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Color in Mental Maps and Geoconcepts of China

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Abstract: This paper is devoted to the study of the role of color in the objectification of mental representations of geographic space in the mental map form. It also examines the influence of color tradition associated with a geo-object on the structural-semantic organization of its geoconcept. The relevance of this research is due, on the one hand, to the contemporary cognitive scientific interest in mental space representations, and, on the other, to the investigation of the functions of sensory information in the organization and objectification of these representations. The research methodology involves a multi-stage process, including: (a) the collection of digital mental maps, carried out with the web application "Creative Map Studio"; (b) the preprocessing analysis and visualization of respondents' color associations using Python and its libraries; (c) the semantic analysis of the textual layer of mental maps and the construction of graph-semantic models of geoconcepts. The study is based on 247 mental maps of China collected in 2019–2024 in Chinese universities. With the new empirical material, the paper statistically confirms the structure-forming functions of color in the organization of geo-mental representations of space, revealing a statistically significant relationship between the number of used color shades and the volume structural information in the mental maps. In addition, the study supports the hypothesis that color has a natural clustering function in the structural-semantic organization of geoconcepts (as exemplified by the geoconcept of *Shanghai*).

Keywords: mental map, geoconcept, geo-object colorimetry, semantic field, graph-semantics, clustering

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оригинальная статья

Цвет в ментальных картах и геоконцептах Китая

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Аннотация: Статья посвящена описанию результатов исследования роли цвета в объективации ментальных репрезентаций географического пространства в форме ментальных карт. Цель – рассмотреть влияние колористической традиции, связанной с геообъектом, на структурно-семантическую организацию его геоконцепта. Актуальность работы обусловлена интересом современной когнитивистики, с одной стороны, к ментальным репрезентациям пространства, а с другой – к исследованию функций сенсорной информации в организации ментальных репрезентаций и их объективации. Методология исследования представляет многоступенчатый процесс, включающий (а) сбор цифровых ментальных карт, проводимый в веб-приложении «Студия креативных карт», (б) предобработку, анализ и визуализацию цветовых ассоциаций информантов, осуществляемых с помощью языка и библиотек Python, (в) семантический анализ текстового слоя ментальных карт и построение графосемантических моделей геоконцептов. Материалом послужили 247 ментальных карт Китая, собранных в 2019–2024 гг. в китайских университетах. На новом эмпирическом материале были статистически подтверждены структурообразующие функции цвета в организации геоментальных репрезентаций пространства: выявлена статистически значимая связь между количеством используемых оттенков цвета и объемом (а также структурой) информации в ментальных картах. В исследовании обоснована гипотеза о наличии у цвета естественной функции кластеризации структурно-семантической организации геоконцептов (на примере геоконцепта *Шанхай*).

Ключевые слова: ментальная карта, геоконцепт, колористика геообъектов, семантическое поле, графосемантика, кластеризация

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Introduction

Color is one of the basic characteristics of visual information processing [Furbee et al. 1996], and the subject area of color and color nominations is a strategically important area of research, since it is at the center of a number of current theoretical problems in the social sciences [Moore et al. 2002]. From an evolutionary point of view, in the ancestors of humans and other higher primates, the role of olfaction declined in parallel with the development of color vision. Color vision evolved from dichromatic (our distant ancestors saw mainly the blue-yellow range) to trichromatic, allowing us to distinguish up to 1 million colors

[King 2005]. There is a hypothesis that some women, due to a genetic variation on the X chromosome, have a potential tetrachromacy, and, thus, they have a more subtle color perception than standard trichromats [Furbee et al. 1996].

Color plays an important role in visual information processing. Color accelerates recognition of scene objects and increases recognition accuracy. In a series of experiments conducted by F. A. Wichmann and colleagues, it was found that the accuracy of object recognition is higher for color images of natural scenes than for brightness-matched black-and-white images. In addition, color helps to better remember complex scenes, and, conversely, achromaticity of the scene worsens memorization [Wichmann et al. 2002].

For mental representations of geographic space, color is one of the most important principles of the conceptual and structural organization of mental maps. Color, being the primary characteristic of a natural visual scene (grass is green, sea is blue, etc.), at the next level of symbolization is transferred to socio-cultural values and realities (power / emperor = red, death = black, innocence = white), which vary in different ethnocultural contexts [Meng 2022]. And if for natural objects of mental maps (reservoirs, relief, etc.) color is naturally borrowed from the coloristic characteristics of the objects themselves, then for non-natural objects, primarily settlements, color is determined by the role that these settlements have played and play in the life of an ethnic group throughout a long history. From this point of view, the coloristics associated with a geographical object is part of its geoconcept, by which we mean a conceptual system formed on the basis of collective ideas about a geographical object [Zelianskaia et al. 2020] (cf. the understanding of a geoconcept as "a product of the conceptualization of a territory, formed under the influence of science, art, politics, and the media" [Kalutskov 2015: 9]).

