental maps that we analyzed is transmitted by the graphic types of objects (points, lines, surfaces, drawings) and their properties (dimensions, location in space, texture). Significant is the presence or absence of an object on the map (for details, see (Zelyanskaya et al., 2017)). The verbal code is represented by toponyms of different types; the presence or absence of textual material accompanying the description of the drawn objects; and the text material itself in natural language accompanying graphic objects.

It can be seen that the graphic signs used by the testees differ from those accepted in map semiotics, in particular, for mental maps an important parameter is not only the presence but also the absence of objects. Another important thing is the degree to which the map is filled with map objects. At the same time, the semantics of signs in “sketch map” is not so “strict” as it is in real maps, it varies from testee to testee. For example, the depiction of cities on maps is related to their size and administrative value. In case of sketch mapping, the relation of characters to displayed objects may be different.

3. General qualitative and quantitative description of objects

3.1. Number of geographic objects

The first significant indication of the graphic level of the analyzed material is the number of objects on the maps.

The selection in the process of analyzing maps of objects is based on the presence of denotative content in images. In this case, the image may either have a verbal description (the name of the object, representations associated with it) or not have it (for example, many pictograms of

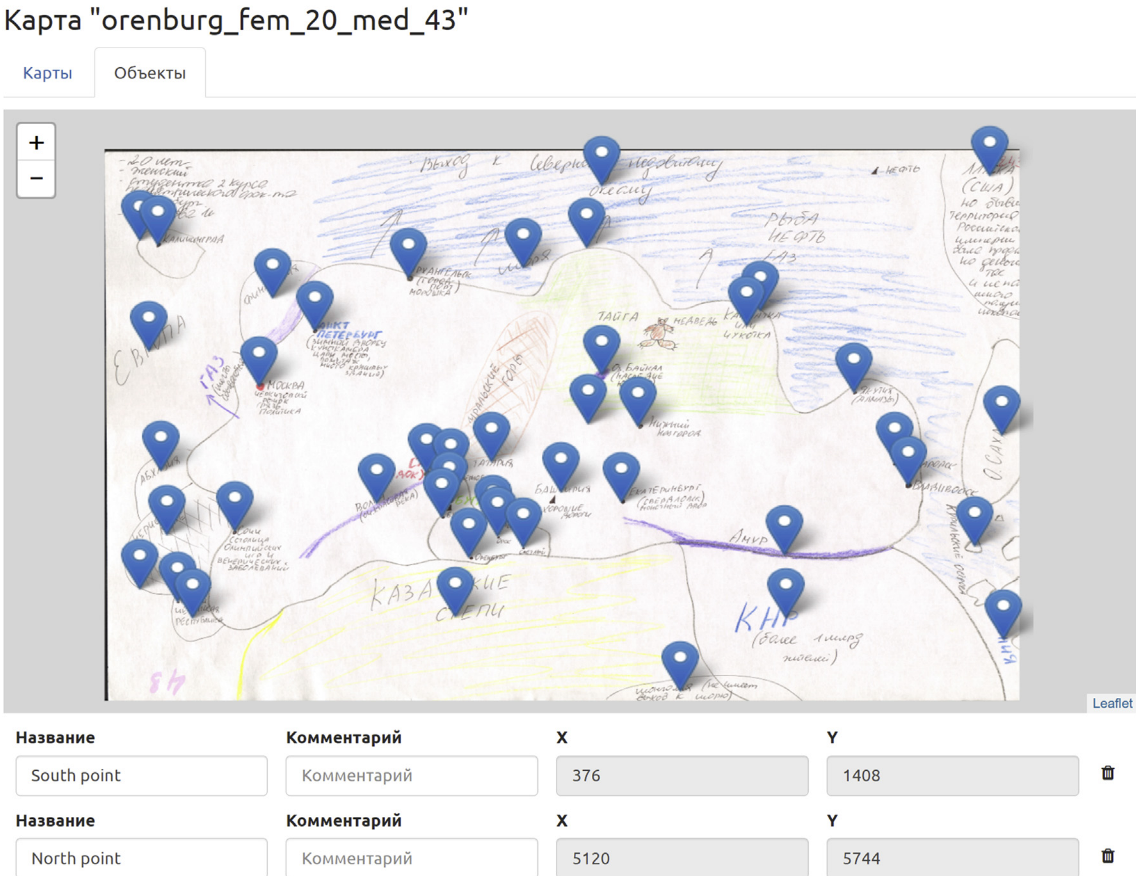

Figure 1. An example of an Orenburg map.

conifers plotted in the place of Siberia, we interpreted as taiga). At the same time images, for which denotative content cannot be set, are regarded as semiotic noise. The objects were countries, cities, roads, regions, rivers, mountains, forests (taiga, forest), seas, etc.

The average number of objects a testee marked is 23.95 and maximum responses (the thickest value) accounted for 18 geographical features. Besides, respondents from different regions show similar results. In the number of objects marked on maps by testees of different age and gender there are no noticeable differences, either.

The information on the objects distribution on the maps once again confirms our thesis about the representativeness of the series: the volume of the studied material is enough to characterize the main features of Russian geoconsciousness. Relatively small quantity of objects marked on the map does not mean a low level of geographical knowledge of the interviewed, but the selectivity of the reflective consciousness of space and emphasizes individual value-based orientation of geomental space. Since the respondents had to coordinate two sign systems in the course of the experiment they were not to demonstrate their knowledge of geography, but to most adequately externalize their ideas about the world.

3.2. Types of geographical objects: natural and social

Of particular interest is the analysis of the types of geographic features plotted on naive maps by testees living in different regions. Two large groups of geographical objects can be distinguished: social (countries, cities, means of communication, state and administrative borders, etc.) and natural (rivers, seas, lakes, mountains, islands, etc.). The results of the analysis of the obtained maps indicate the predominance of social objects, of which the most frequent are the “country” and “city” (they account for 58% of all objects plotted on the map). The following cities are more likely to be found on the maps: Moscow (0.89; represented almost on all the maps), Saint Petersburg (0.73), Vladivostok (0.37), Sochi (0.28), Ekaterinburg (0.27), and Kaliningrad (0.23).

Among natural features the most frequent are rivers (1.64). Further, in decreasing order of frequency, seas (1.03), mountains (0.65), lakes (0.64), oceans (0.41), peninsulas (0.5) and islands/archipelagos (0.43). For the frequency of specific objects, see (Zelyanskaya et al., 2017).

The social space, despite its dominance, is not differentiated: as already noted, it is mainly represented by cities and countries. For comparison, objects such as roads, railways, oil pipelines, etc., which connect the space, are found once on every 25th averaged map. Natural space, on the contrary, is differentiated, however, it is poorly involved in the living space of modern technogenic civilization.

On the whole, the maps are based on man-made space consisting generally of cities and countries. The differentiation of space indicating an interest in economic, industrial, cultural and historical life of the country is very insignificant.

3.3. The size and location of geographical objects: focus on regions

Another important parameter is the size of the objects. First of all, we are interested in any discrepancies of the size of Russia relative to the size of the other geographical objects marked on maps and the total size of the resulting map. But the vast expanses of Russia in the mass geoscience are paradoxically empty: the part of the objects located “beyond the Ural Mountains” is perceived as a store of minerals being given into the power of forces of nature, as an unfavorable climate zone with a minimal number of areas arranged with blessings of civilization. Some testees did not plot a single object in Siberia and the Far East.

