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A Comparative Analysis of the Vowel Systems of Some Slavic Languages Through Dispersion Theory

1. Introduction

According to the results of many studies investigating the vowel systems of different languages, it is observed that languages prioritise some vowels over the others. In his investigation of 317 languages, Maddieson (1984, p. 125) notes that those with five-vowel systems tend to have /i, e, a, u, o/, and those with seven-vowel systems tend to add /ɔ, ɛ/. As the vowels /i, a, u/ exist in the vast majority of the world's languages, they are called point vowels (Bradlow, 1995, p. 1916; Maddieson, 1984, p. 125). Another prioritisation is seen in the languages with six-vowel systems: they tend to have /i, e, æ, u, o, ɑ/, which is almost the same as the Persian vowel system (Bijankhan, 2015, p. 94). It also has been observed that 45.8% of languages have between five and seven vowels in their vowel inventories; consequently, it can be concluded that there is a tendency for languages to have between five and seven vowels in their vowel systems.

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According to the explanations mentioned above, we can see that the vowels that are prioritised in most languages are maximally dispersed in the acoustic space, which has perceptual reasons. This principle is called dispersion theory. It seems that some Slavic languages, according to the data of previous studies, have another prioritisation.

The goal of the present study is to investigate comparatively Russian, Ukrainian, Belarusian, Polish, Czech and Slovak vowel systems through dispersion theory.

2. Preliminaries

2.1. Slavic languages

Slavic languages are a subdivision of the Indo-European family and are spoken primarily by the Slavic people. With around 300 million speakers, Slavic is the fourth largest sub-family of Indo-European languages, after Indic, Romance and Germanic, and ahead of Iranian, Greek, Albanian and Baltic (Sussex & Cubberley, 2006, p. 2). Modern Slavic languages are classified into three groups as follows:

Table 1. Modern Slavic national, sub-national and extinct languages (Sussex & Cubberley, 2006, p. 2)

Slavic languages		
South Slavic	East Slavic	West Slavic
Slovenian Croatian Bosnian Serbian Bulgarian Macedonian Montenegrin Old Church Slavonic	Russian Belarusian Ukrainian Rusyn Ruthenian	Sorbian (Upper and Lower) Polish Czech Slovak Kashubian Polabian Slovincian

The three modern East Slavic languages are Russian, Ukrainian and Belarusian. As a linguistic group they are more homogeneous than South or West Slavic. Under the Soviet regime they were all part of the USSR (Sussex & Cubberley, 2006, p. 79).

West Slavic languages are categorised into two linguistic groups: the Czecho-Slovak group, including Czech and Slovak, and the Lekhitic group, including Polish, Kashubian, and Upper and Lower Sorbian. The Polabian and Slovincian languages became extinct in the eighteenth and twentieth century respectively (Sussex & Cubberley, 2006, p. 89).

South Slavic languages are classified into two sub-groups: North-Western, consisting of Slovenian, Bosnian, Croatian and Serbian, and South-Eastern, consisting of Bulgarian and Macedonian. These Slavic countries are bounded by the Adriatic in the west; the Black Sea in the east; Italy, Austria, Hungary and Romania in the north; and Turkey in the south (Sussex & Cubberley, 2006, p. 62).

2.2. Dispersion theory of the vowel system

Dispersion theory (DT) assumes that vowels are distributed in the vowel space to maximise contrasts. According to Vaux and Samuels (2015, pp. 575–576), there are several variants of DT, and some of them go back to the pre-generative era, such as Jakobson's (1941) proposal stating that vowels are maximally dispersed. All variants of DT consider maximisation of distinctiveness of vowel selection in the vowel inventories of languages. The elements involved in the dispersion include maximal contrast in articulatory space, minimisation of effort, focalisation, maximal overall contrast compensating for F_0, lexical frequency, and formant normalisation (Vaux & Samuels, 2015, p. 576).