Methods and materials

The undertaken research is a multi-stage process, including a) collection and pre-processing of digital mental maps, carried out in the web application "Studio of creative maps", b) pre-processing, analysis and visualization of color patterns, carried out using the Python language and libraries, c) graphosemantic analysis of the text layer of mental maps.

The analysis of mental representations of geographic space is carried out using the cognitive geomapping method, previously tested in the studies of the "naive" geography of Russia and China [Zelianskaia et al. 2017; Jinzhi, Zelianskaia 2022]. The method, based on experiments with drawing the so-called "sketch maps" [Saarinen 1988; Saarinen, MacCabe 1990], was supplemented by collecting the so-called "text layer" of maps and was used in the period of 2008 to 2020. The work was carried out with paper maps and was reduced to a description of the general patterns of the organization of mental maps, analysis of codes (spatial, graphic, linguistic) [Zelianskaia et al. 2020]. During this period, the technological study context of mental maps began to actively change. With the advent of digital technologies, it became possible to create digital mental map representations [Niem, Sean 2007] or digitize mental maps created on paper and analyze them digitally [Aram et al. 2019; Schwering et al. 2014]. Digital mental maps made it possible to radically restructure the data analysis process, since the researcher knows in advance the types of objects placed on the map, their parameters, sets their variations, determines metrics with the help of which it is possible to trace the specifics of the placement of objects on the map, their relationships with each other, sequences and etc., metadata that allow to correctly present the features of spatial knowledge and representations.

Since 2021, our studies have been using the vector graphics web application "Creative Maps Studio"[1], developed specifically for creating mental geographic maps [Chumakov et al. 2021]. The use of the same tools by the informants: object types presented in the form of icons and polygons, uniform control of the parameters of objects plotted on the map (size, color, transparency, etc.), the inclusion of a text layer on the map (names of objects, associations / representations associated with them, the choice of emoji for additional characteristics), as well as a machine-readable map format (the map is exported to json format, and from it to other formats, including tabular type), – all this made it possible to move on to the analysis of previously inaccessible aspects of mental representations of space. One of these aspects is the color that informants assign to objects plotted on their maps.

The informants were asked to draw a digital map of China using all the possibilities of the application: unlimited canvas space; icons depicting objects necessary for reflecting geographical representations; tools for editing color, size, texture of objects, and for

[1] Web application "Creative Maps Studio". URL: https://creativemaps.studio (accessed 12 Feb 2025).

naming them, as well as for recording the evaluative opinion of the subjects regarding the objects, either in a verbal form and / or in the form of an image. While creating the map, it was necessary to:

1. Mark important, in the respondent's opinion, geographical objects of China.

2. Next to the marked geographical objects, in a separate field it was necessary to write down associations, opinions, impressions related to these objects.

The time of the experiment was not limited. After finishing the work, informants saved the maps as a file in json format.

Before the experiment, the user interface of the web application was translated into Chinese, in addition, a training video was made demonstrating the program tools and explaining how to use them in the drawing process.

The cognitive geomapping experiment involved informants from several Chinese cities and provinces. Their age range varies from 17 to 52 years. The data was collected from 2019 to 2024 at the universities in China.

A total of 247 "naive" maps of China were collected. The general gender and age characteristics of the informants are presented in Table 1.

The analyzed material was presented in two formats: a machine-readable file in json format and its visual representation in the "Creative Map Studio".

Figure 1 shows the screenshot of the map of China in the interface of the "Creative Map Studio" with a text layer separately displayed in a modal window, representing the description of Shanghai by the informant 30_M_SHANDONG.

Tab. 1. General gender and age characteristics of informants
Табл. 1. Общая гендерная и возрастная характеристика информантов

Age range	Women	Men
17–21	144	58
22–26	14	10
27–31	4	10
32–36	0	0
37–41	0	0
42–46	0	1
47–51	1	3
52–56	0	1
Average	19.8	22.3
Standard deviation	3.0	6.8

Translation of information from the text layer:

人们也叫上海«魔都»，我个人说到上海首先想到的是纸醉金迷，但上海的繁华又和北京的不太一样，上海是改革开放的第一批城市，他带动了整个长江三角洲的发展 – "Shanghai is also called the "Magic City", I personally think Shanghai is the most prosperous city, but Shanghai's prosperity is not quite like Beijing's. Shanghai is the first city to start reforms and opening up, which led to the development of the entire Delta of Yangtze River".