However, the Asian part of the country, often terra incognita, is clearly perceived as an integral part of Russia, which must be protected from the demands of neighboring countries (for example, China), which is transmitted through verbal associations.

In general, selection, graphic and location of geographical objects on maps is subdued to the principle of regional centricity. The testee's region often seeks to occupy the center's position on the created map. The other geographical objects are transformed either in size or location depending on the distance from the center: the stronger the further they are from the center. Areas located in close proximity to the subject's place of residence are also subject to the principle of regional centricity: their size and significance increase as much as possible: for example, Kazakhstan, depicted by the Orenburg resident, is larger than China.

Data on the exaggeration of the size and location of own region confirm the results obtained by T. F Saarinen (1988) and S. Battersby and D. Montello (2009); the differences in our results relate only to the scale of the displayed maps – in our case, we deal with regions, not continents.

It should be noted that regional remoteness distorts the geopolitical space not only of neighboring countries, but also of Russian territories. Very often respondents mix up, mismatch or omit differential signs of the regions remote from the place of their residence. For example, inhabitants of Orenburg marked Siberia in the region of the Far North; they do not see borders between territories of Siberia and the Far East. There was also a map on which a testee named one of northern areas as *Kamchatka or Chukotka*.

Thus, regional identity is significant for mental representations of geospace. At the same time, regionality can be "suppressed" by testee's professional identity. Thus, the maps drawn by senior geography students are much closer to the actual geographical map than those drawn by the rest of the interviewed.

3.4. Borders. Seeing the world through "us" and "them" prism

One of possible instruments of graphic code realization on maps is the line of borders. Borders belong to sociocultural, not to natural reality, and are marked on naive maps, as well as on political maps, using lines. A line drawn in the space of the map divides sociocultural communities; and its parameters such as the type of line (continuous/intermittent), its shape and thickness on naive maps, indicate a different degree of "otherness" of sociocultural communities.

Therefore in the humanitarian geography concept of border is one of the crucial, since it is used for demarcation of social, territorial, cultural, scientific and other boundaries (Crampton, 2001; Jones, 2009; Leydesdorff et al., 2013; Paasi, 1999).

The testee's ideas about the separation of "his/her own" world from the world of "them", the world of "others'" are manifested at two levels: the macro-level (the borders of Russia and the rest of the world) and the meso-level (borders of the "small homeland").

In this sense, the borders of Russia form the space of a large homeland, and the borders of the region –that of a small homeland. In addition to graphic means, the interviewed show their attitude towards their home area with the help of verbal code containing predominantly positive assessments. For example, to Orenburg they apply phrases: *my favorite city*; *The city where I was born is the most dear and beloved city*; *My hometown - clean, beautiful, good climate; the best city*; to Perm: *native beloved city*; *my city*; *Hometown*, etc.); to Biysk: *Hometown*; *Homeland*; *my city*, *Science City*; *a small cozy town.*

4. Spatial dependencies between geoconcepts (based on mental maps drawn by the interviewed from Perm, Orenburg and Biysk)

Until now, we discusssed the general characteristics of the mental space topology, obtained on the basis of a qualitative description of the naive maps. The analysis of the location of the informants' cities of residence, the sizes of objects, their colour markers, the presence/absence of borders, as well as the frequency list of significant geoobjects were intended to explicate the dominants in the created geomental space and the variability of its features. The next stage of the analysis is associated with an attempt to construct models of the geomental space from the side of its formal and semantic (using the modeling of the geoconcepts) organization.

The formal organization of the mental spaces has been an object of theoretical and practical study since the 70s of the twentieth century. Thus, W.R. Tobler (1976) offers several models for describing mental spaces, both metric and topological. Research by R. G. Golledge and L. J. Hubert (1982) provides a mathematical description of topological models of mental spaces. At the same time, the authors acknowledge the "omnipotence" of the Euclidean metric models of space (Golledge and Hubert, 1982). Modern studies also use predominantly metric models of mental space, based on GIS technologies. Self-descriptions of the previous spatial movements of devices with GIS positioning technologies (Peake and Moore, 2004) can serve as a material for constructing mental maps, and applications specially created for these purposes (Aram et al., 2019) serve as tools for reconstructing mental spatial maps. Our work describes the construction of computable metric models of geomental spaces – models based on the concept of distance.

The topological properties of space, associated "with the properties of order, intermediateness of elements and safety when changing metric properties (not breaking the continuity)" (Golovko, 2006: 42–43) are taken as a whole as an attribute of geomental space.

In this article, we will restrict ourselves to point objects – the most frequent cities displayed on naive maps in different regions. Each such city, as mentioned above, is a geoconcept in the geomental space, and the systems of the most frequent geo-concepts in different regions represent the regional topologies of this space. In other words, the systems of geoconcepts, considered on the basis of regional naive maps, give a "regional" view of the same space of the country and the world (here we restrict ourselves to studying the space of the country).

As a measuring scale, we propose to consider the metric characteristics of the distances between geoconcepts relative to their actual distances on a reference geographic map. As a result of calculations between geoconcepts, metric distortions are established in the representation of space. These distortions are "compression" or "stretching" of the distances between objects relative to the reference (geographical) map. On the material of maps of several regions, we can trace the variability of metric distortions of regional geomental maps. Metric distortions, despite their sometimes striking inconsistency with reality (for example, the Ural Mountains are often located in the middle of the territory of Russia) do not violate the connectivity of space. For example, whatever the relative distances on naive maps between Orenburg, Samara and Moscow, Samara should be located between Orenburg and Moscow. At the same time, there is another type of distortion – topological, which changes the structure of the geomental map, violates the connectivity of space due to a change in the reference order of the objects in space. To illustrate the topological distortion, it is enough in the last given example to locate Moscow between Orenburg and Samara. Our material contains examples of this kind, as a rule, they refer to geoobjects that are infrequent for regional maps. Due to its peripheral nature and complexity for quantitative analysis, topological distortions have not been studied systematically and can be the subject of separate consideration.

4.1. Geomental maps topology

The problem of spatial dependencies between geoconcepts is related to their location with reference to each other, as well as proximity/remoteness on the mental map space.

We marked out the naive maps received during the experiment with the help of the above mentioned image processing application (see Figure 1 for an example) and measured some of the topological characteristics available for us on the maps from three cities – Biysk, Orenburg and Perm. The scope of the material collected in these three regions by now prevails that from other regions (105, 122, 108 maps respectively). We consider this material more representative for the purpose of reconstructing the structure of geoconcepts, showing regional variations of country's territory connectedness in different degrees.

We assessed geomental maps as arrangements of geoconcepts according to a) frequency principle (most frequently mentioned isolated geoobjects, i.e. cities), b) spatial location/proximity in the hypernetwork, forming its typology.

4.2. Most frequently mentioned geoconcepts

Table 1 demonstrated most frequently mentioned isolated geoconcepts (cities) marked on the mental maps from the three regions of our interest. The first line shows values of "being selfmentioned" – thus, it turned out that not all testees put on their city on the map of the country.

The phenomenon of spatial mental "self-liquidating" is attributed to dissatisfaction, mismatch of "reference pattern" spatial significance with understanding one's region importance for the country.

