"Still sounds like a rainbow" - a proposal for a coloured vowel chart

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Abstract The present contribution aims at reinvestigating the idea of sound-colour charts with a view to enhancing L2 pronunciation training through relying on sound and colour perceptual correspondence. A preliminary proposal for a coloured vowel chart is put forward, in which the assignment of colours corresponds to the general tendencies resulting from cross-modal studies on vowel and colour associations in English (Wrembel & Rataj to appear) and Polish (the present study). The expected outcome of the investigation is to develop a system of mapping perceptual attributes between audio and visual senses that would function as a pedagogical aid based on the idea of multimodal reinforcement.

1 Introduction Recently, a holistic approach to learning has found a number of proponents also amongst pronunciation educators, who claim that L2 pronunciation training should involve the whole learner not just the speech apparatus or learners' cognitive faculties (cf. Acton 1997). This approach manifests itself, among others, in the use of multisensory modes of presentation and practice. The process of teaching and learning practical phonetics is thus expected to be enhanced by appealing to a combination of modalities involving different senses through auditory, visual, tactile, kinaesthetic reinforcements. The current contribution focuses on an innovative application of the visual channel reinforcement through encouraging associations between target language sounds and the colour spectrum. The proposed search for multisensory associations corresponds to a visualisation technique that can be adopted from the Neuro-Linguistic Programming to L2 pronunciation training. By visualising a sound or a phonological process in terms of colours, emotions or other aesthetic values the learners are expected to perceptually tune into the target language sounds and to remember them better due to new neurological paths that have been constructed. Consequently, such multi-sensory reinforcement is expected to facilitate transfer to correct L2 production.

2 Theoretical assumptions Jakobson (1962: 386-387) was the first to have applied colour terminology with respect to vowels by pointing to the regularity of colour associations in coloured hearing synaesthesia, a condition involving involuntary cross-sensory experience. Having identified close connections of vowels /o/ /u/ with darker colours, /e/ /i/ with brighter colours, and /a/ with red, Jakobson claimed that there must be some phenomenal affinity between optimal chromaticity (pure red) and vocalic compactness; attenuated chromaticity (yellow-blue) and vocalic diffuseness; optimal achromaticity (black-white) and consonantal diffuseness; attenuated achromaticity (greyed) and consonantal compactness (1962: 488). However, the associations between phonemic features and colour attributes have received little attention to date with the exception of research on synaesthesia. The findings point to a strong correlation between auditory pitch and visual luminance and a general tendency for both synaesthetic and non-synaesthetic populations to associate high pitch sounds with light colours and lower tones with dark colours (e.g. Ward et al. 2006).

Theoretical assumptions on which the study is based are of a threefold nature and stem from (1) research into sound-colour synaesthesia, (2) implications of universal sound symbolism (e.g. phonesthetic associations) and (3) non-modularity of perception. For a more detailed discussion thereof see Wrembel & Rataj (to appear).

3 Experiment The present investigation is a continuation of the study on cross-modal colour mappings which was first conducted on English vowels (Wrembel & Rataj to appear).

The aim of the present study is to verify further the general trends reported in the previous experiment and to provide some evidence for the universal nature of the sound colour associations by comparing the results for Polish and English vowels. The ultimate goal is to transform the reported tendencies in the mapping of perceptual attributes between audio and visual senses into a colour-coded vowel chart that could be used as an L2 pronunciation teaching aid.

3.1 Participants and procedure The participants of this part of the experiment included 29 first year Polish students of English and 8 phonetics teachers at Adam Mickiewicz University in Poznan, Poland. They consisted of 30 females and 7 males and their mean age was 22 years. Auditory stimuli used in this experiment included 6 Polish pure vowel sounds recorded in isolation (i.e. in the citation form) and in b_d context . The stimuli were recorded by a male native speaker of Polish in a professional recording studio as 16-bit mono files at a sampling frequency of 16000 Hz using Audacity software. In the aforementioned English part of the experiment, the English vowel stimuli were recorded by a male native speaker of English in the same conditions.

