Sound-grapheme-color Associativity in Komi-permyak Language (Vowels)

Svetlana Sergeevna Shlyakhova[1]

[1] Perm National Research Polytechnic University, Russian Federation

Correspondence: Svetlana Sergeevna Shlyakhova, Komsomolsky prospekt, 29, Perm, 614990, Russian Federation. E-mail: shlyahova@mail.ru

Abstract

The article deals with preliminary results of experimental investigation of the sound-grapheme-color associativity of vowels in Komi-Permyak language. The obtained data on Komi-Permyak language is interpreted in the context of data in Russian, English and other Romano-Germanic languages, obtained using the same procedure. It is established, that the sound-grapheme-color associativity of graphons A [a] and O [o] presents a universal phenomenon with high degree of probability. The relative dependence of color associativity of vowels on the initial consonant and the following vowel in color denomination was established. It was established that Komi-Permyak graphons do not have stable and regular link with colors, the names of which are borrowed. It is possible to assume that the letters of the native language are connected with the original color denominations. A tendency of Komi-Permyak vowels, being attracted to chromatic color grade (red, blue, yellow), is revealed.

Keywords: psycholinguistics, phonosemantics, sound symbolism, sound-color associativity, color-grapheme synaesthesia, vowels, Perm languages, Komi-Permyak language, Finno-Ugric languages

1. Introduction

Sound-grapheme-color associativity was investigated in many languages, and it has a long tradition.

The studies show that color-grapheme (phonemic) associations can be considered regular: among the most frequent types of synaesthesia, the following ones are distinguished: *letter + color* (62,51%), *time units + color* (23,3%), *musical sounds + color* (19,23%), *sounds of the outside world + color* (14,7%), *speech sounds (phonemes) + color* (8,9%) (Day, 2014).

Color-grapheme (phonemic) synaesthesia is a state, when the visual image of letter (grapheme) or sound pronunciation, denoted by the letter, induces a definite color sensation (for instance, a letter or sound "a" in Russian linguistic consciousness causes frequently a simultaneous sensation of "red").

The article deals with the term *graphon*, used in Russian linguistics, which includes the features of grapheme, phoneme, letter and sound in one denomination (Prokofieva, 2008).

The investigation of color-grapheme (phonemic) synaesthesia reveals both stable associative links of color and grapheme (Zhuravlev, 1974; Day, 2001; Prokofieva, 2008; Kim et al., 2013), and the factors, influencing these links (Witthoft & Winawer, 2006; Mills et al., 2009; Simner et al., 2005; Beeli et al., 2007; Brang et al., 2011; Watson et al., 2012; Asano & Yokosawa, 2011, 2012 & 2013; Rothen et al., 2013; Blair & Berryhill, 2013).

Despite great variety of languages, which become the material to study the phenomenon of color-grapheme synaesthesia, Perm languages stay out of the researchers' sight. Out study is aimed at revelation of regular and stable links of graphon and color in Komi-Permyak language.

Komi-Permyak language is a language of Komi-Perm population, the main population of Komi-Permyak district, located northwestwards of the Russian Federation. It refers to Perm branch of Finno-Ugric sub-family of Uralic languages and stays in close relationship with Komi-Zyrian language (Komi Republic, RF). In Europe, these languages are perceived as exotic (something like African tribal languages), but only 65 000 people speak Komi-Permyak language, increasing almost twice the population of Monaco, San-Marino or Liechtenstein.

Nearly 90% of Komi-Permyaks speak Russian fluently. Judging by Komi-Permyaks, it is possible to speak about the situation of unipolar bilingualism, i.e. the predominant influence of Russian language on Komi-Permyak.

Color denominations are repeatedly studied in Perm languages (Rakin, 1990; Ryabina, 2010&2011; Goncharov, Knyazev, 2010), but we do not know the investigations on grapheme-color synaesthesia in Permian languages, including the Komi-Permyak one.

The article presents the results of the experiment, aimed at revelation of stable and regular associative links between the color and graphons of Komi-Permyak language. The obtained data on Komi-Permyak language is interpreted in the context of data in Russian, English and other Romano-Germanic languages, obtained using general procedure (Zhuravlev, 1974; Prokofieva, 2008). It is being established that the sound-grapheme-color associativity of graphons A [a] and O [o] presents a universal phenomenon with high degree of probability. Relative dependence of color associativity of Komi-Permyak vowels on the letter-sound composition of color denominations was revealed. A tendency of Komi-Permyak vowels, being attracted to chromatic color grade (red, blue), is revealed.

The pronunciation of letters of Komi-Permyak alphabet A [a], Я [ja], У [u], Ë [jo], Ö [is pronounced as i in English *girl*], i [i], Yu [ju], Y [y], E [je], I [i], O [o], E [è].

2. Procedure

2.1 Specificity of Investigation

Modern investigations usually involve online-questionnaire (S.Day: http://www.synesthete.org/index.php; O.V. Opredelennova: http://q-eng.host56.com/) or the use of special computer programs, but in life realias of Komi-Permyaks, these types of questionnaire become difficult due to many reasons. Firstly, Komi-Permyaks predominantly present the rural ethnos (there is only one city in Komi-Permyak district - Kudymkar - with the population of nearly 30000 people) with rather low level of computerization. Secondly, the situation of unipolar bilingualism required the study of linguistic consciousness, which was subject to the influence of Russian language least of all, i.e. rural undereducated habitants of the older generation, who do not have computers.

That is why a series of experiments was carried out as individual (the habitants of villages of the Komi-Permyak district) and group (the students of Philological Faculty of the Komi-Permyak Department of the Perm State Humanitarian-Pedagogical University) questionnaire from 2009 to 2014.

2.2 The Experiment Procedure

The respondents were suggested a questionnaire with the Komi-Permyak alphabet and a list of color denominations (colored in corresponding color) in Komi-Permyak and Russian languages with graphic distinguishing of Komi-Permyak name: *vezh* (yellow), *gird* (red), *rud* (grey), *korichneviy* (brown), *liz* (blue), *sid* (black), *zeleniy* (green), *chochkom* (white). It was suggested to relate a graphon to the colors from the list, but it was not prohibited to write the color at the choice of the respondent. The additional colors were received: *orange, violet, pink, scarlet*.

The experimentator (Komi-Permyak language speaker) showed a card with the letter and pronounced a sound (i.e. sounding and writing of the graphon is presented), and the respondents wrote a color in the questionnaire opposite to the letter. The respondents were suggested to use the language, in which the colors will be written (Russian or native). The spontaneity of associations was provided by the dynamic regime of the questionnaire filling.

2.3 Reliability and Selection of the Experiment

The experiment reliability was provided by the delayed replicated experiments (group questionnaire), the results of which did not come into contradiction with the previous ones, as well as the expectation of urban (Kudymkar city) and rural (Zyryanovo, Petukhovo, Pelym, Kuzmino, Proshino villages of Kochevk region; Chazevo, Podyachevo, Kosa villages of Kosinsk region) population of Komi-Permyak district within six year.