This phenomenon deserves a deeper study.

The tendency to consider one's region a center is strong: the place of residence is one of the most frequently mentioned geoobjects, and only sometimes it is second to Moscow in being mentioned on the map.

Top 10 geoobjects most frequently mentioned on the maps from all regions (objects with frequency index >0.1 are considered non-significant) are divided into groups, indirectly characterizing regional self-awareness in terms of the loci which are considered significant for the country.

On maps from Perm such objects as Moscow, Perm and Saint Petersburg are mentioned with equitable frequency. Perm is a million-plus city, a regional center and the fact that its citizens do not mention any other significant loci with the same frequency proves that they consider their region in terms of central, capital discourse.

The other frequency group includes such loci as Yekaterinburg, Kaliningrad and Vladivostok. While Yekaterinburg is perceived as a major regional rival in the Ural region, Kaliningrad and Vladivostok are geographically important western and eastern points of the country.

In Orenburg the problem of being understood as a "capital"and "center" is statistically more complicated. Though is a regional center, the city is not large and has up to 600 thousand people, but its frequency of being mentioned is equitable with that of Moscow and Saint-Petersburg; moreover, the city is mentioned in the context of being a "capital/center", thus, regional geoconsciousness sees it as autonomous. We can assume that people from Orenburg juxtapose Moscow and Orenburg as "us/them", as "capital/province" and so on, while Saint-Petersburg is perceived in a different way, exclusively in terms of culture and history.

People of Orenburg attach great importance to Samara, a million-plus city and a closest regional center, which in a number of parameters is considered as "personally" connected to Orenburg.

Biysk is a small town in the Altai Territory (with population of about 200000 people). From the point of view of a small provincial town mental geovision of the "capital" is absolutely different. Moscow stands apart and is perceived as a capital without any possible alternative, without any idea of rivalry. Biysk ranks next in terms of statistics, being clearly different both from Moscow and other loci. Biysk "centricity" in the mental space of the interviewed is attributed particularly to the vision of one's region a central one, to understanding it as own, native world, personalized and emotionally colored.

Saint-Petersburg, Barnaul and Novosibirsk are seen by provincial Biysk people as "capital-cities" understood as important in terms of politics, economics and culture. Interestingly, these "capitals"are juxterposed only with each other and in Biysk people geoconsciousness there is no idea of possible rivalry or opposition to them. For Biysk people Saint-Petersburg is a "cultural" "northern" capital of Russia, Barnaul – a regional center, the closest "capital" space, Novosibirsk is the nearest megalopolis in Siberian region.

Thus, regional geoconsciousness proved to be directly linked to understanding of the scale of one's own place of residence in terms of value-based political, economic, cultural geospaces of the country in general. Million-plus cities and/or regional centers become more significant due to the rivalry with other megalopolises and regional and local centers due to redesigning objective geopolitical picture in regional vision.

For residents of small provincial towns the main principle shaping special features of regional mental space is not the rivalry with geographical centers, but personal impressions, experience and congenial system of shared (stereotype) cultural, historical and/or broadly conveyed modern values.

4.3. Distance between geoobjects

Data received after marking out naive maps were represented as a table (the fragment can be seen in Table 2).

After that we performed computations of the distances between objects. Scaled distance between geographical objects on the naive maps and standard (geographic) maps was computed using the equation (Eq. (1)):

$$L_{AB} = \sqrt{\frac{(X_B - X_A)^2 + (Y_B - Y_A)^2}{(X_E - X_W)^2 + (Y_S - Y_N)^2}} \tag{1}$$

Table 1. The most important cities on the maps from Perm, Orenburg and Biysk.

Geographical Object/Testees' Maps	Perm's maps	Orenburg's maps	Biysk's maps
Perm/Orenburg/Biysk	0,76	0,92	0,76
Moscow	0,81	0,95	0,95
St. Petersburg	0,73	0,70	0,59
Vladivostok	0,37	0,37	0,44
Kaliningrad	0,42	0,28	0,22
Yekaterinburg	0,44	0,36	0,17
Sochi	0,29	0,32	0,22
Novosibirsk	0,17	>0,1	0,56
Kazan	0,19	0,18	>0,1
Irkutsk	>0,1	>0,1	0,12
Barnaul	>0,1	>0,1	0,59
Samara	>0,1	0,53	>0,1
Ufa	>0,1	0,35	>0,1
Arkhangelsk	0,15	>0,1	>0,1

Table 2. Coordinates of geographical objects on the naive maps (fragment of the table).

Geographical Object/Testees' Maps	Testee 1		Testee 2		Testee 3		Testee 4	
	x	y	x	y	x	y	x	y
Moscow	9.24	9.93	5.89	10.27	9.88	8.24	15.49	13.07
St. Petersburg	8.96	7.46	8.30	8.85	8.06	7.11	15.65	14.13
Perm	16.42	14.52	16.33	13.49	13.93	9.85	20.4	14.16
Kazan	14.44	13.47					21.63	11.39
Yekaterinburg	18.48	12.71			13.43	10.91	22.22	16.61
Kaliningrad	0.41	6.95	4.67	6.07	5.29	6		
Vladivostok			36.98	22.28	32.9	16.2		
Sochi					9.59	13.54	14.49	17.96
Arkhangelsk			6.93	19.11	11.56	7.22		
Novosibirsk			20.36	16.35	22.57	11.22		
West (to the left)	0		4.46		4.81		7.88	
East (to the right)	37.23		39.67		36.77		32.05	
North (upper part)		2.98		3.89		4.46		6.95
South (lower part)		21.95		22.56		16.44		24.43

where, A, B are cities A and B; E and W are extreme points on axis OX (eastern and western); S and N are extreme points on axis OY (southern and northern).

To show the distance as we know it we multiplied the data received in Eq. (1) by the ratio equal to diagonal line length of the standard (geographic) map (r = 10732.825 km). It allowed us to show all naive maps in the uniformed scale of the standard map (Eq. (2)).

$$R_{AB} = r\, L_{AB} \tag{2}$$

4.4. Distance diagrammatic models in the framework of regional naive maps

Ration of the distance median value between objects on naive maps to the distances on the actual geographic maps illustrates the structure of