The machine-readable file contains a lot of structured information not only about the map, but also about

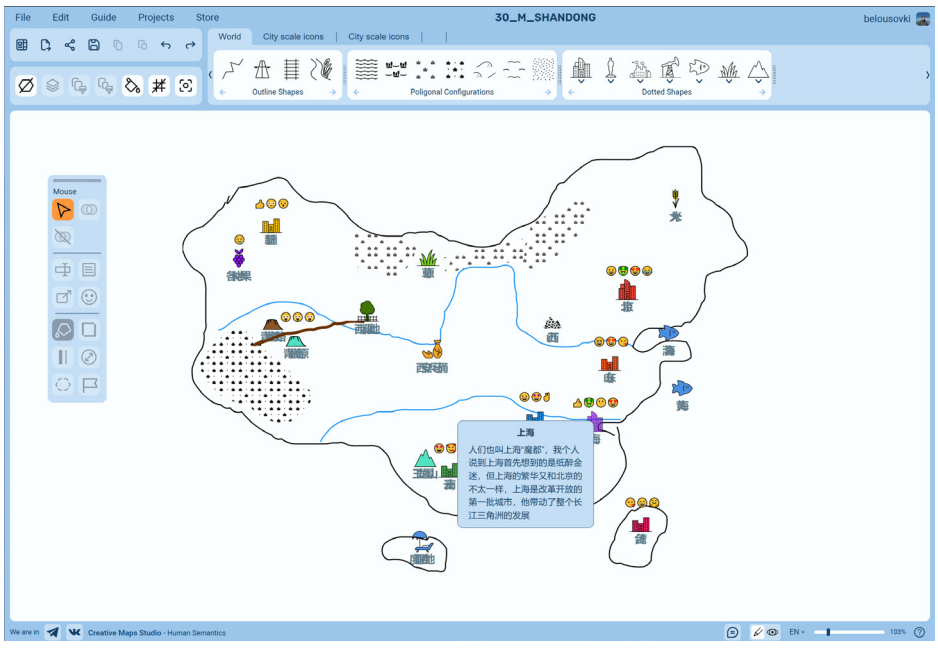

Fig. 1. Screenshot of the mental map of China in a graphical web editor (informant 30_M_SHANDONG)
Рис. 1. Скриншот ментальной карты Китая в графическом веб-редакторе (информант 30_M_SHANDONG)

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the application itself (and its "reading" of the map). For the convenience of data presentation, a converter was created that collects/groups information only about map objects. For example, we will give a converted record of the same map 30_M_SHANDONG:

- "2450810:_Мегаполис_40^上海^x:138.7,y:36.07^PURPLE(#8601AF)_{上海, 人们也叫上海«魔都», 我个人说到上海首先想到的是纸醉金迷，但上海的繁华又和北京的不太一样，上海是改革开放的第一批城市，他带动了整个长江三角洲的发展, , 👍,🤑,😗,😍}"
- "2577033: Растительные ресурсы_40^各种水果^x:-492.34,y:-253.59^PURPLE(#8601AF)_{各种水果, , , 🤤}"
- "2644182:_Пляж_40^度假胜地^x:-166.48,y:249.86^BLUE(#0247FE)_{度假胜地, 海南省近年来发展迅速，已经成为中国夏季和冬季最热门的旅游景点，这里的免税店也很受欢迎, , }"
- "2689219:_Плато_40^青藏高原^x:-390.62,y:-115.66^GREEN(#66B032)_{青藏高原, , , 😲,😲,😲}"

Commentary.

- The number 2450810 shows the time of object application,
- Megapolis is the object type,
- 40 is the object size,
- 上海 is the object name,
- x:138.7,y:36.07 are the object coordinates on the canvas,
- PURPLE(#8601AF) is the object color (PURPLE is the color on the Itten scale, #8601AF is the original color on the map),
- 上海, 人们也叫上海 «魔都,<...> are associations/ideas related to the object,
- 👍, 🤑, 😗, 😍 are emoji as an additional characteristic of the object.

Pre-processing, analysis and visualization of color patterns of mental maps

The color analysis of geoobjects presented on the mental maps was performed using the Python language and libraries for processing color and numerical data (webcolors, numpy, matplotlib, etc.).

At the first stage, all color values of the objects on 247 mental maps were extracted in HEX format (hexadecimal color notation). The total number of unique color shades was 209. Then, all the obtained colors in HEX format were converted to the HSV (Hue, Saturation, Value) model. This color decomposition format allows to analyse the hue, saturation, and brightness separately. Hue is the parameter that determines the color "family" (red, orange, blue, etc.), while Saturation and Value help distinguish pastel, dull tones from bright and saturated ones. In addition, the brightness value allows to distinguish achromatic shades (black, white, gray) and chromatic ones.

At the second stage, a color classification algorithm was created, distributing color values in accordance with one of the classification systems used in coloristics – the Itten circle [Bláha, Štěrba 2014]. This system identifies primary (red, blue, yellow) and intermediate colors (orange, green, violet and their variations), and takes into account not only the "position" of the hue, but also the degree to which the color can be mixed with similar colors in the spectrum. In total, the color shades were distributed into 12 chromatic and three achromatic categories.