The experiment was run on a specially designed computer program, implemented in Visual Basic, that offered the following functionality: (1) playing a given number of sounds - in every testing cycle the order of the sounds was randomised; (2) displaying the palette of 11 basic colours - in every testing cycle the position of every colour was randomised; (3) registering in a text file the sound that was played, the selected colour, tester's name, and response time. The experiment was carried as a series of individual sessions with the participants seated in front of a computer screen in a dimmed room. They were instructed to listen to individual sounds and choose one colour from a palette of 11 basic colours, including red, yellow, green, blue, brown, purple, pink, orange, black, white and grey. The choice was made by clicking on one of the 11 coloured rectangles presented in 3 rows against a light grey background. The colour palette appeared automatically on the screen with a 2s delay after a 'Play' button was clicked in order to play a particular vowel sound.

3.2 Results and discussion In order to determine whether the associations between the vowel sounds and selected colours were random or not, a statistical analysis was performed by SPSS. The results of a nonparametric chi-square analysis point to the statistical significance of sound-colour associations for all the Polish vowels under investigation at the significance level $p<.001$ for /e/, /i/, /o/, /ɨ/, and $p \leq .01$ for /a/ and /u/ (see Table 1).

	/a/	/e/	/i/	/o/	/u/	/ɨ/
chi2	22,6	114,8	184,4	54,2	25,5	42,9
df	10	10	10	10	9	10
p	0,012	0,000	0,000	0,000	0,002	0,000

Table 1 Chi-square analysis for vowel-colour associations in Polish

Table 2 presents the data generated by the experiment, highlighting these particular colour associations which were above chance level as demonstrated by the chi-square test results comparing the observed values to the expected ones.

	/a/	/e/	/i/	/o/	/u/	/ɨ/
green	5%	26%	24%	5%	5%	12%
yellow	8%	7%	35%	7%	9%	11%
blue	9%	24%	7%	15%	18%	3%
orange	11%	9%	5%	19%	7%	12%
grey	7%	11%	5%	8%	12%	20%
brown	11%	4%	4%	18%	15%	12%
red	19%	7%	5%	9%	5%	3%
purple	9%	5%	7%	4%	14%	7%
white	7%	4%	4%	9%	0%	7%
pink	7%	1%	1%	4%	5%	8%
black	7%	1%	1%	1%	9%	5%

Table 2 Vowel-colour associations for Polish (highlighted values statistically significant p<.01)

The strongest correlations were yielded for /i/, which triggered significant associations with green and yellow, as well as for /e/, which was associated mainly with green and blue. The strength of the remaining associations was at a similar level with /a/ generating red, /o/ mostly orange and brown, /ɨ/ grey, and /u/ blue and brown. It has to be emphasised that if a particular sound was associated above chance level with more than one colour, these pairs of colours appeared to be closely related on the colour spectrum.

In order to verify if there was any discrepancy in the colour associations between Polish vowels perceived in isolations and the same vowels in the b_d context, respective reaction times were examined in a paired-sample t-test analysis. The results of the test (t= -2.686, p=.007) indicate that the reaction times in both conditions are significantly different, with the mean time needed to assign a colour to a vowel in isolation (M=5.8) being significantly lower than in the context (M=6.4).

If we compare the findings of the present study on Polish vowels against the data generated in the previous study on English vowels we can observe some cross-linguistic regularities. The English high front vowel /iː/ and Polish /i/ are prevailingly associated with yellow and green, while front mid /e/ in both languages tends to elicit associations from the green-blue spectrum. More centralised close mid vowels (English /ɪ/ and Polish /ɨ/) tend to elicit grey hues, in the case of English mixed with green and yellow. There is a considerable tendency for English central mid vowels /ɜː/ and /ə/ to be mapped to grey. Open vowels, i.e. English /æ/ and /ɑː/ and Polish /a/ tend to generate red associations, the second choice for the front open /æ/ being yellow, and black for the more retracted /ɑː/. Back vowels, in general, trigger dark colour associations; English /uː/ and /ɔː/ tend to be perceived as brown or black, /ʊ/ as brown and grey, and /ɒ/ as black or blue. Polish /o/ is associated with brown or orange, whereas /u/ with blue and brown. The strength of these associations varies within languages and cross-linguistically.