There are different predictions that determine the most common vowels in languages, which are as follows:

Table 2. Lindblom's (1990) optimal system and the most common seven-vowel systems according to Crothers (1978) (Vaux & Samuels, 2015, p. 577)

Lindblom (1990)	**Crothers (1978)**	
/i, ʉ, u, ɛ, a, ɑ, ɤ/	/i, e, a, ɨ, u, o, ə/	/i, e, ɛ, a, u, o, ɔ/

According to maximal dispersion and the definition of DT, we can argue that these predictions extracted from typological investigations may not be pertinent to DT, as some vowels violate maximal dispersion. However, Crothers' (1978) prediction including /i, e, ɛ, a, u, o, ɔ/ is in line with the definition of DT, following maximal dispersion.

3. Literature review

As discussed by Timberlake (2004) and Yanushevskaya and Bunčić (2015), the Russian vowel system has six-vowels: /i, e, a, ɨ, u, o/, and vowel reduction exists in this language. However, there is no investigation concerning dispersion theory in Russian.

Bird and Litvin (2021) present the Belarusian vowel system, which has /i, e, a, u, o/, but in the data of their study it is observed that there are allophones for the vowels, which are /ɛ, ɨ, ʉ, æ, ɵ/. The existence of these allophones is related to palatalised and non-palatalised consonants. The study does not include explanations concerning the dispersion of Belarusian vowels.

Pompino-Marschall et al. (2017, p. 353) and Hanulíková and Hamann (2010, p. 375) illustrate and explain the Ukrainian and Slovak vowel systems. It is observed that Ukrainian has /i, u, a, ɪ, ɛ, ɔ/, and Slovak has /i̟ː, i̟, u̟ː, u̟, aː, a, æ, ɛː, ɛ, ɔː, ɔ/. In Slovak, /æ/ is becoming rare and is often merged with /ɛ/, and it is orthographically represented as <*ä*> (Hanulíková & Hamann, 2010, p. 375). It seems that both languages violate DT, but the articles do not offer explanations.

Comrie and Corbett (1993) provide comprehensive information about almost all Slavic languages. They first explain their genealogical classification and elucidate the Proto-Slavic linguistic system, and then investigate several modern Slavic languages: four from the South Slavic group, six from the West Slavic group, and three from the East Slavic group. Although the vowel and consonant systems of these languages are illustrated, they are not transcribed into the IPA. The main focus of this book is on morphology, syntax and morpho-syntactic investigations.

In the data and explanations by Jassem (2003) and Gussmann (2007, p. 2), it is observed that the Polish vowel system has /i, ɨ, u, e, a/ and /ɔ/ (Gussmann, 2007, p. 2), but there is no investigation concerning dispersion theory.

According to Dankovičová (1997, p. 79), the Czech vowel system is /iː, ɪ, ɛ, ɛː, u, uː, o, oː, a, aː/, and the data provided by Šimáčková, Podlipský and Chládková (Šimáčková et al., 2012, p. 228) show the vowel systems of Bohemian Czech and Moravian Czech, the latter including the vowels /iː, i/ instead of /iː, ɪ/. There is no explanation concerning the violation of DT in Czech.

To conclude this section, we can observe that previous studies do not investigate the vowel systems of these languages regarding DT, and the systems are either merely described or examined through different approaches. Also, these studies do not include comparative analysis.

4. Methodology

To conduct the present study, information about the vowel systems of the six Slavic languages under discussion was extracted from the works presented in Section 3. The data were also checked with PHOIBLE[1] (except Belarusian). The data will be analysed through dispersion theory, and the ways in which DT is violated will be elucidated. Then the data will be compared with Lindblom's (1990) and Crothers' (1978) analyses and proposals to observe how they are violated.

5. Data analysis and discussion

Except Belarusian, all the languages considered in this study violate DT in different ways: Russian and Polish – by using the high central vowel /ɨ/, Ukrainian – the short vowel /ɪ/, and Czech and Slovak – by forming both short and long vowels with the same quality in the same vowel space. Table 3 shows these different ways of violating the theory.