At the third stage, all "pure" colors of objects on mental maps were replaced with their categorical values. Then, the realization of each category was calculated and the results were subsequently visualized.

Graphosemantic analysis of the mental maps text layer

The study of a geographic object collective concept is carried out using semantic analysis of the text layer of mental maps in several stages:

1. Using the analytical "Studio" module, a "text layer" (name of objects, associations and ideas associated with them, as well as emoji) with metadata of objects (color, size of named objects) is extracted from each map.

2. A common table in .csv format is generated for all data of the text layer of all collected maps and the table is imported into the "Semograph" information system[2].

3. The field analysis method is used to classify the informants' linguistic material. The result of the analysis is a hierarchical system of semantic fields with assigned linguistic units describing specific geo-objects on the maps.

4. Based on the classification results, semantic maps are generated showing the relationship of semantic fields for samples. Samples can be associations related to one geo-object, as well as to the same geo-object that has a certain color characteristic on mental

[2] Information system "Semograph". URL: https://semograph.org/ (accessed 12 Feb 2025).

maps. The Shanghai city was taken as such an object: accordingly, one sample was formed with all the contexts that relate to this metropolis, and the second one presented only those contexts where Shanghai is marked on mental maps with its dominant (marked) color characteristic.

Results

Relationship between Color Palette and Volume / Variety of Information

At the first stage, the task was to study the functions of color in the organization of geomental representations of space. The chosen parameters were a) the number of unique colors on the informant's map, b) the number of unique types of objects, c) the number of comments to them (associations and / or representations of informants), the number of emoji accompanying objects on the map, and d) the total volume of the text layer (comments + emoji).

Table 2 shows the result of the correlation analysis between the number of unique colors on the map and the other parameters. It is evident that the increase in the number of different shades of color on the map positively correlates with the increase in the number of different types of objects and the text accompaniment of the drawing process. That is, the use of the color palette by Chinese informants has a direct impact on the volume and diversity of information transmitted through mental maps.

When dividing all observations into groups (by the number of used colors), the increase in the average values is observed in each group (Tab. 3).

Tab. 2. Unique colors: Pearson correlation coefficients (p < 0.001)
Табл. 2. Уникальные цвета: коэффициенты корреляции Пирсона (p < 0,001)

Parameters	p
Unique objects	0.55
Comments	0.52
Emoji	0.31
The entire text layer	0.55

Tab. 3. Characteristics of color groups
Табл. 3. Характеристики колористических групп

Color groups, units	The entire text layer	Comments	Emoji	Number of maps
0–5	4.76	4.34	0.42	92
6–10	9.09	7.30	1.80	88
11+	16.10	13.15	2.96	67

The results of the one-way analysis of variance (ANOVA) conducted to assess differences in the volume of text information (the variable *Entire text layer*) between groups defined by the number of unique colors (*Color groups*) showed significant differences: $F(2.244) = 54.31$, $p < 0.001$.

Thus, we can speak about a statistically significant relationship between the use of color and volume (as well as the structure) of information in mental maps, which is consistent, on the one hand, with the functions of color in cognitive information processing, and on the other hand, with the special significance of color associations in the historical and socio-cultural context of Chinese civilization. "Color designations of the Chinese language are correlated with the semiotic, value and philosophical-ideological picture of the world. Considering the conceptual sphere of color of the Chinese civilization, we reveal not only the phenomenon of color as a kind of concept of worldview, <...> but also the system of color symbolism as an ancient mythological system built into the lexical base" [Zhang, Golovnya 2014: 135] (cf. Chinese colors are "the quintessence of the East wisdom, the embodiment of the aesthetic genes of the nation" [Hao 2024: 19]).

Color functionality in structuring geoconcepts

The hypothesis about the color cultural genesis in Chinese linguaculture can be considered using the example of the structural-semantic organization of geoconcepts. The hypothesis can be formulated as follows: in the process of geomapping objects, the use of color characteristics typical of the China cultural tradition influences the structure of the geoconcept as a structured set of modern ideas about this object by ordinary bearers of the linguaculture. In other words, the structure of ideas about a geoobject is reproducible and less contradictory in cases where this object is "colored" on mental maps in colors traditionally associated with this object in the cultural tradition. If the hypothesis is confirmed, the cultural color of the geoobject, on the one hand, should be included in the structure of the geoconcept itself, and on the other, it should play the role of natural semantic clustering.

The visualization of the color palette was carried out, as was said above, using polar diagrams stylized as Itten's circle: each sector denotes one of the basic colors, and the area and radius of the sector reflect the frequency of its use in mental maps. Achromatic shades (black, white, gray) are displayed in a separate concentric semicircle, which allows a visual assessment of their role in relation to saturated chromatic colors.