Experimental integrity requires the obligatory delayed repetition, using the similar methods, that is why questioning of Komi-Permyak speakers was carried out at intervals within six years. At that, the participants of the prolonged experiment were both new informants (the habitants of different Komi-Permyak villages) and those, who participated in the experiment earlier (the students of the Komi-Permyak Department of the State Humanitarian-Pedagogical University).

The repeated experiments did not come into contradiction with the previous one: the increase of number of informants gradually resulted in strengthening of veracity of obtained data. In numerical expression, it provided the increase by 1-2%, rarely - by 3%.

In the course of experiment, 186 Komi-Permyaks were interrogated (schoolchildren, students, peasants, pensioners), aged from 15 to 60 years (average age is 37.5 years).

There were obtained 186 inquiry forms, where 6510 reactions were revealed, including 32 (0.5%) refusals, 5631 (86.5%) reactions in Komi-Permyak and 846 (13%) of reactions in Russian. It is meaningful that the inquiry form was in Russian, but the respondents were oriented at the native language.
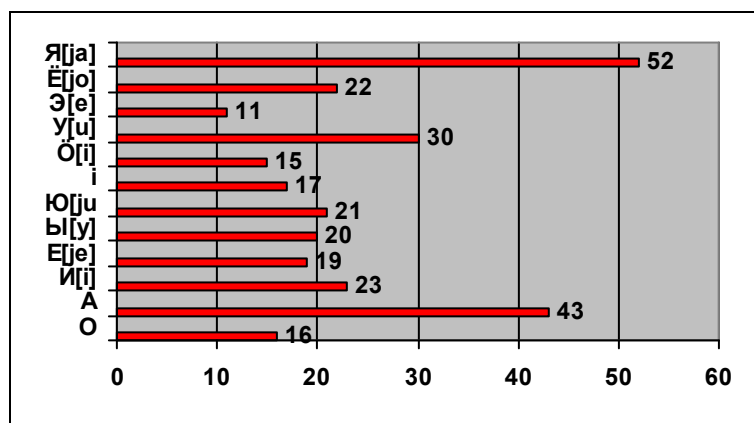
3. Results

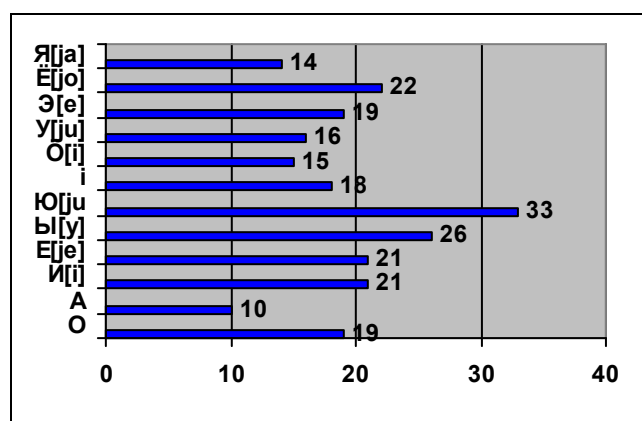Figure 1. Sound-grapheme-color associativity of red color

Figure 2. Sound-grapheme-color associativity of blue color

Relative data (% of reactions) on coloristics of the Komi-Permyak vowels is presented in Figures from 1 to 9. Let us consider the results within the interval of 25% of reactions and above to be consistent results, the ones within the interval from 15 to 24% to be relatively consistent. Within the confidence interval, there are the graphons, color associativity of which lies within the interval from 9% to 14%, i.e. exceeds the threshold of random coincidence, but significantly drops behind the absolute mass selection.

The most frequent, regular and stable associative links of color and Komi-Permyak graphons are located in the area of red and blue spectrum (Figure 1-2).

The data (Figure 1) on graphons Я [ja] (52% reactions), А [a] (43% reactions), У [u] (30% reactions) can be considered as reliable for red color (the reactions *raspberry-red* and *scarlet* were also taken into consideration); relatively reliable - Ё [jo], Ö [as i in English *girl*], i, Ю [ju], Ы [y], Е [je], И [i], О [o] (15-23% of reactions).

A tendency of attraction of practically all vowels to red spectrum in the consciousness of Komi-Permyaks is obvious. The same tendency is also noted in the sphere of blue color (Figure 2).

The data on graphons Ю [ju] (33% reactions) and Ы [y] (26% reactions) can be considered as reliable for blue color (the reactions *sky-blue, violet* and *turquoise* were also taken into consideration). High degree of conformity is observed for the vowels Е [je] (21%) - Э [è] (19%); О [o] (19%) - Ё [jo] (21%); И (21%) - i [i] (18%).

It is interesting, the blue and red colors dominate in color scale of clothes of Komi-Permyaks (Figure 3). It is possible to assume that red and blue colors are of special significance for the culture of Komi-Permyaks.

Figure 3. The habitants of Peshnigort village at the festival

There is no reliable data on yellow spectrum (Figure 4). The data on the graphons E [je] (20%) - Э [è] (20%); i [i] (15%) can be considered as relatively reliable. High degree of conformity is observed for the vowels E [je] (20%) - Э [è] (20%); Ю [ju] (13%) - У [u] (14%).
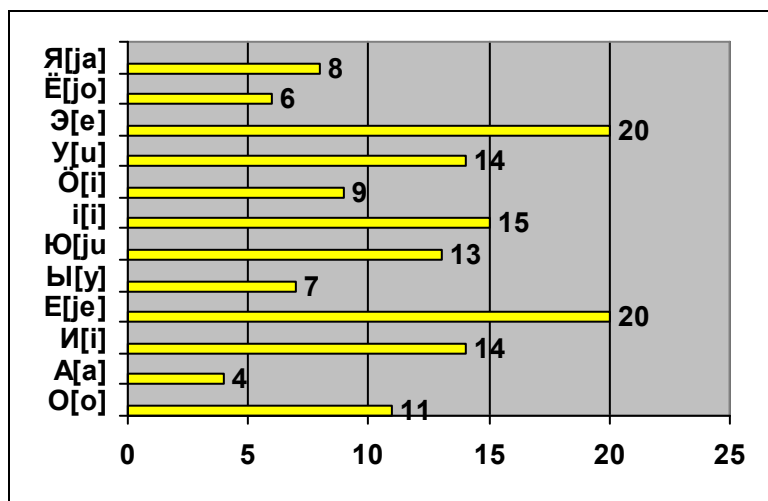

Figure 4. Sound-grapheme-color associativity of yellow color

The coloristics for black (Figure 5) and white (Figure 6) colors does not get the satisfactory results.
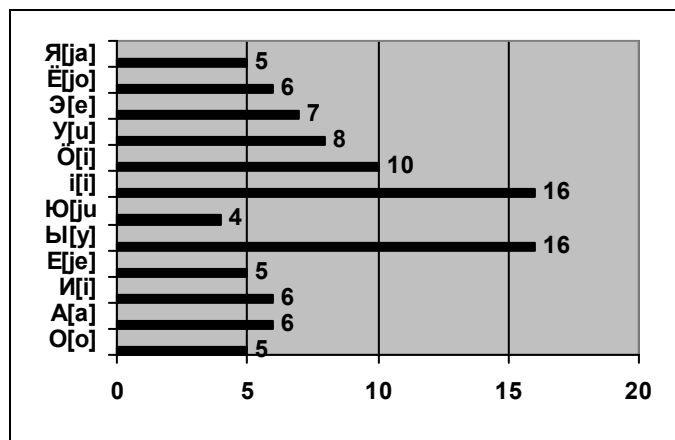