Table 3. DT violations in the investigated languages

DT is not violated	Belarusian	
DT violated	By the vowel /ɨ/	Russian, Polish
	By the vowel /ɪ/	Ukrainian
	By forming both long and short vowels in the same vowel space	Czech, Slovak

[1] PHOIBLE is a repository of cross-linguistic phonological inventory data, which have been extracted from source documents and tertiary databases and compiled into a single searchable convenience sample. Release 2.0 from 2019 includes 3,020 inventories that contain 3,183 segment types found in 2,186 distinct languages (Moran & McCloy, 2019).

As can be seen in Table 3, five languages not only violate DT, but also do it in different ways. The vowel systems of the six languages under study do not confirm Lindblom's (1990) analysis at all. Considering Crothers' (1978) analysis, it can be observed that the data for Russian and Polish confirm his proposal, but Ukrainian, Czech and Slovak have different behaviours. Ukrainian has the short vowel /ɪ/, and both Czech and Slovak have short and long vowels with the same quality – these phonological behaviours are explained neither by Lindblom's (1990) nor Crothers' (1978) proposals. Belarusian does not violate DT, and its phonological behaviour is very similar to Crothers' (1978) observations and results.

5.1. Results

1. In the languages violating DT, it is observed that three of them use a high vowel: /ɨ/ in the case of Russian and Polish, and /ɪ/ in the case of Ukrainian. Although Belarusian does not violate DT, the vowel /ɨ/ is observed as an allophone in this language (Bird & Litvin, 2021). It can be concluded that Slavic languages tend to use a high vowel, except /i/, in the phonological system, and it seems that the tendency is more towards the vowel /ɨ/.

2. In East Slavic languages, Russian and Ukrainian violate DT by using two high vowels in the same vowel space, but Belarusian does not. In West Slavic languages, all the three languages, Polish, Czech and Slovak, violate DT. Polish uses two high vowels in the same vowel space, which is similar to Russian and Ukrainian, so regardless of the vowel quality, Polish, in violating DT, shows a behaviour similar to East Slavic languages. The other two West Slavic languages, Czech and Slovak, also violate DT but in a different way, which is explained above. This means that, firstly, DT is violated in all three West Slavic languages under discussion. Secondly, they display two ways of violating DT: (1) using two high vowels in the same vowel space; (2) forming both short and long vowels with the same quality in the same vowel space. There is also another possible approach if we exclude the vowel /ɨ/ and its feature [+central, +high]. It can be inferred that there is solely one way of violating DT, namely forming both long and short vowels in the same vowel space; Czech and Slovak are in the last stage of the process, forming short and long vowels in all similar vowel spaces, but Ukrainian only formed short and long vowels /i, ɪ/ in the space of high front vowels. This analysis can be challenged because, firstly, we exclude the vowel /ɨ/, which can be seen in Russian and Polish, and, secondly, the other

Slavic languages have not been investigated in this study, which means that the first analysis above is more grounded in the data.

3. Slovak and Czech behave similarly in DT violation by forming both long and short vowels in the same acoustic space. According to Hanulíková and Hamann (2010, p. 375), the vowel /æ/ is becoming rare and is merged with /ɛ/, so now it does not exist in Slovak. The reason for this linguistic behaviour may be perceptual in nature. As the three vowels /a, a:, æ/ are in the same vowel and acoustic space, it is difficult for the listener to distinguish them; consequently, as this could pose perceptual problems, the vowel /æ/ was removed from the vowel inventory. This type of vowel prioritisation is not in line with Lindblom's (1990) and Crothers' (1978) predictions. Although we can observe DT violation in these languages, we need to consider that articulatory economy can counterbalance perceptual reasons, so the principle of sufficient dispersion, as opposed to maximal dispersion, must be considered. This principle has been further substantiated by Fletcher and Butcher's (2003) investigation of three languages of northern Australia (Kayardild, Dalabon and Mayali) (Trudgill, 2009). It can be argued that in both Czech and Slovak, sufficient dispersion, or articulatory economy, is preferred to maximal dispersion. According to Fletcher and Butcher (2003), this tendency is observed in the three non-Slavic languages analysed in their study.