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Figure 2 shows the palette of colors associated with Shanghai in Itten's system.

Shanghai, after the capital, is the second most frequently present city on China's mental maps, appearing on 38% of the collected geographic maps. The analysis also revealed that Shanghai is the most vividly colored city in China's perceptions by Chinese informants. In the informants' understanding, the city is characterized by the following colors: blue (34 maps), white (14 maps), yellow, amaranth, light cherry (8 maps each), the light green sea color (7 maps), red, yellow-green, purple (5 maps each), orange, blue-purple (3 maps each), gold, gray, black (2 maps each), cinnabar, green (1 map each). It should be clarified that while white is often associated with the coloristic non-markedness of an object (the default icon of an object is white), the blue color (and any other color) is an obvious markedness of the object. Blue is primarily associated with the theme of water (note that in general, in the entire volume of objects of China's mental maps, blue as a marked color dominates among all chromatic colors). On the one hand, the water element connects the regions of China (rivers), and on the other hand, it provides an outlet beyond the country (seas). An important color is red as a basic color and the most important one – a traditional symbol of power, used today having the status of a state color [Zhang, Golovnya 2014: 137].

The main color of the Shanghai geoconcept is also blue (in this aspect, Shanghai reflects the essence of all China colors), which is due to the natural and historical-cultural context. Informants associate Shanghai with the river, since the city is located in the Yangtze River delta. Since ancient times, river transportation has been developed in Shanghai, which contributed to the special position of the city as an import ant transport center. Shanghai's associations with the Yangtze reflect the historical, economic, and transport significance of the water element for the development of the city.

In addition, Shanghai is the largest seaport on the East China Sea coast, which determines its role in international trade. These circumstances explain the dominance of blue and similar color shades in the "naive" geography of ordinary Chinese people – blue-purple and light green sea color (only 44 maps out of 64): 中国东部吧，长江汇入此海，中央政府直接管辖的超级大都市 "Eastern China, where the Yangtze River meets the sea, a metropolis directly ruled by the central government"; 靠近大海，经济中心，时尚魔都，黄浦江，中国发展的领军人 "Near the sea, economic center and fashion capital. Huangpu River is the leader of China's development"; 上海市是长江以南经济区，三角经济发展的箭头带动作用，这里有大量的外国友人，是中国联系世界的重要纽带城市 "Shanghai is an economic zone south of the Yangtze River and plays a leading role in the development of the triangle economy. Here there are many foreign friends, and it is an important link between China and the world".

Color as a factor in natural semantic clustering

As was already mentioned, color is an important factor of structuring meaning, which in a cultural and historical context simultaneously indicates the directions of conceptualization of important concepts for society.

The reconstruction of geoconcepts from two positions 1) as a system of semantic fields built

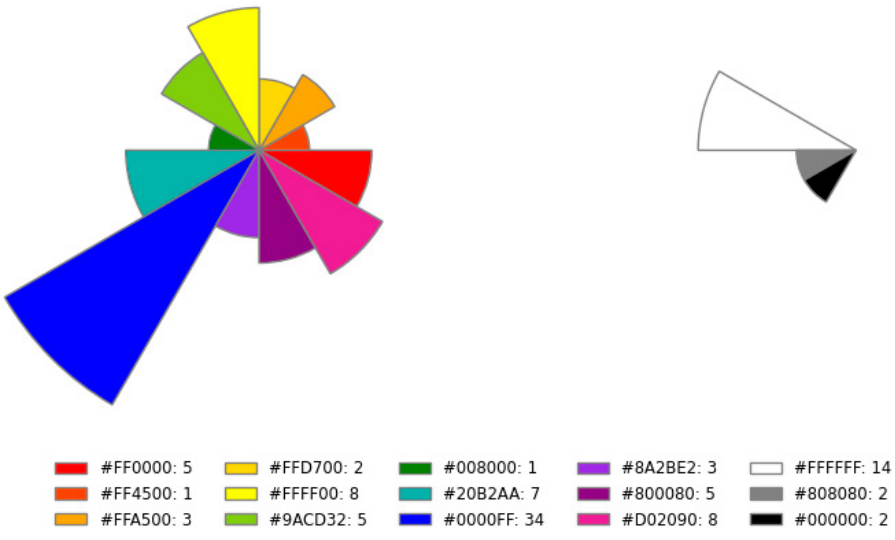

Fig. 2. The color scheme of Shanghai in the mental maps of Chinese informants
Рис. 2. Колористика Шанхая в ментальных картах китайских информантов

on the basis of the indicators modularity of joint occurrence in the respondents' associations, and 2) as a system of meanings, primarily determined by the respondents' coloristics, and only secondarily through the indicators' modularity of joint occurrence – gave us the opportunity to compare the Shanghai geoconcept from the point of view of its general content regardless of the meanings and significance of colors and in the context of the structure-forming influence of its dominant color semantics (Shanghai as a "blue city"), i.e. to test the hypothesis formulated above.