Figure 5. Sound-grapheme-color associativity of black color

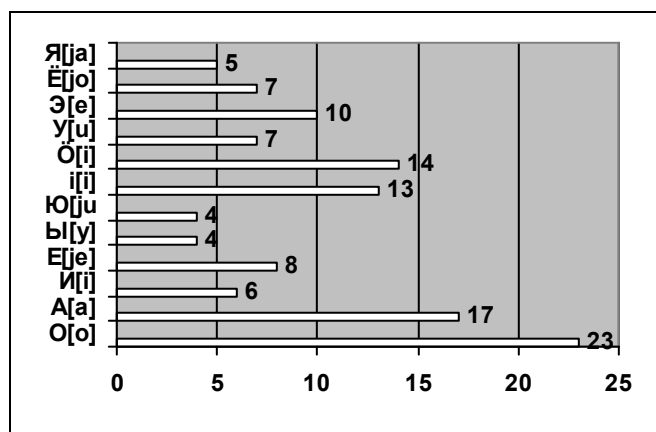The data on the graphons Ы [y] (16%), i [i] (16%) can be considered as relatively reliable for black color.

Figure 6. Sound-grapheme-color associativity of white color

The data on the graphons A [a] (17%), O [o] (23%) can be considered as relatively reliable for white color.

The coloristics for grey (Figure 7), green (Figure 8), orange (Figure 9) and brown (Figure 10) colors does not get the satisfactory results.
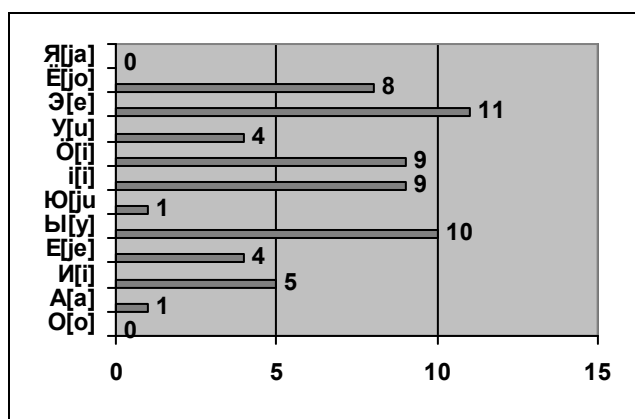

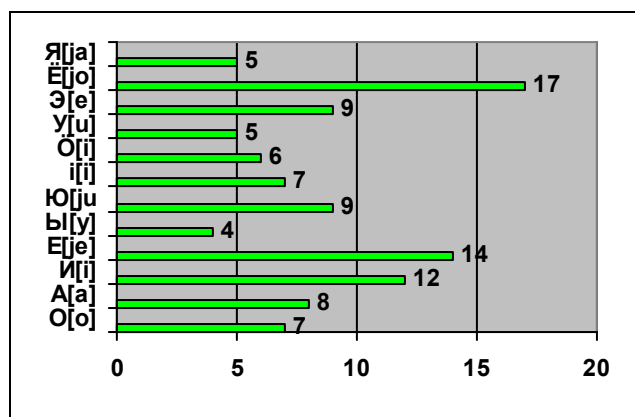Figure 7. Sound-grapheme-color associativity of grey color

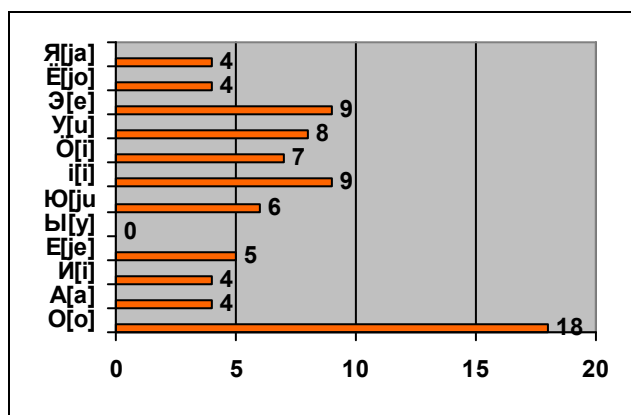Figure 8. Sound-grapheme-color associativity of green color

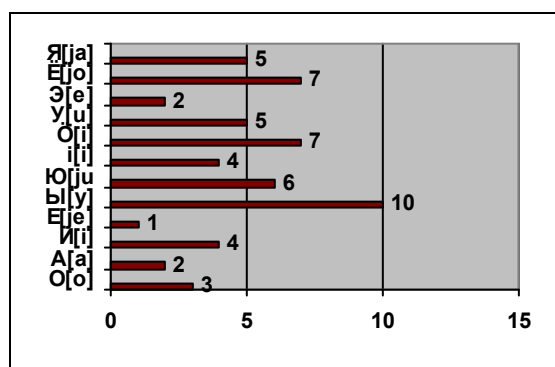Figure 9. Sound-grapheme-color associativity of orange color

Figure 10. Sound-grapheme-color associativity of brown color

The Figures 7-10 show that the Komi-Permyak graphons do not get the stable links with grey (*rud*), green, orange and brown colors. The data on orange O [o] (18% reactions) and green Ё [jo] (17%) can be considered as relatively reliable.

Table 1. A matrix of sound-grapheme-color associativity of the Komi-Permyak vowels

Color	Komi-Permyak graphons
BEZH (yellow)	i [i], E [je], Э [è]
GIRD (red)	Ы [y], О [o], И [i], E [je], i [i], Ö [as i in English *girl*], Ю [ju], Ё [jo], **У** [u], **Я** [ja], **А** [a]
RUD (grey)	-
KORICHNEVIY (brown)	-
LIZ (blue)	У [u], О [o], И [i], E [je], Э [è], i [i], Ö [as i in English *girl*], Ё [jo], **Ы** [y], **Ю** [ju]
SID (black)	Ы [y], i [i]
ZELENIY (green)	Ё [jo]
CHOCHKOM (white)	А [a], О [o]
ORANZHEVIY (orange)	О [o]

In Komi-Permyak language, color denomination *рудˈ* (rud) is understood both as grey and carrot (fox) colors. There are no denominations of brown color in Komi-Permyak language: there is a denomination of "earth color"

in Komi-Permyak language, and the color denomination *korichneviy* (brown) was borrowed from Russian. In the villages, the habitants refused not only to determine the link of graphon and brown color, but even to link the brown color with any notion. The color denominations *zeleniy* (green), *oranzheviy* (orange) also present Russian borrowings.