4. Except Belarusian, it has been observed that the Slavic languages analysed in the present article have a priority of forming their vowel systems which is different from Lindblom (1990) and Maddieson (1984). If we investigate more Slavic languages, the model of vowel prioritisation in this branch can be clarified in more detail. It seems that Maddieson's (1984) observations, based on the investigation of 317 languages, do not give sufficient consideration to all Slavic languages, and nor do they consider the vowels /ɨ, ɪ/ in the vowel inventories of languages with between five and seven vowels.

According to the definitions proposed by Bradlow (1995) and Maddieson (1984), vowel inventories of the vast majority of the world's languages include the vowels /i, a, u/, and these three vowels are known as the point vowels (Bradlow, 1995, p. 1916). This means that the point vowels are the first three vowels of the vowel inventories of different languages. Point vowels are also observed in the six languages under discussion, and this is in line with both Maddieson (1984) and Bradlow (1995). The differences from Maddieson (1984) concern the prioritisations of the point vowels in the case of Russian, Polish, Ukrainian, Czech and Slovak. Only Belarusian displays the phonological behaviour which is in line with Maddieson (1984).

6. Conclusion

This article has investigated phonological behaviour and prioritisations in Russian, Polish, Ukrainian, Belarusian, Czech and Slovak vowel systems through dispersion theory (DT). It has been found that, firstly, five of these languages (Russian, Polish, Ukrainian, Czech and Slovak) violate DT in different ways, such as using the vowels /ɨ, ɪ/ or forming short and long vowels with the same quality in the same vowel space. Secondly, the five languages have prioritisations in forming vowel inventories which are different than the results of Maddieson's (1984) observations. Only Belarusian does not violate DT, and its vowel prioritisation is in line with Maddieson (1984).

Historical reasons for the violation of DT can be considered. Sussex and Cubberley (2006, p. 26) present the phonological system of early Proto-Slavic: in the same non-central (peripheral) vowel spaces, there were two vowels, which can violate DT. This historical reason can be a strong one to explain why these languages violate DT, but we need further investigations.

It seems that further investigations are needed in other Slavic languages – and languages from other branches and families – firstly, to see whether and how they violate DT, and, secondly, to determine their prioritisation(s) in vowel selection.

References

Bijankhan, M. (2015). *Vājshenāsi: Nazariye behinegi* [Phonology: Optimality Theory]. SAMT.

Bird, S., & Litvin, N. (2021). Belarusian. *Journal of the International Phonetic Association*, *51*(3), 450–467. https://doi.org/10.1017/S0025100319000288

Bradlow, A. R. (1995). A comparative acoustic study of English and Spanish vowels. *Journal of the Acoustical Society of America*, *97*(3), 1916–1924. https://doi.org/10.1121/1.412064

Comrie, B., & Corbett, G. G. (Eds.). (1993). *The Slavonic languages*. Routledge.

Crothers, J. (1978). Typology and universals of vowel systems. In J. Greenberg (Ed.), *Universals of human language* (Vol. 2, pp. 93–152). Stanford University Press.

Dankovičová, J. (1997). Czech. *Journal of the International Phonetic Association*, *27*(1–2), 77–80. https://doi.org/10.1017/S0025100300005442

Fletcher, J., & Butcher, A. (2003). Local and global influences on vowel formants in three Australian languages. In M. J. Solé, D. Recasens, & J. Romero (Eds.), *Proceedings of the 15th International Congress of the Phonetic Sciences, Barcelona 3–9 August 2003* (pp. 905–908) [CD-ROM]. Univ. Autònoma de Barcelona.