Figure 3 shows the graphosemantic model of the geoconcept *Shanghai* without taking into account coloristics (graph 1). In Figure 4, Shanghai is presented from the point of view of semantic associations related to the idea of Shanghai as a "blue city" (graph 2).

Graphically, the occurrence of each semantic field in the corpus and the indicators of the joint occurrence of fields in the associates of informants are conveyed by the size (for a node) and thickness (for edges). Using the modularity method [Lambiotte et al. 2015], the graph was divided into modularity classes – subgraphs and automatic and manual laying of the graph was carried out, as a result of which the nodes belonging to one cluster were grouped in space and separated from the nodes forming another cluster. In this case, each class is visually represented by a separate color. Note that the selected modularity classes (clusters) as fragments of the hypernetwork are isolated from each other only conditionally: any of the nodes of a given class can have connections with other nodes of the hypernetwork belonging to different modularity classes

In both models, the most significant semantic field is *General economic characteristics*. Shanghai is primarily presented as a center of concentration of important economic resources, infrastructure and opportunities for self-realization: 我国经济最发达的地方，<...> 当然，沪有自己的沪币，消费极高 "The most economically developed place in China <...> Of course, Shanghai has its own Shanghai currency, consumption is extremely high".

Interestingly, the image of the city's economic prosperity is often combined with irony. In particular, the expression *Shanghai currency* is a well-known idiom in China, which is used to ridicule the high prices in Shanghai.

But in general, the geoconcept differs in the number and composition of semantic fields: 19 (column 1) and 22 (column 2). Column 1 consists of four clusters, distinguished by color in the figure. The first main cluster (purple) is a generalized stereotypical idea of Shanghai as an *Economic center*, the city of great *Opportunities and achievements* (here also *The highest degree of manifestation of the feature*, associated with the image of Shanghai as the highest financial freedom, well-being, benefits, temptations and troubles accepted in the mass consciousness of the Chinese). The inactive field *Culture as a whole* confirms the template, non-specific idea of rich and multifaceted

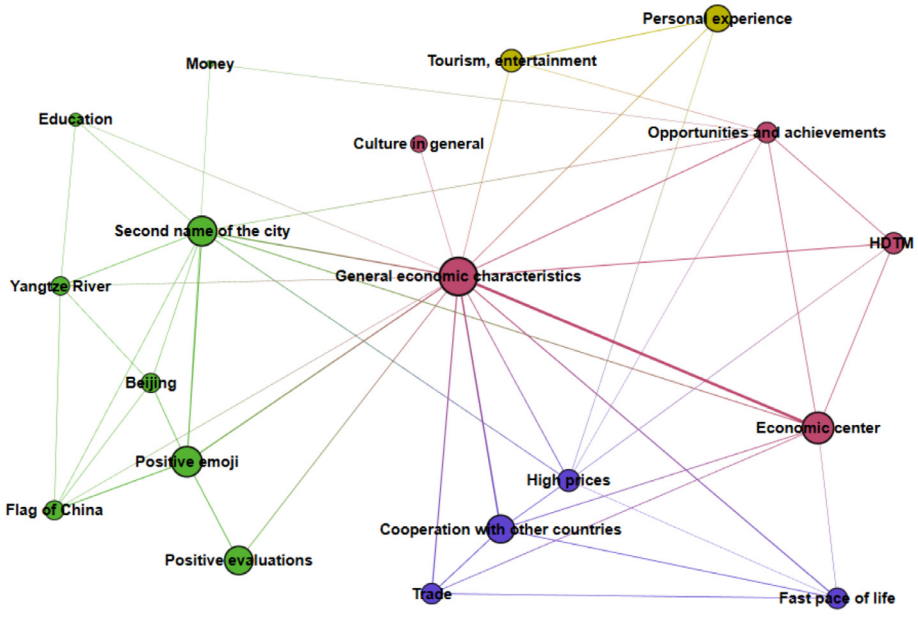

Fig. 3. System of semantic fields of the geoconcept Shanghai
Рис. 3. Система семантических полей геоконцепта *Шанхай*

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development opportunities associated with the opening economic potential of the city. Typical reactions of informants: 经济发达的大城市 <...> 现代，资本，交通发达 «An economically developed large city, <...> modern, capitalism, developed transport»; 医疗资源多 "Many types of medical services".

The second cluster (blue), practically absorbed by the first, but concretizing it through spheres (also traditional for the stereotypical image of Shanghai), determining continuous development, financial flows, modern rhythm of life. According to informants, this is ensured by *Cooperation with other countries*, *Trade* with them and with other regions of China.