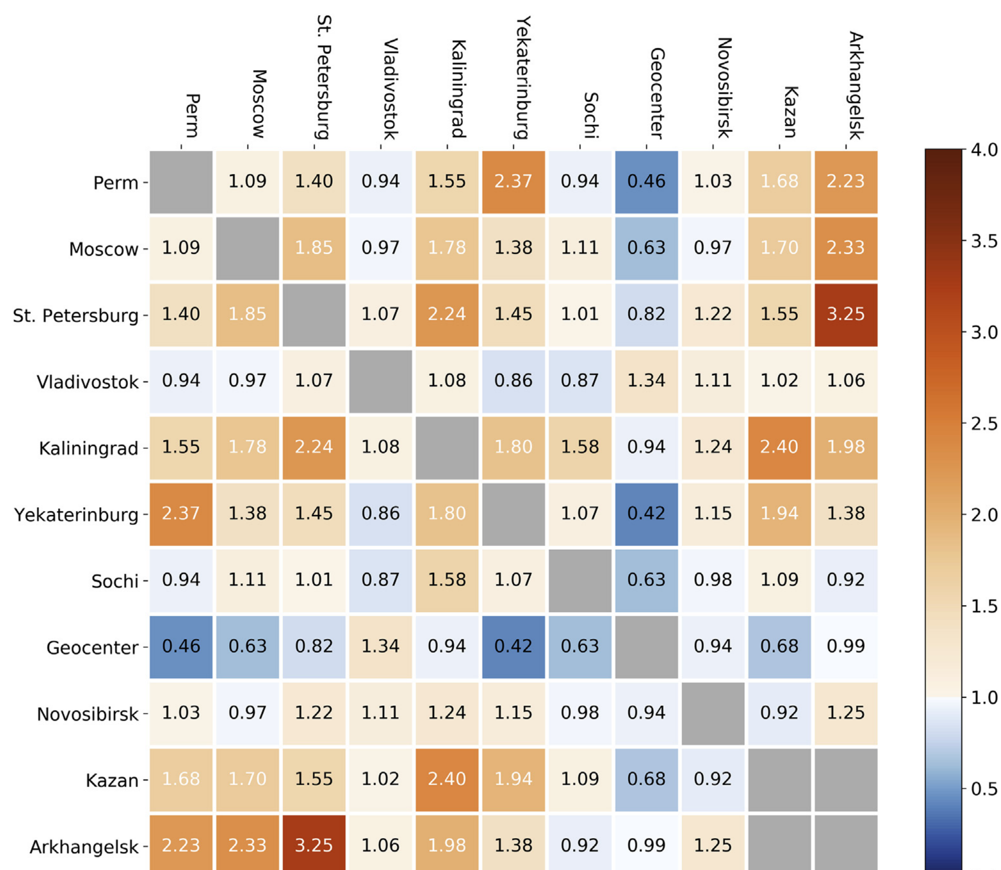

Figure 2. Structure of the spatial relations between geographic objects on the Perm naive maps.

the space (in the context of shrinkage/expansion relative to the standard of comparison), viewed upon from any point in any direction.

Figures 2, 3, and 4 visualize the structure of space maps from Perm, Orenburg and Biysk in the aspect of the distance between geolocations with maximum frequency.

Boxes at the intersection of the rows and columns, referring to cities, demonstrate a degree of space shrinkage/expansion between these cities. Blue pole (from 0 to 0.89) reflects a degree of mental space shrinkage relative to reality: the more intense is the blue color, the closer to each other the interviewed put geoobjects. The red pole (from 1.11 and higher) shows the degree of space expansion: the more intense is the red color, the farther from each other are the loci on the naive maps. White and pale-colored boxes (from 0.9 to 1.1) reflect geolocations the distance between which is closest possible to that on the actual geographic map. If the cities are not shown on the same map within one series, their intersection on the diagram is colored gray. Besides location of cities we focused on the geographic maps center – on both naive and actual maps – since we aimed at estimating the degree to which mental space of the Russian citizens is region-oriented, region-centered.

Figure 2 reflects mental distances between geoobjects characteristic of Perm series of studies.

A considerable part of distances in the structure of Perm maps corresponds to the geographic parameters (white sector being 35% of all distances between geolocations). Approximately 15% of all distances accrue to space shrinkage (blue sector), space shrinkage tendency being characteristic for the distances set from geocenter, i.e. the interviewed tend to approximate a great number of the cities located in European part of Russia to the center of the map. 50% of all distances accrue to space expansion (red sector). Space expansion is common on the one hand cities located far from each other geographically and on the other hand for the cities located near the northern (Arkhangelsk) and western (Kaliningrad) borders of the country. Expansion of the mental distance from Perm to Yekaterinburg can be considered an example of regional rivalry implying different scaling, so-called "regional scaling". Space expansion in respect of cities, "moved" to the borders can be attributed to the fact that the interviewed tend to misplace other cities located in European part of Russia to the center of the map, thus increasing the distance towards the boundaries of the country. However, the most easterly point – Vladivostok is generally perceived realistically: a minor space expansion can be seen only in respect of the geocenter which, especially if we take subjective approximation of Perm to center into consideration, only highlights the remoteness of the Far East from the center of the country and problematic communication with this region.

Figure 3 shows distances between cities on Orenburg maps.

Mental space of this region proved to be the least realistic. Only 7% geolocations are close to actual geographic location. These are primarily cities on the western and eastern borders of the country: Kaliningrad and Vladivostok are located quite realistically relative to each other. The eastern point of the country is located correctly relative to Moscow and Saint-Petersburg, while the western point – relative to geocenter.

The rest of the space is subject to subjective distortion. Distance shrinkage (24% of all geoobjects of the region) is mainly attributed to approximation of the significant loci to the geocenter. All cities are misplaced towards the center of the map, so, while western and eastern boundaries of the country are designated correctly, the northern and southern boundaries are narrowed or left "empty", since mentioned locations from these regions are considerably moved towards the central part. The city of Orenburg itself though located close to Kazakhstan is misplaced by the interviewed closer to the geocenter. Vladivostok is the only exclusion: this city is on the contrary, further moved from the center, since it is perceived as a significant, but remote region.

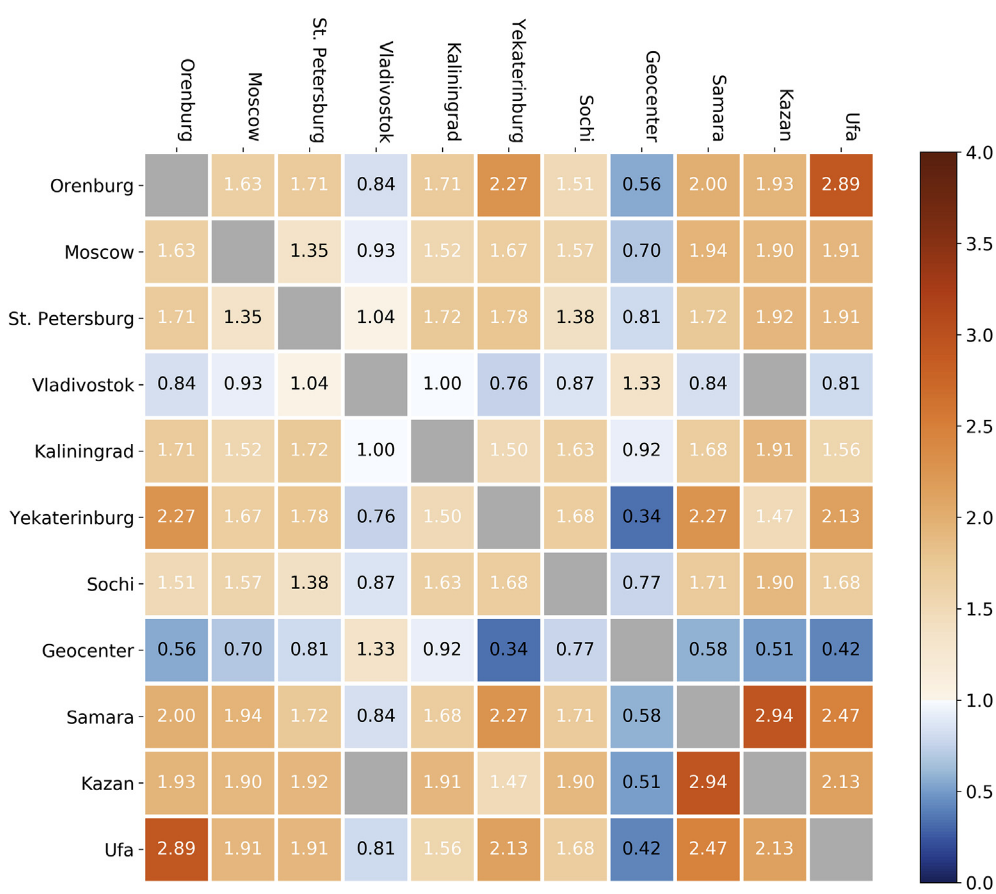

Figure 3. The structure of spatial relations between geographical objects on the naive maps of Orenburg.

