The Ideal Sonority Profile of Diphthongs across 3,020 Inventories

Diphthongs are widespread segments cross-linguistically, yet the dispersion of diphthongs is not looked into as much as the dispersion of vowels, nor of consonant clusters, with even less studies focusing on the preference and optimization of diphthongs. Prior studies (Sanchez Miret 1998, Sands 2004) have pointed out how principles such as dispersion between the two halves of a diphthong can increase the overall perceptibility of these vocalic sequences. The current cross-linguistic survey based on PHOIBLE (Phonetics Information Base and Lexicon) 2.0, on the diphthongal segments of 3,020 language inventories, strengthens the conclusion that [ai] is the most frequent diphthongal segment and the most possible candidate for the optimal diphthong. However, we argued that should be F1 distance between the targets, rather than a preference for fall in sonority.

The aim of this paper is to try to find the ideal diphthong through a cross-linguistic survey on diphthong dispersion and try to suggest a potential explanation. The work is inspired by Minkova and Stockwell's research on the potential logical link between English vowel shift and "optimal" diphthongs (Minkova & Stockwell, 2003). In their paper, it is argued that the English vowel shift is the result of phonological restructure caused by several constraints competing against each other to reach the optimal form of diphthong (see also Becker et al 2018 on the constraint *SHALLOWDIPHTH as applied to Brazilian Portuguese plural alternations). The constraints and the ranking of constraints that they have proposed yield a direction in terms of OT constraints based on Dispersion theory in the search for an ideal diphthong and how the constraints might account for this ideal form.

Similar work has been done through a typological survey on a limited range of languages and diphthongal segments, and a potential explanation based on sonority contrasts proposed by Kubozono 2001 has been provided. However, in this paper, a cross-linguistic survey on a much wider range of languages and segments is carried out to find the optimal diphthong, and a possible explanation based on Minkova and Stockwell's research is discussed, in particular based on their constraint HEARCLEAR: Maximize the auditory distance between the nuclear vowel and the following glide (as measured in formant frequency). Given an overall number 3,020 inventories in PHOIBLE, after analysis, 92 of them have [ai], 79 have [au], and so forth, as shown below:

Diphthong	Representation	Percentage
ai	92	3.046
au	79	2.616
ia	63	2.086
ua	60	1.987
ui	56	1.854
oi	41	1.358
ei	39	1.291
ie	35	1.159
iu	34	1.126
uə	33	1.093
ou	30	0.993

	HEAR CLEAR F2	HEAR CLEAR F1
ei	****	****
ie	****	****
uə	***	***
au	***	
ua	***	
ai	**	
ia	**	
ui		******
iu		******
oi		****

With these two constraints, a great deal of the patterns can be derived (with additional interaction of markedness constraints on inventories and some of the effort minimization constraints that generally form part of Dispersion Theory). Previous research has established that there is a relation between vowel sonority and vowel height, and thus the following ranking has been proposed: High-central vowel < Mid-central vowel < High vowel < Mid vowel < Low vowel (Kenstowicz 1997, de Lacy 2002, 2004, Gordon 2006), which is overall upheld in our results, with the exception of [ui] being more frequent than expected and [uə] being less frequent. Nonetheless, the relation between the frontness-backness and roundedness of the vowel and vowel sonority remains undetermined. For the front-back dimension, we refer to Kaisse's study (1977) on Greek, which employs the sonority ranking of [a > o > u > e > i], although we note the results of Gordon et al. in 2012, who examine four factors related with vowel sonority in vowels of five distinct languages.

As for rising versus falling diphthongs, we consider the constraint *REVERSE: An articulation which occurs in the opposite direction of the sonority hierarchy is disfavored. In addition, looking at the specific numerical results of the survey, it is demonstrated that [ai] is more preferred than [au] as a possible candidate for an optimal diphthong. Therefore, [ai] should be more widespread than [au], and allows us to formalize an implicational universal whereby every language that possesses [au] should also possess [ai]. In a detailed examination of the dataset, it turns out that 9 out of 79 of the inventories (about 11%) that possess [au] do not have [ai], which will be further examined in terms of licensing in stressed vs unstressed positions or other potential complicating factors. In general, these results may pave the way artificial grammar learning in a manner parallel to Berent et al's (2009) work with consonant clusters, to see if learners apply the kind of phonological preferences for more dispersed diphthongs over less dispersed ones even in novel experimental situations.

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