On the basis of the two studies conducted on the English and Polish vowels it appears that sound-colour associations demonstrate some visible cross-linguistic tendencies and that it is specific phonemic features that trigger particular colour attributes. The general trend is for front vowels to elicit bright colour associations (i.e. green/yellow), while back vowels generate darker colour associations (i.e. brown/black/blue). Open vowels commonly trigger red associations; central regions of the vowel space tend to be mapped onto grey. Comparing the present findings to

the results obtained in research on synaethesia (e.g. Simner et al. 2005, Ward et al. 2006) it appears that certain patterns of response are common both to synaesthetes and non-synaesthetes. Simner et al. 2005 conclude that such visible similarities may result from a mechanism of cross-modal perception that is common to all humans.

3.4 Pedagogical implications - coloured charts revisited The idea of colour-coded vowel charts was first explored in 1970s by Caleb Gattegno, the founder of the Silent Way, in which learning was facilitated by pronunciation charts, i.e. Sound-Colour Chart (coloured rectangles corresponding to target language vowels and consonants) or Fidel Chart (spelling-sound correspondence) (http://www.englishraven.com/Phonics_soundcolor.html).

I would like to put forward a proposal for coloured vowel charts for English and Polish in which the assignment of colours is not arbitrary but corresponds to the general tendencies resulting from the investigations of colour-sound associations. The charts may be used as a pronunciation teaching aid in the foreign language classroom to accompany and reinforce conscious perceptual experience of speech sounds, and eventually to facilitate foreign language phonological acquisition. The guiding principle behind the use of colour is to contrast and show similarities between target sounds. The application of the coloured vowel chart could involve better visualisation, reinforcement and practice of fine phonemic distinctions. Through colour associations learners may identify sounds with aesthetic values and activate additional affective learning pathways. Colour-coding could also be applied to facilitate the use of transcription symbols and to illustrate spelling-sound correspondence with graphemes being coloured in accordance with the master sound chart. It is hoped that the proposal may raise awareness of the existing potential of cross-modal mechanisms that may be applied to facilitate foreign language learning.

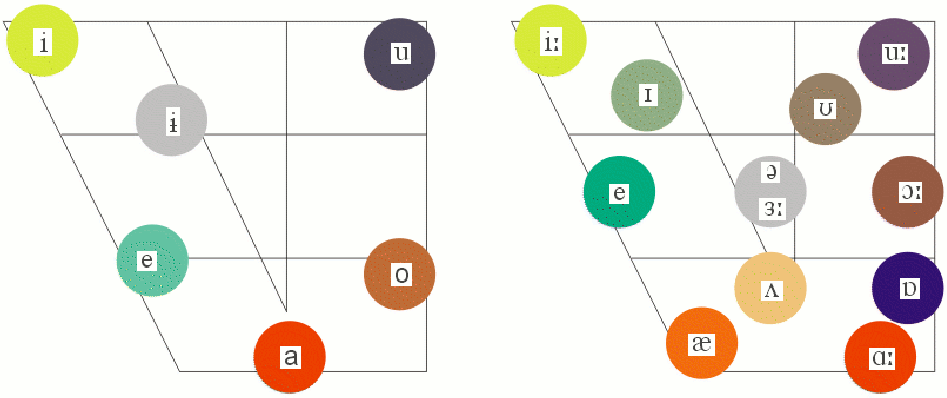

Figure 1. Coloured vowel charts for Polish and English

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