Interestingly, among other most frequently marked loci drawn by Orenburg citizens Vladivostok is the only locus from western and northern parts of Russia.

Vast spaces of Trans-Urals – Siberia, Far East are terra incognita for Orenburg citizens and they leave them barren of any locations. That is why Vladivostok, paradoxically, as a part of unexplored world is drifted away from the geocenter, but at the same time is moved closer to Orenburg and other regional centers and large cities. Thus certain approximation in this case is attributed to value criteria, not to geography.

For other, more closely located and famous cities Orenburg mental space follows the law of regional scaling: they are placed farther from each other than on actual geographical maps. Distance shrinkage between objects is observed in 69% of cases and these are the loci of the European part of the country, to where according to its citizens, Orenburg belongs, too.

Remoteness of Orenburg from Moscow and Saint-Petersburg as a rule looks more realistic than its remoteness from cities of Ural region. The space becomes especially expanded when showing distance from Orenburg to Samara and Ufa, the nearest million-plus cities. Distance expansion together with a strong tendency to give local geolocations more details can be attributed to involvement of personal implications – likes and dislikes, competition, absence or presence of transportation and communication facilities, etc.

Thus, Orenburg mental space follows general trend of considering one's region a central one, which in case of a city from southern part of the Cis-Ural region results in a considerable displacement of loci. Central part of Russia becomes too large in comparison to the whole Russia, Trans-Ural regions are barren of special features, are very sketchy or disappear altogether.

Figure 4 represents Biysk testees' vision of the distance between cities, most frequently shown on the naive maps.

Biysk citizens showed the most realistic spatial correspondence in their mental vision of the country's geography: distances between 43% of geoobjects on their maps have not been distorted. Such accuracy must be attributed to the fact that Biysk location is very close to the center of the actual geographical map which is reflexively taken by all testees as a model when reconstructing the map of Russia. Biysk citizens have a right to consider their region a central one, their mass geoconsciousness does not digress from the truth.

Still, a great number of frequently mentioned objects are shown closer to the center (all in all, space shrinkage was noticed with regard to 13% of the loci). Distorted centralization with regard to geocenter affected Moscow, Saint-Petersburg, Yekaterinburg – an important million-plus city of the Ural region, Novosibirsk – a Siberian metropolis, Sochi – one of the most popular and growing resorts of Russia. Geographical center again becomes almost completely equivalent to the value-based center.

However with regard to Biysk the above mentioned loci are located more or less realistically. Thus, Biysk citizens' value-based personal space coincides with geographic space which fact proves our earlier made conclusion on absence of rivalry discourse in respect to metropolises from regional mental space of minor provincial towns.

Still, the regional scaling law becomes challenging for Biysk citizens, too. Geoloci, closely located to Biysk – Siberian cities of Irkutsk, Novosibirsk and especially Barnaul (the closest capital city) are mapped by them farther that they are located in physical world. Siberian region is growing, is expanding, is accumulating facts of personal history.

At large, space expansion was notices in 44% of loci. Besides distances between Siberian cities, there is increase in the distance to western boundary. The reasons must be of a different nature.

The westernmost point of the country – Kaliningrad – from Biysk is considered remote both in terms of territory, and in terms of values. The

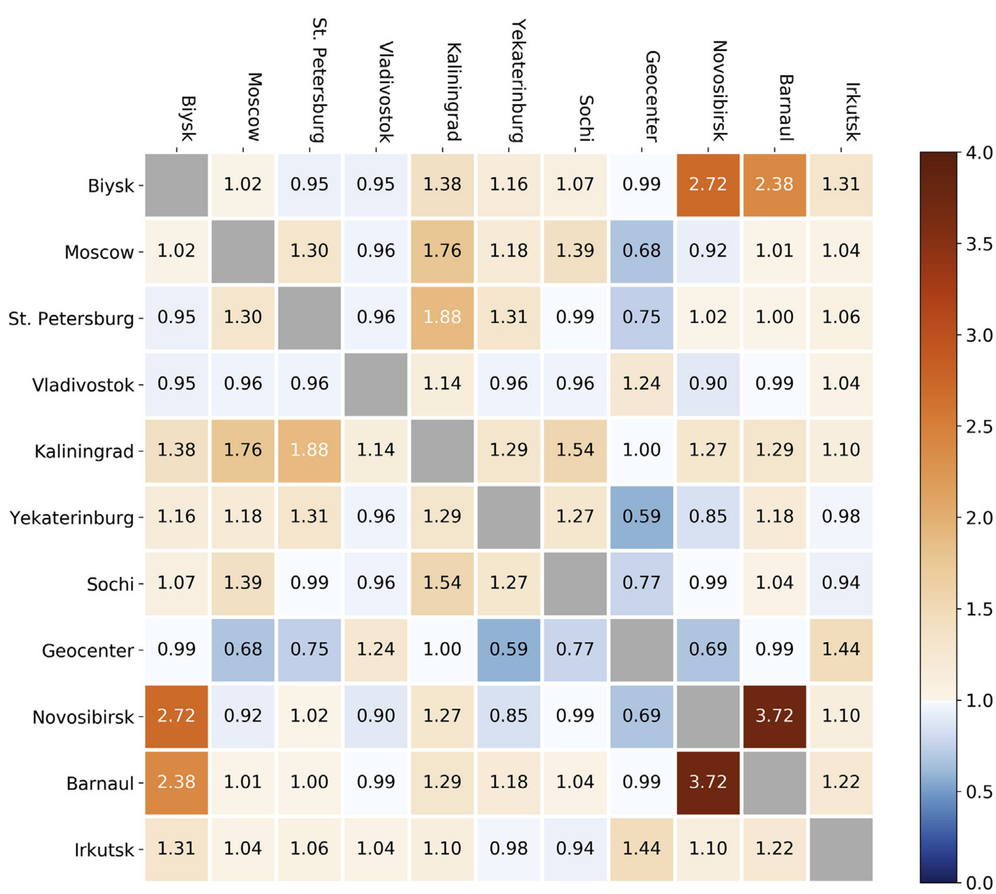

Figure 4. The structure of spatial relations between geographic objects on Biysk naive maps.

greatest distance expansion was noted between Kaliningrad and Russian capitals – Moscow and Saint-Petersburg, i.e. with regard to central regions as representing main cultural and historical values of the country and its recent social and political attitudes.

Thus, distance shrinkage/expansion on the naive maps as compared to actual geographic standard allowed to reveal a number of essential factors of mental mapping the country spacefrom regional points of view.