The third cluster (green) is built around the two most frequent and active semantic fields – *Second Name* and *Positive Emoji* (reinforced by *Positive Evaluations*). Unlike the clusters already considered, the socio-cultural meanings of the geoconcept are concentrated here, which force us to abstract from the financial and economic sphere and transfer the opportunities it opens up into a symbolic layer, to build a special world (assessed predominantly positively), opposed to Beijing as a significant alternative to China (Shanghai is considered the second capital of China, which is why the *Flag of China* is also in this cluster). Symbolization is primarily associated with the *Second Name* of the city: there are two unofficial names – the Magic City and the Pearl of the East.

The name Magic City comes from the novel 魔都 Motu (1924) by Japanese writer S. Muramatsu [Muramatsu 2023], which is translated into English as Demon City / Magic City (the Chinese *mo* literally means *magical*). This informal toponym reflects the symbolic duality of Shanghai as a city of dreams and as a source of disappointment. Informants often point to the mixture of opposites in Shanghai: 上海是既远又近的城市，它可以很高贵，高的让你没有踏进去的勇气，也可以很低，让你有一种像回家的感觉，在这就是很神奇，符合它的魔都称号 "Simultaneously, the city that is both familiar and unfamiliar; it can be so distant that you don't have the courage to step into it; or it can be so close that you feel at home, and this is where its magic comes, as its name suggests, the Magic City".

The name 东方明珠 "Oriental Pearl" was given due to Shanghai's location on the East China Sea coast, as well as due to its famous architectural structure, the tallest television tower in Asia, the Oriental Pearl Tower, which is the symbol of a rapid technological development. These symbolic meanings are reinforced by the subordinate less active fields of the *Yangtze River*, *Education*, and *Money*.

The socio-cultural cluster of graph 1 contains the semantic fields that were filtered out when constructing graph 2 – these are *Money*, *Education* and *Beijing*. It can be assumed, based on the degree of significance of these fields, that through the prism of color semantics the context of opposition to Beijing has become irrelevant (also by the comparison of the socio-cultural potential of the education sphere and the role of the financial sphere).

The last (olive) cluster of Column 1 concerns the personal space of a person, connected with

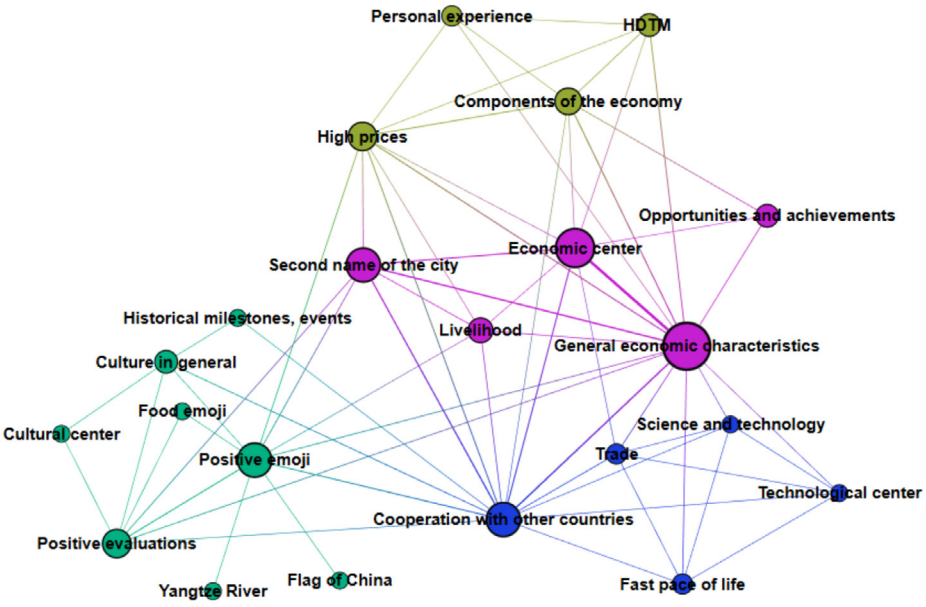

Fig. 4. Semantic associations of Shanghai (blue) on naive maps
Рис. 4. Семантика ассоциаций Шанхай (синий цвет) на наивных картах

the *Personal experience* of a tourist visiting Shanghai to get acquainted with the sights and entertainment (*Tourism*, *entertainment*). This cluster completely disintegrated during the redistribution of semantic accents of the geoconcept by means of the color significant factor: the field *Tourism*, *entertainment* did not overcome the boundaries of significance, since the stereotypical connection between personal impressions and tourist travel turned out to be too universal (and impersonal) to be included in the composition of more personalized characteristics of the geoconcept.