As a result of data reduction, the matrix of sound-grapheme-color associativity for the vowels of Komi-Permyak language was compiled (Table 1). One and the same graphon in different lines of the table demonstrates the multiplicity of its color evaluation by the respondents. Relatively reliable data (15-24% of reactions) is denoted in normal font, the reliable results (from 25% and above) are shown in semi-bold.

Thus, the reliable results were obtained for four vowels of Komi-Permyak language (У [u], Я [ja], А [a] of red color, Ы [y], Ю [ju] of blue color), color associativity of which lies within the significant vowels (from 25% to 52% reactions). "It is they that constitute the nationally-conditioned matrix" (Prokofieva, 2008).

4. Discussion

4.1 Factors, Influencing the Sound-grapheme-color Associativity

At present, the leading factors, influencing the sound-grapheme-color associativity, still stay unclear. The researchers mention a lot of reasons of grapheme-color synaesthesia: visual shape of grapheme (Brang et al., 2011; Watson et al., 2012); sound (Asano & Yokosawa, 2011 & 2012); essence or meaning of the notions, with which the graphon is connected (Rich et al., 2005; Asano & Yokosawa, 2012); grapheme frequency (Beeli et al., 2007); color denomination, i.e. the order of letters in the color name (Cytowic, 1989; Motluk, 1997; Witthoft & Winawer, 2006; Watson et al., 2012); memory, for instance, toys, containing colorful letters, magnets on the refrigerator etc. (Witthoft & Winawer, 2006 & 2013); a complex of enumerated factors (Asano & Yokosawa, 2011 & 2012; Watson et al., 2012).

Let us consider the factors, influencing the grapheme-color synaesthesia in Komi-Permyak language.

4.2 Features of Speech Sound.

It is impossible to correlate clearly expressed color characteristic of vowels with the characteristics of sounds, denoted by letters. It is observed a tendency of blue spectrum of high vowels and yellow - mid vowels. Red spectrum is typical of high and low vowels.

4.3 Grapheme Leading Role

It is noted that, when determining the colors of letters/sounds, grapheme plays the leading role (Cytowic, 1989; Motluk, 1997; Witthoft & Winawer 2006), as the color associativity frequently depends on the initial consonant and following vowel in color denomination. However, this tendency is not absolute for Russian and English languages (Prokofieva, 2008). This tendency is not proved in Komi-Permyaks bilinguals for native and Russian languages for *red/gird, black/sid, white and vezh* (yellow) colors (Figure 11).

It is possible to assume the influence of initial and following letters in color denomination on coloristics О [o] as white (*чочком-chochkom*) or orange (*оранжевöй-oranzheviy*), Е [je], as yellow (*веж-vezh*). However, this consistent pattern is not observed in qualification А [a], Я [ja] as red (*гöрд-gird*), Ы [y], Ю [ju] as blue (*лöз-liz*), А [a] as white (*чочком-chochkom*), Ы [y], i [i] as black (*сьöд-sid*).

"Color nominations have a significant impact on the associativity of graphons, however, this impact is not absolute, but "directive". <…> the inner capacity of the sound for intermodal links and its "attraction" to one or another physical color of the spectrum could become the basis for its linguistic denomination" (Prokofieva 2008, p. 217).
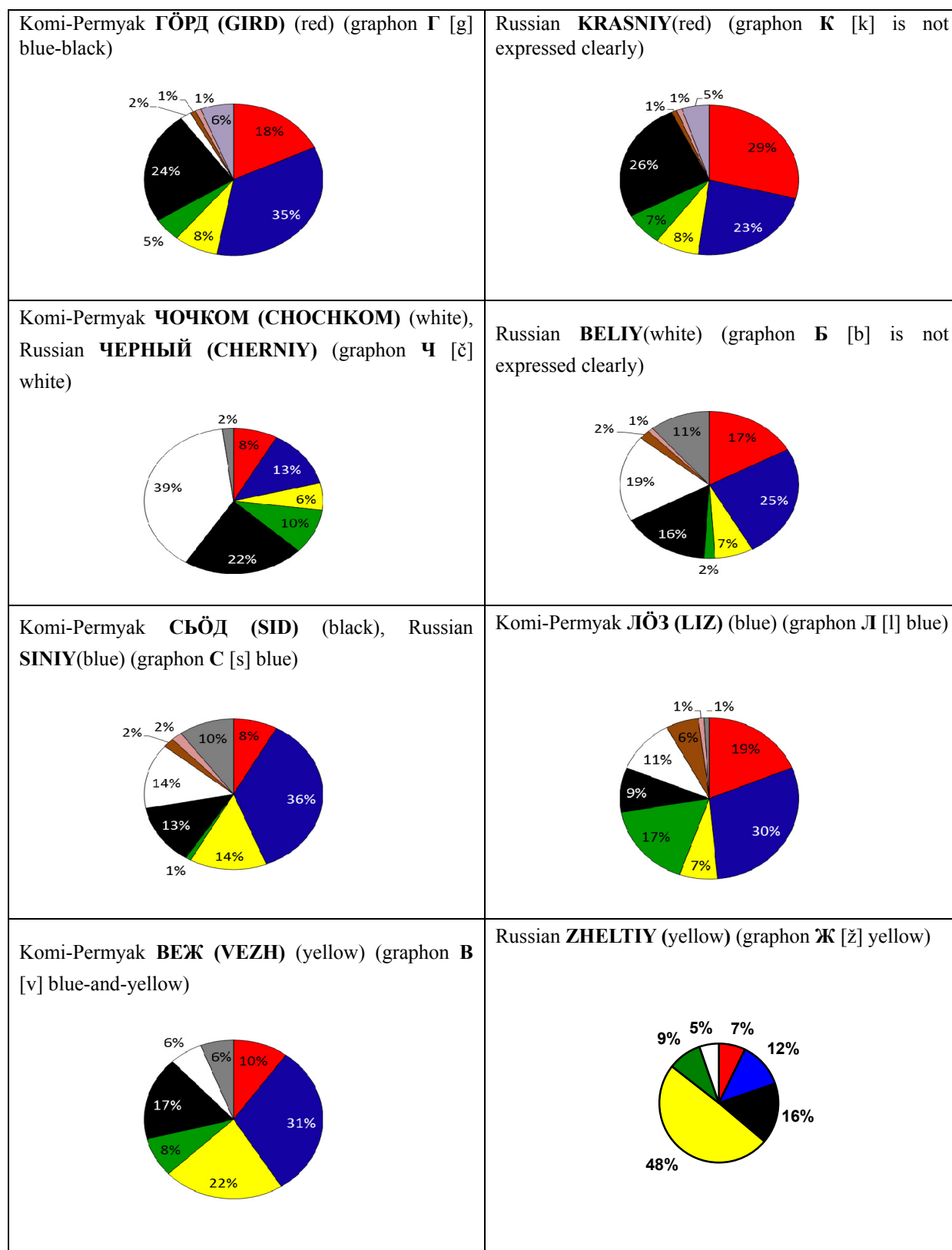
Komi-Permyak **ГӦРД (GIRD)** (red) (graphon **Г** [g] blue-black)

Russian **KRASNIY**(red) (graphon **К** [k] is not expressed clearly)

Komi-Permyak **ЧОЧКОМ (CHOCHKOM)** (white), Russian **ЧЕРНЫЙ (CHERNIY)** (graphon **Ч** [č] white)

Russian **BELIY**(white) (graphon **Б** [b] is not expressed clearly)

Komi-Permyak **СЬӦД (SID)** (black), Russian **SINIY**(blue) (graphon **С** [s] blue)

Komi-Permyak **ЛӦЗ (LIZ)** (blue) (graphon **Л** [l] blue)

Komi-Permyak **ВЕЖ (VEZH)** (yellow) (graphon **В** [v] blue-and-yellow)

Russian **ZHELTIY (**yellow**)** (graphon **Ж** [ž] yellow)

Figure 11. Relative dependence of color associativity on initial consonant in color denomination

4.3 Grapheme and Phoneme

Separate experiments (Day, 2001) show that color perception of the grapheme and sound differs insignificantly

(Figure 12): a tendency of attraction to one or another color is preserved.