Gussmann, E. (2007). *The phonology of Polish*. Oxford University Press. https://doi.org/10.1093/oso/9780199267477.001.0001

Hanulíková, A., & Hamann, S. (2010). Slovak. *Journal of the International Phonetic Association*, *40*(3), 373–378. https://doi.org/10.1017/S0025100310000162

Jakobson, R. (1941). *Kindersprache, Aphasie, und allgemeine Lautgesetze*. Mouton.

Jassem, W. (2003). Polish. *Journal of the International Phonetic Association*, *33*(1), 103–107. https://doi.org/10.1017/S0025100303001191

Lindblom, B. (1990). On the notion "possible speech sound". *Journal of Phonetics*, *18*(2), 135–152. https://doi.org/10.1016/S0095-4470(19)30398-5

Maddieson, I. (1984). *Patterns of sounds*. Cambridge University Press

Moran, S., & McCloy, D. (Eds.). (2019). *PHOIBLE 2.0*. Max Planck Institute for the Science of Human History. Retrieved January 27, 2025, from http://phoible.org/

Pompino-Marschall, B., Steriopolo, E., & Żygis, M. (2017). Ukrainian. *Journal of the International Phonetic Association*, *47*(3), 349–357. https://doi.org/10.1017/S0025100316000372

Šimáčková, Š., Podlipský, V. J., & Chládková, K. (2012). Czech spoken in Bohemia and Moravia. *Journal of the International Phonetic Association*, *42*(2), 225–232. https://doi.org/10.1017/S0025100312000102

Sussex, P., & Cubberley, R. (2006). *The Slavic languages*. Cambridge University Press.

Timberlake, A. (2004). *A reference grammar of Russian*. Cambridge University Press.

Trudgill, P. (2009). Greek dialect vowel systems, vowel dispersion theory, and sociolinguistic typology. *Journal of Greek Linguistics*, *9*, 165–182. https://doi.org/10.1163/156658409X12500896406041

Vaux, B., & Samuels, B. (2015). Explaining vowel systems: Dispersion theory vs natural selection. *The Linguistic Review*, *32*(3), 573–599. https://doi.org/10.1515/tlr-2014-0028

Yanushevskaya, I., & Bunčić, D. (2015). Russian. *Journal of the International Phonetic Association*, *45*(2), 221–228. https://doi.org/10.1017/S0025100314000395

A Comparative Analysis of the Vowel Systems of Some Slavic Languages Through Dispersion Theory

Summary

This article attempts to investigate comparatively the vowel systems of Russian, Polish, Ukrainian, Belarusian, Czech and Slovak through vowel dispersion theory (DT). The results show that only Belarusian does not violate DT, but the other languages violate this theory in two ways: Russian and Polish have

the vowel /ɨ/, and Ukrainian has the vowel /ɪ/; Czech and Slovak formed short and long vowels in the same vowel space. The vowel prioritisation of these languages is not in line with Maddieson (1984) and Lindblom (1990).

Analiza dyspersji w systemach samogłoskowych wybranych języków słowiańskich

Streszczenie

Niniejszy artykuł stanowi próbę analizy porównawczej systemów samogłoskowych języków: rosyjskiego, polskiego, ukraińskiego, białoruskiego, czeskiego i słowackiego za pomocą teorii dyspersji samogłosek (*vowel dispersion theory*). Wyniki wskazują, że jedynie język białoruski potwierdza tę teorię, zaś pozostałe naruszają ją na dwa sposoby: rosyjski i polski mają samogłoskę /ɨ/, a ukraiński – /ɪ/, natomiast czeski i słowacki wykształciły krótkie i długie samogłoski w tym samym kontekście. Systemy wokaliczne omawianych języków nie potwierdzają wniosków Iana Maddiesona (1984) i Björna Lindbloma (1998).

Keywords: Slavic languages; vowel dispersion theory; comparative linguistics

Słowa kluczowe: języki słowiańskie; teoria dyspersji samogłosek (*vowel dispersion theory*); językoznawstwo porównawcze

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