Considering one's region a center of the personal vision is a factor contributing to space distortion: all significant geoloci – beginning with the testee's region, are moved to the geocenter. Insignificant geoobjects are shown sketchily and unsystematic, or completely disappear. Awareness of Russian boundaries is also influenced by chosen partially geographic but mainly value-based location of the important loci towards the center: when identifying their region as European, the interviewed misplaced eastern boundaries, when ascribing themselves to eastern part of the country they misrepresent the most westerly point of the country.

Aggravating factor, adding to redesigning geographic reality is region's assertiveness, beliefs of its citizens into the region's self-sufficiency and into the importance of their cultural, economic and political input into the country's development. From this perspective all significant loci with which the region builds up relations of cooperation and/or competition tend to undergo centralization.

However irrespective of the own assertiveness, people living both in smaller provincial towns and million-plus cities are influenced by the regional scaling law, which we singled out during our investigation. Distances between loci geographically nearest to each other become longer on the mental map, which contributes to augmentation of the regionally important areas in comparison to other regions of the country.

5. Geoconcept MOSCOW through collective regional vision

Semantics of verbal associations gives an insight into alternative topology, which has a different nature in comparison with geospatial topology. Connections between words in the mental space shine a spotlight on the reasons why these or those loci were shown on the naive maps and located this or that way, give a clue to the logic with which Russian geospace mental representations was organized by the testees. One of the most representative markers of the mental space structure is collective regional vision of the capital.

Analysis of the verbal associations (naive maps verbal level) was performed with the help of graphosemantic simulation using SEMOGRAPH Information System (http://semograph.org), meant to reveal connections between units of the information space of the text or texts selection (learn more about how to work with texts using SEMOGRAPH Information System (Baranov et al., 2019; Belousov et al., 2017).

The analysis was done in several stages.

1. All verbal associations connected with Moscow from Perm, Orenburg and Biysk maps were fed into SEMOGRAPH Information System.
2. Using words-associates we developed a system of semantic fields; components of each field contain semes found in words-associates. We understand a semantic field as “corpus of language units with common content and reflecting conceptual, thematic and functional similarity of the denominated phenomena” (Apresyan, 1995: 252). Associations, connected by a testee to one locus may refer to more than one field (for example, *Capital of Russia*, *Red Square*,*damned city* (from testee Perm, female, 18, philologist) – fields *Capital*, *Red Square*, *Negative attitude*). When developing a system of fields we used materials on studying an image of a city (see (Sevin, 2014; Vailaya et al., 1998).
3. We classified all words-associates attributing them to one or several semantic fields depending on the number of semes included into different fields.
4. When classification was finished we generated Table 3, showing frequency of semantic fields in the words-associates of Perm, Orenburg and Biysk naive maps.
5. Since one word-associate (testee's reaction) may refer to several semantic fields there is an opportunity to generate a semantic map

Table 3. Frequency of semantic fields in the words-associates of Perm, Orenburg and Biysk naive maps.

Fields	Perm	Orenburg	Biysk	Examples
Capital	0,67	0,44	0,26	The capital of our country!
Other locations	0,10	0,10	0,04	Cherkizovskiy market; Metro; TSUM; The Mausoleum
Positive attitude	0,06	0,10	0,08	Beautiful; The city of the dream
Negative attitude	0,21	0,08	0,06	Corruption; Haste, bed health
The Kremlin	0,15	0,08	0,06	The Kremlin
Red Square	0,06	0,07	0,02	Red Square
Center	0,08	0,06	0,04	Center of Russia
Contemporary leaders, rulers, outstanding politicians	0,13	0,06	0,03	Yeltsin, Putin, Medvedev
Dense population	0,08	0,06	0,02	Dense population; traffic jams
Large scale	0,04	0,05	0,01	Metropolis; Great; Huge
Political center	0,10	0,05	0,03	Politics; Government; President
External stereotypification	0,04	0,04	0,03	Haste, matreshkas, ushankas, tourists, foreigners
Historical and Cultural milestones	0,02	0,04	0,00	Ancient city; Victory parade
Personal connections, experience	0,04	0,04	0,03	The person I love studies there
Prosperity	0,00	0,04	0,03	Moneybags harbor there, prominent businessmen
Money	0,04	0,03	0,04	A lot of money; Money eater
Show business	0,04	0,02	0,03	Show business; Eurovision
Power	0,02	0,02	0,01	Nobody loved power, but all loved Russia
Trade	0,00	0,02	0,00	The most important trading center; Many shops
Prospects and opportunities	0,00	0,02	0,03	One can make a lot of money there
High prices	0,02	0,02	0,01	One of the most expensive cities
Irony	0,02	0,02	0,01	Rubber city
Celebrities	0,02	0,01	0,02	Celebrities; Stars
Counterposition to the country as a whole	0,02	0,01	0,08	Another state
Object of desire	0,00	0,01	0,02	The city where I would like to stay
Average number of fields per map	2,00	1,54	1,03	

showing fields connectedness as being referred to the same contexts. Visually semantic map is represented as a semantic graphical chart, whose peaks are semantic fields and whose edges show the number of simultaneous reference of two fields to the same words-associates. To develop charts we used desktop application Gephi. Geoconcept here is represented as a system of interconnected semantic fields. Figures 5, 6, and 7 demonstrate Perm, Orenburg and Biysk "projections" of the geoconcept MOSCOW.

Visual representation of the geoconcepts as a semantic fields system facilitates interpreting every regional "section" taking the following factors into consideration: 1) field weight, i.e. its frequency among words-associates of every regional series (weight is conveyed with the size of the peak); 2) edge weight, i.e. joint/simultaneous presence of the two fields in the same contexts is an indication of the fields connectedness (is shown by the edge thickness); 3) subgraphs (modularity classes) inside the graph, singled out based on graph modularity method (Blondel et al., 2008; Lambiotte, 2015). Modularity classes enable us to see subgraphs within the graph, whose peaks are oriented into more or less independent substructures. Semantic fields location refers to graph drawing algorithm (sudgraph division and minimum amount of edges intercrossing).

Figures 5, 6, and 7 demonstrate that fields connectedness system decreases when moving towards the next graph while the number of subgraphs is contrastingly growing.

Tightness of Perm graph (see Figure 5) makes up 0.229; tightness of Orenburg graph – 0.212; Biysk graph tightnessis 0.169. The decrement can be attributed to the decrease of the average number of fields (correlating with the increase of the distance from Moscow): on Perm maps there are on average 2.00 fields, on Orenburg – 1.54, on Biysk – 1.03. Weakening of graph connectivity leads to detachment/separation of new subgraphs, which denotes the absence of the common ground for certain regional interpretation of the geoconcept. Regional projections of the geoconcept MOSCOW considerably vary. Thus, dominating semantic field on the Perm maps is *Negative attitude*, connected within the graph with almost all fields.

The impact of the opposite field *Positive attitude* is noticeably weaker and is linked with *Landmarks* and *Large scale*. The latter is interesting since testees from Perm unlike other interviewed consider *Large scale* as an advantage, which however is not revealed through connections with fields of potential self-actualization.

Miscellaneous locations, connecting "state-constituting" subgraphs (*The Kremlin*, *Red Square*, *Contemporary leaders*, *Historical and cultural milestones*, *Political center*) with social sphere subgraphs (*Trade*, *Prosperity*, *Dense population,* etc.) proved to be the most significant for Orenburg projection (see Figure 6). Moreover, state-constituting subgraphs are interpreted as *Positive attitude*, while social sphere subgraphs are referred to as *Negative attitude*. Furthermore, *Prospects and opportunities* are revealed not via private sphere ("myprospects and opportunities"), but via prospects and opportunities of state institutions.