In our experiment, insignificant differences in perception of the phoneme and grapheme are shown by high consistency of reactions per the graphons Е [je] (20%) - Э [è] (20%); Ю [ju] (13%) - У [u] (14%) for yellow color; Е [je] (21%) - Э [è] (19%); О [o] (19%) - Ё [jo] (21%); И [i] (21%) - i [i] (18%) for blue spectrum.
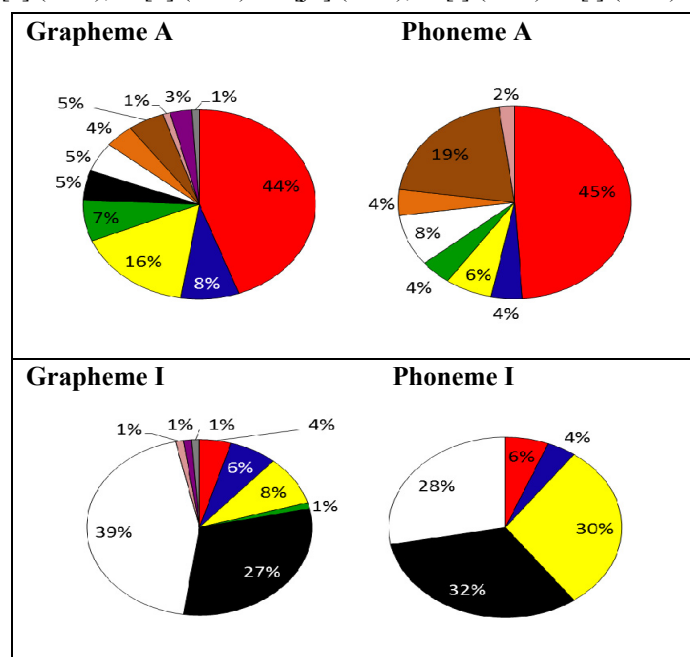

Figure 12. Color associativity of English graphemes and phonemes (according to S. Day)

4.4 The Influence of Bilingualism

As the Komi-Permyaks are the natural bilinguals and speak Russian fluently, it is possible to assume the impact of Russian language on the sound-grapheme-color associativity of Komi-Permyaks.

Let us compare the obtained results (Table 2) on Komi-Permyak language with the data on Russian and English languages (Prokofieva, 2008).

Table 2. A matrix of sound-grapheme-color associativity of the Komi-Permyak, Russian and English vowels

Color	Komi-Permyak	Russian	English
Komi-Permyak *веж(vezh)* Russian *желтый(zheltiy)* English *yellow*	<u>i</u> [i], <u>Е</u> [je], <u>Э</u> [è]	<u>Е</u> [je], Ё [jo], **О** [o], <u>**Э**</u> [è]	<u>**Е**</u> Y
Komi-Permyak *гöрд* Russian *красный* English *red*	Ы [y], О [o], И [i], Е [je], i [i], Ö [as i in English *girl*], Ю [ju], Ё [jo], <u>**У**</u> [u], <u>**Я**</u> [ja], <u>**А**</u> [a]	<u>**А**</u> [a], **Ю** [ju], <u>**Я**</u> [ja]	<u>**А**</u>
Komi-Permyak *руд* Russian *серый* English *grey*	-	-	-
Komi-Permyak *коричневöй* Russian *коричневый* English *brown*	-	Ы [y]	-
Komi-Permyak *лöз* Russian *синий* English *blue*	<u>У</u> [u], О [o], <u>И</u> [i], Е [je], Э [è], i [i], Ö [as i in English *girl*], Ё [jo], **О** [o], **Ы** [y], <u>**Ю**</u> [ju]	<u>**И**</u> [i], <u>У</u> [u], Ю [ju]	<u>**U**</u>
Komi-Permyak *сьöд*	<u>Ы</u> [y], i [i]	<u>**Ы**</u> [y]	-

Color	Komi-Permyak	Russian	English
Russian *черный* English *black*			
Komi-Permyak *зелёнöй* Russian *зеленый* English *green*	Ё [jo]	**Е** [je], **Ё** [jo], **У** [u], **Э** [è]	**Е**
Komi-Permyak *чочком* Russian *белый* English *white*	A [a], O [o]	A [a], **O** [o]	**I O**
Komi-Permyak *оранжевöй* Russian *оранжевый* English *orange*	O [o]	-	O

The comparison of data on Komi-Permyak, Russian (supposed impact on the synaesthesia) and English languages shows that the impact of bilingualism on the sound-grapheme-color associativity is not determinative. In whole, the data on Komi-Permyak language coincides with the results, obtained in Russian and English languages (they are underlined in the Table 2).