Column 2 demonstrates the change in the geoconcept *Shanghai* under the influence of the structuring factor of the objects dominant color preferred by informants: the model was built on the basis of the associations that were attributed to the images of Shanghai as a "blue city".

First of all, we note that the composition of the semantic fields has changed, *Components of the Economy* and *Livelihood* have appeared, expanding and differentiating the socio-economic parameters of the geoconcept; in addition, we see a group of meanings associated with the development of scientific and technical thought in China and with specific ways of its organization and implementation: *Science and Technology*, *Technology Center*. The semantic fields *Historical Milestones*, *Events*, *Food Emoji* and *Cultural Center* are aimed at personifying the cultural life of Shanghai, while not just declaring its significance compared with the capital (see Column 1).

The first (blue) cluster of column 2 also consists of those directions of meaning that are related to economic development, the organization of the cluster is carried out around the most significant field *General economic characteristics*. But the traditional perception of Shanghai as the space of economic achievements and great opportunities in this case seems to get rid of stereotypical exaggeration and generalization, but at the same time it is specified and clarified. Economic factors become the basis for improving specific living conditions of a person (*Livelihood*), which allows us to rethink the figurative and symbolic component of the geoconcept (a very important aspect for the Chinese), to transfer the *Second name of the city* from the plane of metaphysical duality to the subject-sensory world of progress and technology: the unofficial toponym "Pearl of the East" is associated with the economic components of meaning, reconciling Chinese tradition-centrism with the demands of the time.

The second cluster (red), like the similar (blue) cluster of column 1, unites a group of meanings indicating the factors that ensure the rapid development of the city potential. However, in this case we do not see the complete conditioning of development by the concept *Shanghai money*. In addition to the meaning *Trade*, such meanings as *Science and Technology, Technology Centers* appear as independent areas of development characterizing the geoconcept, becoming the basis for the meaning *Cooperation with Other Countries* and, accordingly, contributing to the modernization of all spheres of life in China, making it open to the world community. The cluster of *active factors of economic development* in column 2 acquires significant connections both with the block of cultural meanings of the city (emerald cluster) and with transformed personal meanings (olive cluster), i.e. it has independent significance in the system.

The personal sphere reflected in the geoconcept *Shanghai* is built around the semantic fields of *Components of the Economy* (unites different sectors of the national economy) and *High Prices*. In this case, the complex of financially oriented semantics closely associated with Shanghai is strongly personalized, refracted through the perception of different types of activity as a possible area of self-realization or through a consumer experience: 魔幻城市，有机会想在这里工作，全是钱 "A magical city, I want to work here if I have the opportunity, it's all about money." This assumption is confirmed by the meanings united by the fields *Personal experience* and *Highest degree of manifestation of the feature*.

The last cluster under consideration demonstrates specific features of the socio-cultural sphere of Shanghai. As in Column 1, the city culture is presented mainly through emoji with positive semantics and *Positive avaluations*. Differentiation of cultural events without the intrigue of comparison with Beijing is carried out inactively, mainly through identification with traditional symbols (*Yangtze River, Flag of China*, *Historical milestones*, *events*), through the statement of the important cultural role of the city (*Cultural center*) and the unification of traditional Chinese culture with modern trends (*Culture in general*, *Historical milestones*, *events*). However, the Shanghai culinary culture stands out as an independent sphere worthy of attention and unequivocally assessed positively (*Food emoji*), which apparently has become a distinctive feature of the city in the general context.

In general, graph 2 demonstrates the more structured and logical clustering, with the clear division of topics and the inclusion of additional, more specific semantic fields. This makes it more informative and convenient for analyzing the associative ideas of Chinese residents

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about Shanghai compared to graph 1, which mainly absorbed the generalized-stereotyped meanings of the geoconcept.

Conclusion

The creation and objectification of a space mental map on an external medium are associated with neurocognitive mechanisms and are substantiated by modern neurobiological research. Thus, the work [Hafting et al. 2005] provides a rationale for the fact that human brain contains specialized neural groups that form "internal mental maps" and support our ability to navigate and remember spatial relationships. Colored images (compared to black and white) cause increased activation in brain areas that are usually associated with spatial perception and semantic processing of scenes [Bramão et al. 2010]; color information can enhance the formation of spatial memory (through the selection of landmarks and context) [Fritch et al. 2021]. In this regard, it seems important to consider the factor and functions of color in structuring mental representations of (geo)space and their visualizations. The methods and models proposed in our work, combining the coloristics of mental maps and the semantics of geoobjects, demonstrate the prospects of the direction, since the obtained results, on the one hand, confirm the basic principles of cognition on new empirical material, and on the other, allow color to be included in the composition of geoconcepts, where it performs the function of natural clustering of relevant (from a cultural and historical point of view) information.

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