Biysk projection of the geoconcept MOSCOW (see Figure 7) is greatly sampled; its every subgraph is relatively self-sufficient. One of the two most significant fields is *Counterposition to the country as a whole*, which on the one hand, is revealed through green subgraph (*Money*, *Prosperity* and the like) and the interlinked field *High prices*, while on the other hand it intersects with subgraph *Prospects and opportunities*, in this case it is personalized and linked to the field *Object of desire*.

Geoconcept MOSCOW on Biysk maps is structured in terms of *Positive attitude*. *Negative attitude* is revealed locally and associated with *Dense population* and *External stereotypification*.

Despite structural difference between Perm, Orenburg and Biysk graphs (Figures 5, 6, and 7) there is much in common in their content. Among other things, all personal experience of the interviewed associated with Moscow was represented. For Biysk testees it is limited by the city's geography: The Kremlin, Red Square and other places, referred to "personal story" via *Positive attitude* (violet subgraph).

For Orenburg testees, like for Biysk testees, own experience is realized through the geography of the city (The Kremlin, Red Square and other places). Personal experience of Perm testees is negative (violet subgraph) and refers to diverse aspects of the concept: "overcrowdedness"of a big city, geography of the city and many others, which is difficult to put into a single category. However *Positive attitude* to Moscow is also included into this cluster.

Thus, simulated geoconcept MOSCOW gives a clue to understanding different principles, underlying mental representations of one and the same locus, associated with its significance for the geospace, and affected by the remoteness of the testee and parameters of the locus where the testee resides.

6. Conclusion

Naive maps, being subjective visualizations of individual ideas about the space are a source of scientific generalization on mental representations of the geospace and geoconcepts. naive maps are first of all characterized by reproducibility and repeatability, which was proved in the investigations by M. Blades (1990). It means that mental representations of the geospace and geoconcepts are stable which proves that collective representations of the geospace, geoconcepts and their structures are stable, too.

Polycode nature of the naive maps combining spatial-graphic and verbal signs contributes to the close connection with semiotics, while "passage" through naive maps to the mental representations of the geospace is linked with cognitive science. Regionality as was proved by our investigation is another essential aspect to study. Whenever professional activity of the interviewed had nothing to do with geography, "region-oriented point of view" became a dominating factor affecting their understanding and interpreting geospace.

For the concept presented in the study significant is the notion of geoconcept and related notions of geomental map and geoconceptology. A geoconcept, synthesizing ideas about a geographical location, its name (toponym) and spatial parameters, is considered both as a neurocognitive unit of an individual mental space and as a sociocognitive construct obtained by summarizing mental representations of the same geoobjects from representatives of certain sociocultural communities. Our modeling of geoconcepts is connected, first of all, with the semantic analysis of verbally expressed representations of geographical objects, resulted in graphs of semantic fields. Semantic graphs indicate the directions of categorization of geographical objects in the mental spaces of subjects and sociocultural communities.

Geoconcepts taken at the levels of individual or collective representation of geographical objects exist in interconnection with each other. Systems of interconnected geoconcepts in the study are designated as geomental maps. The paper shows some of the possibilities of analyzing the system of geoconcepts representing the most significant cities for mental maps of three regional communities.

In general, the understanding and interpretation of geospace on the basis of naive maps can be studied within several "paradigms": a) general qualitative-quantitative description of objects and their codes; b) space topology – i.e. variable geospace structure, depending on the region of the testees and showing spatial relations between geoconcepts, including their potential localization zones, location with reference to each other, proximity/remoteness on the geomental map space; c) geoconceptology – i.e. a system of geoconcepts whose structure depends on the "point of view" of the beholder (region of residence).

The scope of this work allowed us to consider only three regional points of view on the geospace of Russia and three projections of one geoconcept – MOSCOW. However even these results showed a considerable discrepancy in understanding the country's territory and its political and economical center.

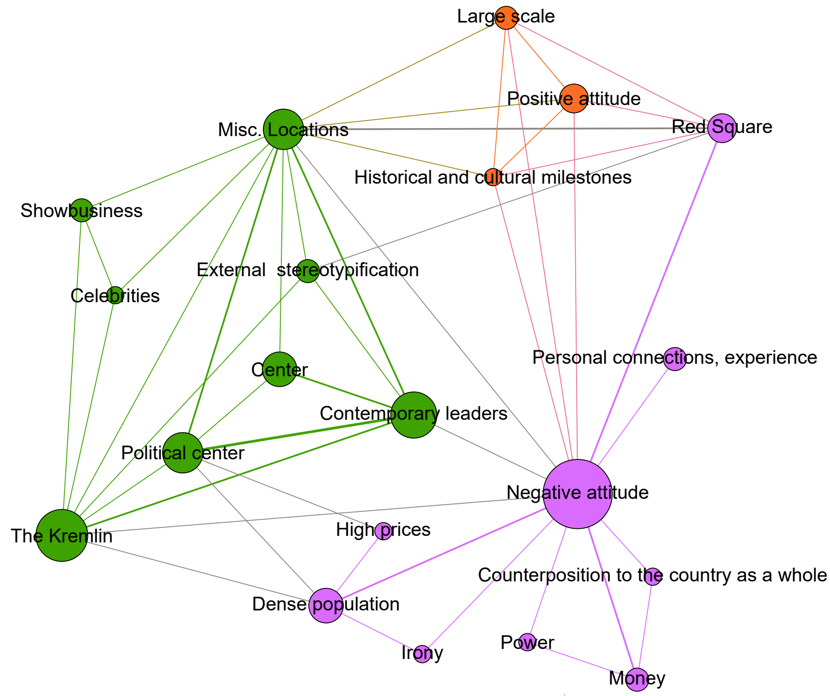

Figure 5. System of semantic fields of the geoconcept MOSCOW (maps from Perm).

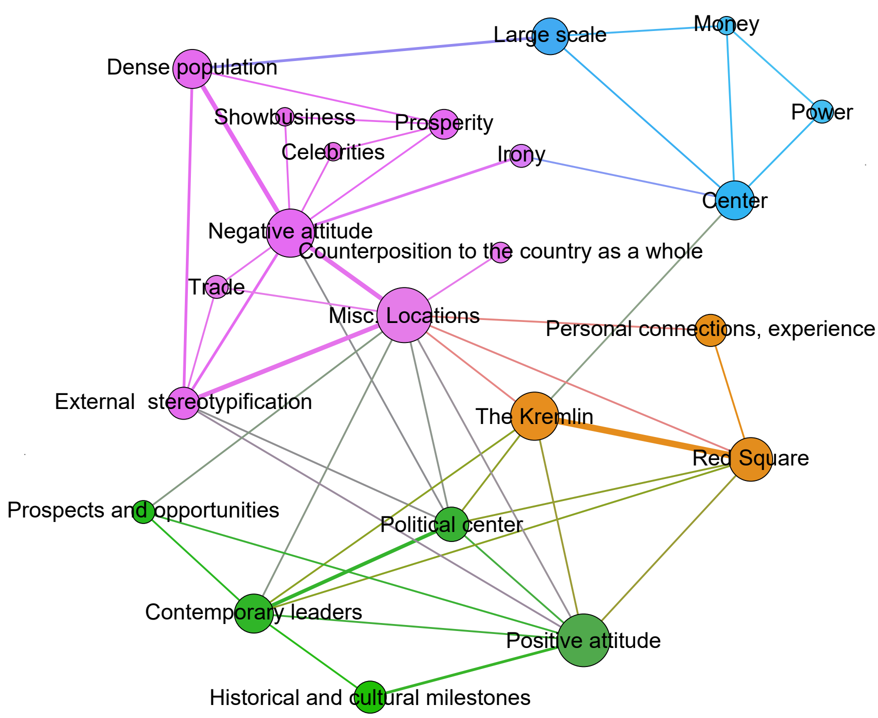

Figure 6. System of semantic fields of the geoconcept MOSCOW (Orenburg maps).