Besides, the argument for the hypothesis about insignificant impact of bilingualism on the sound-grapheme-color associativity is that the Komi-Permyak graphons do not have the stable and regular link with colors, the names of which are borrowed from Russian (green, orange, brown). This fact allows speaking about the existing role of "native" letters with original color denominations.
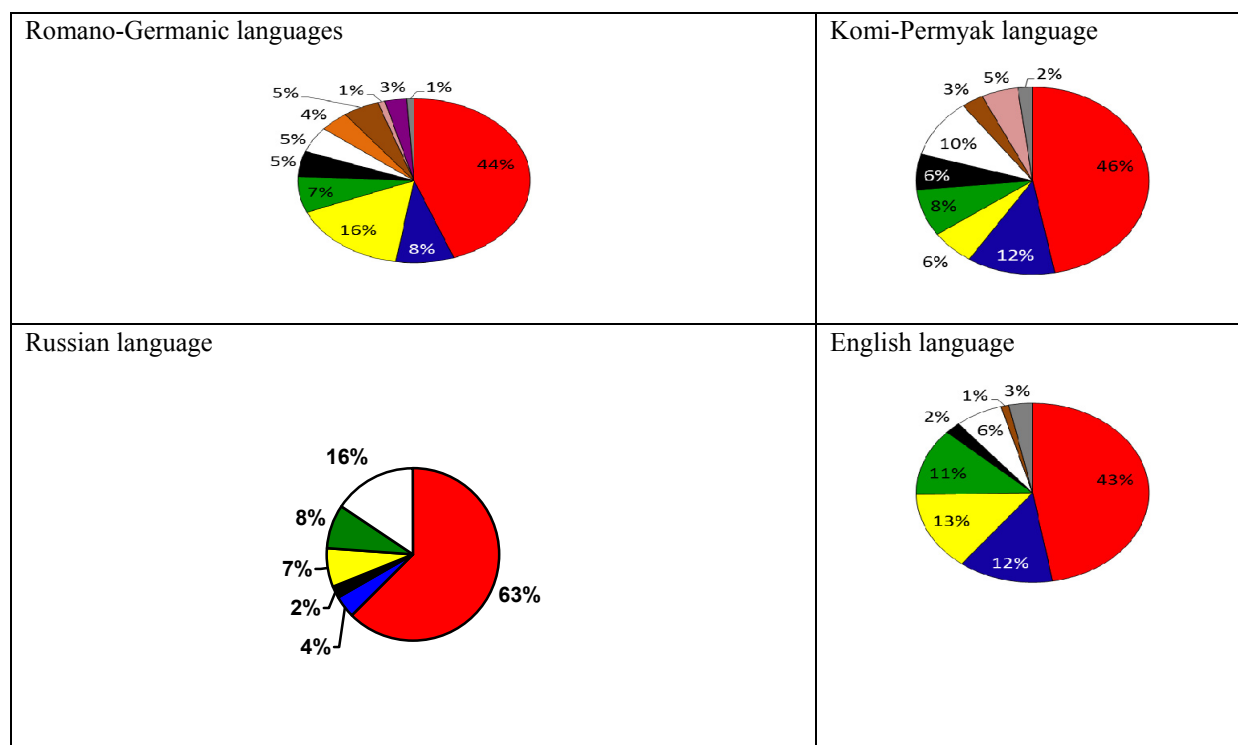
4.5 Universality and Specificity

Figure 13. Color associativity of the graphon A [a]

According E. Sepir and S. Tsuru, color associations of consonants are nationally conditioned, and the phonosemantic potential of vowels allows referring their associativity to universal phenomena (Sepir, 1993; Tsuru, 1933). The data on English, Russian (Prokofieva, 2008) and Komi-Permyak languages do not prove this statement.

Let us compare the data on Komi-Permyak vowels with the data, obtained at the material of Russian (Zhuravlev, 1974; Prokofyev, 2008), English (Hollingworth & Weischer, 1939; Prokofieva, 2008) and Romano-Germanic (Day, 2001) languages (Figure 13-15).

The evaluations for the graphon A [a] (Figure 13) coincide in all languages in the red spectrum; they partially coincide for the graphon O [o] in white and yellow areas (Figure 14).
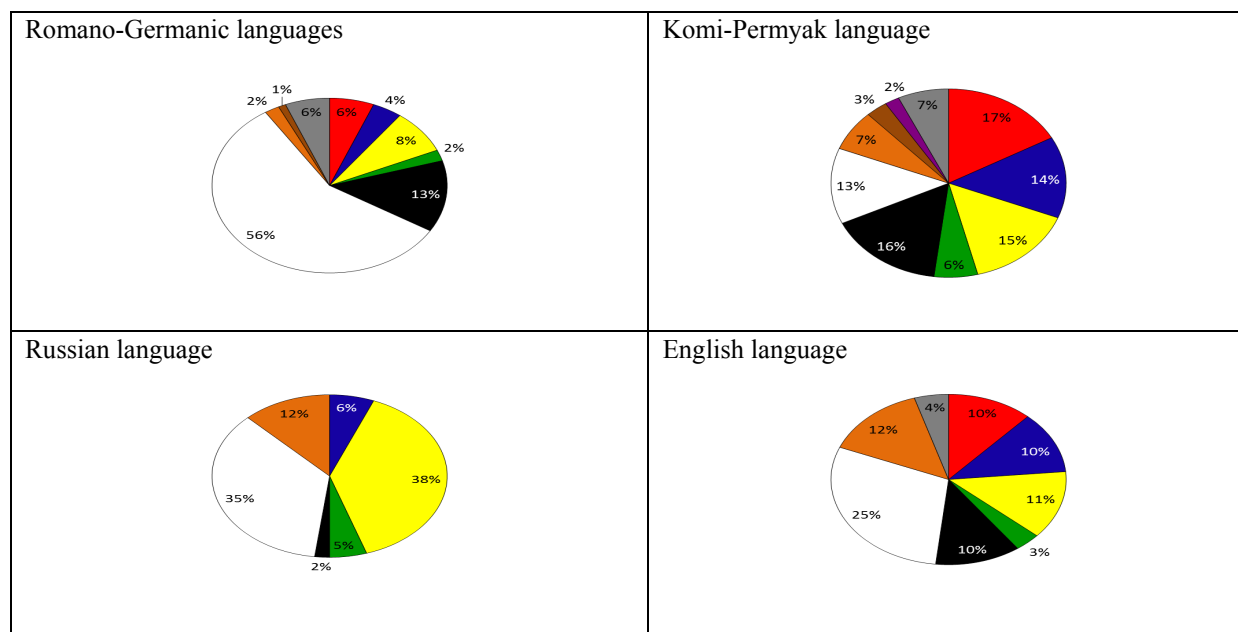

Figure 14. Color associativity of the graphon O [o]

It is illegally "to search for the coincidences for the other graphons (Figure 15), due to articulatory differences of the pronounced sounds and positional interchanges" (Prokofieva, 2008), what requires additional check.
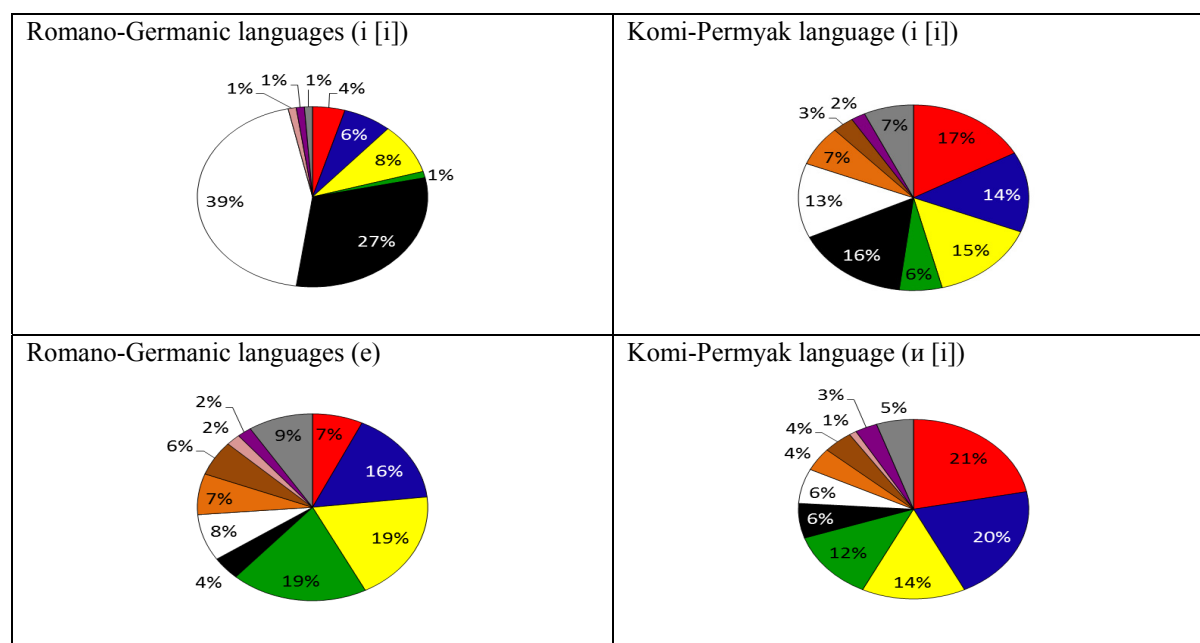

Figure 15. Color associativity of the graphons И [i] (Komi-Permyak), i (Romano-Germanic and Komi-Permyak), E (Romano-Germanic)

It is possible to assume that sound-color associativity of the graphons A [a] and O [o] with high degree of probability presents a universal phenomenon, as the associativity of the rest vowels is nationally conditioned, what requires the additional check. Thus, the specific Komi-Permyak graphons i [i] (Figure 15) and Ö [pronounced as i in English *girl*] (Figure 16), which are absent in Russian and cannot be subject to the impact of bilingualism, do not have clearly expressed color.
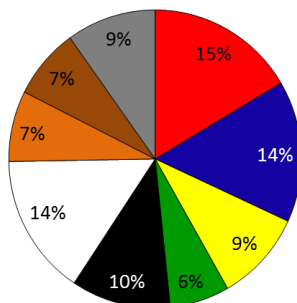

Figure 16. Color associativity of the graphon Ö [pronounced as i in English *girl*]

4.6 The Presence of Color Name in the Language

Our experiments show that the Komi-Permyak graphons do not have the stable and regular links with colors, the names of which are borrowed from Russian (green, orange, brown). This fact allows speaking about the existing link of "native" letters with original color denominations.

At the material of 98 languages, B. Berlin and P. Kay (1969) showed that the system of color denominations passed seven stages in its development (Figure 17).
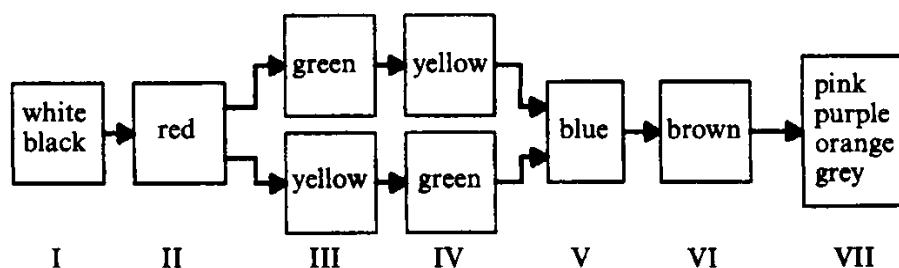

Figure 17. Evolution of development of color denominations according to B. Berlin and P. Kay

At the stage I, the language lexically distinguishes two colors: black, involving dark tones, and white, involving all light tones. The category "red" appears at the stage II; it involves all shades of red, orange, yellow, brown, pink and violet. Yellow and green are distinguished at the stage III, and the filling of the categories "white" and "black" narrows. At the stages III and IV, there can be two variants of development, as yellow and green appear one after another randomly, but not simultaneously.

The rule of evolution of color denomination, according to B. Berlin and P. Kay, is the following: if the language has color denominations of the definite stage of development, it is obliged to have all color denominations of the previous stages. Thus, if the language distinguishes the category "blue", it also has the names for white, red, green and yellow colors.

Komi-Permyak language has six main color denominations: *göpð(gird)* 'red', *liz* 'blue', *sid* 'black', *chochkom* 'white', *vezh* 'yellow', *rud* 'grey'.

In the evolution of color terminology in languages, according to B. Berlin and P. Kay (Figure 17), the formation of color denomination of blue (stage V) follows yellow and green (III-IV stages). Psychological experiments also point at this: when distinguishing green square, the reaction time of Russians and Komi-Permyaks is practically the same, but to distinguish the blue square, Komi-Permyaks spend much more time, that Russians (Goncharov

& Knyazev, 2010).

In Komi-Permyak language, "the failure" of the evolutionary scheme under review takes place: Komi-Permyak language has the color denomination for blue *лӧз* (liz) (V stage) and for grey - *руд(rud)* (VII stage) colors, but there are no names for green (III-IVstages) and brown (VI stage) colors. It complies with the theory of B. Berlin and P. Kay, where some exceptions were mentioned.

As per calculations of ethnolinguists, there is no more than 5% languages (predominantly of Slavonic group) in the world, where blue and sky-blue have self-designation. At the same time, in many languages, the whole green-blue range is denoted by one color, and there exist much more names for the warm red-yellow range.

This tendency is noted in Komi-Permyak language: indivisible character of green-blue (the lack of Komi-Permyak denomination for green), but the presence of warm yellow and red color denomination. At present, there are no main terms to denote orange, pink and violet colors.

Despite the radical differences in verbal mark of color intervals, people of different cultures perceive the colors similarly, i.e. they tend to distinguish the same focal colors. The easily named (red, green and blue) and difficultly named colors, for which there are no names in the language, are distinguished.

Thus, it is possible to assume that the easily named (identified) main colors (the formedness of color denominations in the language) have the greater degree of coincidence, the less degree of coincidence in evaluation of graphons color in Komi-Permyak language is connected with the peculiarities of color picture of the Komi-Permyak world.

In the sphere of vocalism, it is also possible to assume the mythological impact of sound-grapheme-color associativity in Komi-Permyak language. The obtained data allows speaking about the attraction of Komi-Permyak vowels to chromatic colors (red, yellow, blue), which are the symbols of middle world in the culture, whereas achromatic colors, symbolizing top (white) and bottom (black) worlds, are not associated with vowels.

Namely, the world of people is presented in obvious colors, generalized in yellow, blue and red colors, which dominate in Komi-Permyak culture. Green color in Komi-Permyak culture was not endued with special meaning, only in the end of the XX century, a special color denomination of green began to appear. It is pointed out by the fact, that Komi-Permyak denomination of green was borrowed from Russian language - *зеленӧй (zeleniy).*

It is possible that "not all graphemes in the language have the similar associative possibilities, and that it is connected with the peculiarities of human brain activity rather than the language peculiarities" (Prokofieva, 2008, p. 215).

5. Conclusion

Our experiment provided us with the satisfactory results on four vowels of the Komi-Permyak language (У [u], Я [ja], А [a] of red color, Ы [y], Ю [ju] - of blue color), color associativity of which lies within the significant numbers (from 25% to 52% of reactions).

As per our data, color characteristics of vowels in Komi-Permyak language does not have the one-value link with the characteristics of sounds, denoted by letters.

The data of our experiment shows the relative dependence of color associativity of vowels on the initial consonant and following vowel in color denomination.