Naive geography investigations are difficult to conduct since naive maps are not easy to collect in other regions and process. Besides there is a problem of measuring all polycode texts parameters and choosing accurate analytical methods when singling out regularities in distribution of the parameters and dependencies between them, especially if these are parameters of different types. The problem can be solved by applying information technologies implying qualitative transformation of naive geography. State-of-the-art computer technologies facilitates naive geography investigations at all stages: those of collecting, processing and analysis of data and of results representation. Modern technologies allow to enhance the territory of collecting data (digital naive maps) and to analyze maps with the help of computer programs, which otherwise would be next to impossible since they are a multimodal object of study, combining a) geoobjects spatial-graphic codes (size, color, coordinates, location), b) language codes (represented by associations/ideas, connected to these objects and by their names), c) timing parameters (order of mapping objects, time intervals between mapping this or that object), d) frequency parameters (frequency of occurrence of this or that object in

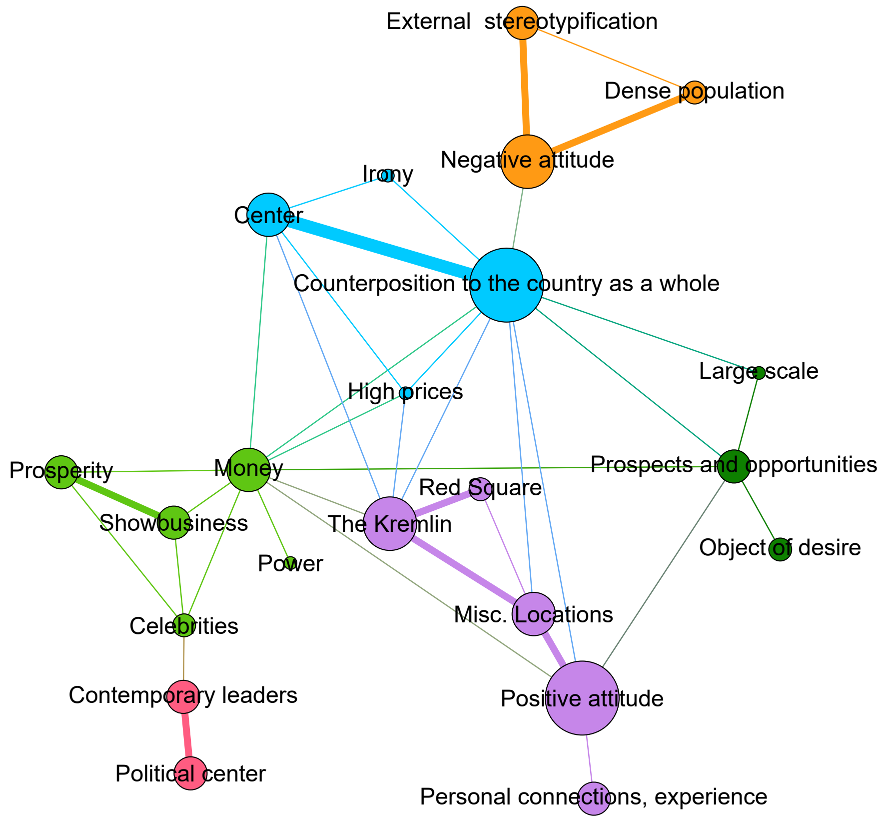

Figure 7. System of semantic fields of the geoconcept MOSCOW (Biysk maps).

the naive maps series) and e) geographic data on the objects, which enables to reveal latent dependencies and structures in the naive maps data.

Naive maps online processor CREATIVEMAPS. STUDIO we have been developing within the framework of our investigation will help to enhance the database of the maps, to variegate regional representation of the testees and will add to more detailed and informative processing of the received material.

Thus the future of the naive geography is in transition from qualitative descriptions and descriptive statistic methods to simulation based on multivariate statistic methods, computer-aided learning and visual analytics. This transition will allow researchers to use collective representations of the people from different regions of the country on geospace to solve urgent problems, since the country's most crucial issues are synthetically reflected in the collective representations of the country's citizens. For Russia these are the problems triggered by its great spatial extension, low population density (especially in Siberia and Far East), poor development of the infrastructure, geopolitical status of being a "bridge" between Europe and Asia, cultural isolation, remoteness from the centers and many others. Diverse regional projections help to reveal the importance of certain geoconcepts for different regions, and in the long run to make conclusions on connectedness of the territories and clusters formed by these stable connections.

This material, especially with the transition to methods of collecting primary data using web applications, can be used to search for relevant metric and topological models of the mental maps. Since it is reasonable to assume that the topology of the mental space cannot have the same properties for all people, it should be assumed that for different naive maps (and maybe for different fragments of one map), different mathematical models that have been tested earlier can be used (Tobler, 1976; Golledge and Hubert, 1982; Peake and Moore, 2004). The metric models we use can be applied not only to analysis of the regional distortions of the country general space, but also in research on the mental mapping of cities from the point of view of the social and ethnic groups living in these cities.

The current limitations are related to the original data format – digitized sketch maps, which allow building models primarily on point objects. With this approach, we are limited in the analysis of other semiotic systems (the colors of geo objects, for example) due to the possible absence of an appropriate tool (the necessary pencil, pen, etc.). Another side that is difficult to take into account in the analysis process is the variability of graphic objects (images of any realities), which are sometimes difficult to differentiate. Transition to the digital naive maps, which are created in the web editor on the basis of the tools and icons of objects (settlements, cultural heritage, landscape, natural objects, etc.) makes it possible to work with the entire spectrum of data (coordinates, size, color, length, etc.). The limitations in this case are associated with the predefined types of objects and their instances. At the same time, collecting maps using a web application allows us to contact directly people who live in different parts of the country (this is especially important for Russia).

Declarations

Author contribution statement

Zelianskaia N. L.: Conceived and designed the experiments; Wrote the paper.

Belousov K. I.: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Galinskaia T. N., Ichkineeva D. A: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

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Data availability statement

The research data (the most interesting and discoverable sketch maps) used in the paper are available from: http://naivemaps.ru [in Russian]. The most part of the primary material is available as follows: sketch maps of Russia performed by the testees from Orenburg ('Orenburg maps') - from https://naivemaps.ru/?page_id=392; 'Biysk maps' - from https://naivemaps.ru/?page_id=395; 'Perm maps' - from https://naivemaps.ru/?page_id=388.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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