In our experiment, high conformity of reactions for separate graphons in the sphere of yellow and blue spectrums points at the insignificance of differences in color perception of the phoneme and grapheme.

In near-core and peripheral areas, Komi-Permyak vowels get the same characteristics, as in the Indo-European languages. The evaluations for the graphon А [a] coincide in the red area of spectrum; they partially coincide for the graphon О [o] in white and yellow areas.

It is possible to assume that color associativity of the graphons А [a] and О [o] with high degree of probability presents a universal phenomenon, whereas the associativity of the rest vowels is nationally conditioned, requiring the additional check.

At the same time, our experiments show that Komi-Permyak graphons do not have the stable and regular link with colors, the names of which are borrowed (green, orange, brown). This fact allows speaking about the existing link of "native" letters with the original color denominations.

We also assume the mythological impact on sound-grapheme-color associativity in Komi-Permyak language. The tendency of Komi-Permyak vowels to the spectrum of chromatic colors (red, blue, yellow) is obvious, but

their brightness and saturation turns out to be erased, "water-color", pale, as compared to Russian language.

The preliminary data, obtained on Komi-Permyak language, require additional check. It is important to specify the factors, which influence the associativity of graphons, including the mythology and the surrounding environment. These problems require additional investigations.

Acknowledgements

References

Asano, M., & Yokosawa, K. (2011). Synesthetic colors are elicited by sound quality in Japanese synesthetes. *Conscious. Cogn., 20*, 1816-1823. http://dx.doi.org/10.1016/j.concog.2011.05.012

Asano, M., & Yokosawa, K. (2012). Synesthetic colors for Japanese late acquired graphemes. *Conscious. Cogn., 21*, 983-993. http://dx.doi.org/10.1016/j.concog.2012.02.005

Asano, M., & Yokosawa, K. (2013). Grapheme learning and grapheme-color synesthesia: Toward a comprehensive model of grapheme-color association. *Front. Hum. Neurosci., 7*, 757. http://dx.doi.org/10.3389/fnhum.2013.00757

Beeli, G., Esslen, M., & Jäncke, L. (2007). Frequency correlates in grapheme-color synaesthesia. *Psychol. Sci., 18*, 788-792. http://dx.doi.org/10.1111/j.1467-9280.2007.01980.x

Berlin, B., & Kay, P. (1969). *Basic Color Terms*. Their Universality and Evolution, Berkeley and Los Angeles: University of California Press.

Blair, C. D., & Berryhill, M. E. (2013). Synesthetic grapheme-color percepts exist for newly encountered Hebrew, Devanagari, Armenian and Cyrillic graphemes. *Consciousness and Cognition, 22*(3), 944-954. http://dx.doi.org/10.1016/j.concog.2013.06.002

Brang, D., Rouw, R., Ramachandran, V. S., & Coulson, S. (2011). Similarly shaped letters evoke similar colors in grapheme-color synesthesia. *Neuropsychologia, 49*, 1355-1358. http://dx.doi.org/10.1016/j.neuropsychologia.2011.01.002

Cytowic, R. (1989). *The Man who Tasted Shapes*. New York. Putnam.

Day, S. (2001). *Trends in Sinesthetically Colored Graphemes and Phonemes*. Retrieved from http://www.daysyn.com/Day2004Trends.pdf

Day, S. (2014). *Types of synesthesia*. Retrieved form http://www.daysyn.com/Types-of-Syn.html

Goncharov, O. A., & Knyazev, N. N. (2010). Linguistic determination of perception of colors in Russian and Komi. *Psychological Journal of International University of Nature, Society and Man "Dubna", 2*. Retrieved from http://www.psyanima.ru/journal/2010/2/2010n2a1/2010n2a1.pdf

Hollingworth, H. L., & Weischer, V. (1939). Presistent alphabetical synesthesis. *American Journal of Psychology, 12*, 361-366. http://dx.doi.org/10.2307/1416743

Kim, S., Blake, R., & Kim, C. Y. (2013). Is "∑" purple or green? Bistable grapheme-color synesthesia induced by ambiguous characters. *Consciousness and Cognition, 22*(3), 955-964. http://dx.doi.org/10.1016/j.concog.2013.05.012

Mills, C. B., Metzger, S. R., Foster, C. A., Valentine-Gresko, M. N., & Ricketts, S. (2009). Development of color-grapheme synesthesia and its effect on mathematical operations. *Perception, 38*, 591-605. http://dx.doi.org/10.1068/p6109

Motluk, A. (1997). *Two Synaesthetes Talking Colour. Synaesthesia*. Cambridge, MA: Blackwell.

Prokofieva, L. P. (2008). *Sound-color associativity in language consciousness and literary text: Universal, national, individual aspects*. PhD thesis. Saratov.

Rakin, A. (1990). Vocabulary color terms in the Permian languages. *Uurali keelte aktuaalseid probleeme, Tartu (FU 16)*, 112-121.

Riabinina, E. (2011). *Basic color terms in the Permian languages*. Tartu. Retrieved from http://www.dspace.utlib.ee/dspace/bitstream/handle/10062/18808/rjabina_elena.pdf?sequence=1

Riabinina, E. S. (2010). The vocabulary of color terms in Udmurt: Gender and age differences. *Yearbook of Finno-Ugric studies, 2*(Izhevsk), 127-135.

Rothen, N., Tsakanikos, E., Meier, B., & Ward, J. (2013). Coloured Letters and Numbers (CLaN): A reliable factor-analysis based synaesthesia questionnaire. *Consciousness and Cognition, 22*(3), 1047-1060. http://dx.doi.org/10.1016/j.concog.2013.07.005

Sepir, E. (1993). *A study in phonetic symbolism*. Edward Sapir. Selected Papers on linguistic and cultural studies. M.: Progress Universe.

Simner, J., Ward, J., Lanz, M., Jansari, A., Noonan, K., & Glover, L. (2005). Non-random associations of graphemes to colours in synaesthetic and non-synaesthetic populations. *Cogn. Neuropsycho., 22*, 1069-1085. http://dx.doi.org/10.1080/02643290500200122

Tarakanov, I. V. (1990). *Terms of colorsname in Udmurt language in comparison with the Komi, Mari and Mordovia languages*. Questions dialectology and lexicology Udmurt language. Izhevsk.

Tsuru, S., & Fries, H. S. (1933). Sound and meaning. *Journal of General Psychology, 8*, 281-284. http://dx.doi.org/10.1080/00221309.1933.9713186

Watson, M. R., Akins, K. A., & Enns, J. T. (2012). Second-order mappings in grapheme-color synesthesia. Psychon. *Bull. Rev., 19*, 211-217. http://dx.doi.org/10.3758/s13423-011-0208-4

Witthoft, N., & Winawer, J. (2006). Synesthetic Colors Determined by Having Colored Refrigerator Magnets in Childhood. *Cortex, 42*(2), 175-183. http://dx.doi.org/10.1016/S0010-9452(08)70342-3

Zhuravlev, A. P. (1974). *Phonetic value*. L.: LSU.

Copyrights