

## CONSONANT CLUSTERS AND DISTINCTIVE FEATURES

JAN CYGAN

*Wrocław University*

Among the English prevocalic consonant clusters there is one type that differs markedly from all the others. This is the two turbulents type (spirant + stop) represented by the three clusters /sp, st, sk/. Distributionally, this is the only type that occurs both initially and finally (Jones 1956 : 249; cf. also Hultzén 1962 : 311 to the contrary), all other clusters being either initial or final. Initially, the type is unique in that it runs counter to the so-called 'Law of Sonority' which says that in clusters sonority must increase toward the vowel. It is also peculiar phonetically, the position after /s/ being one of neutralization of the tense — lax resp. voiced — voiceless opposition; /p, t, k/ are voiceless but lax here (cf. Hultzén's phonemicization of these clusters as /sb, sd, sg/ and critique by Lisker 1963). In view of this, some linguists prefer not to specify the stops in this case as either /p/ or /b/, etc., but to use the archiphonemes P, T, K /sP, sT, sK/ (the Prague school), or to speak of a third type of stop, the "sigmatized" /sp, st, sk/ (Hill 1966 : 211). The well-known phenomenon of alliteration requiring the clusters to alliterate in their entirety, i.e. *sp-* with *sp-*, etc. only, also points out to their being regarded as a kind of units closer to single consonants than to other cluster types. In his study on the Norwegian syllable Vogt (1942 : 14) called clusters of this type 'composite' phonemes. The composite nature of these clusters has been convincingly explained by Kuryłowicz (1966) by their irreversibility in initial position in Germanic (the non-existence of initial \*/ps-, ts-, ks-/).

On the whole, then, the peculiarities of these clusters are well known. The question that we would like to tackle in this article is, whether there is anything in the internal structure of these clusters that would justify their external behaviour manifested in their greater cohesion than that of other clusters. First of all, why is it just /s/ and not any other spirant that combines so closely with the stops /p, t, k/? To the best of our knowledge the question has not been asked so far.

The first suggestion that occurs is the historical reason that /s/ was the only spirant in Indo-European and the clusters were inherited. This, however, does not stand up to criticism. The conditions prevailing at the Indo-European period need not be decisive for the situation in its present-day descendants. In contemporary Spanish, for example, the s+stop clusters are no longer initial (explosive) (*espada, estado, escuela*); in French they are totally non-existent (*épée, état, école*). But even in a language as close to English as German, there is no initial /s/ whatsoever; prevocally there is only /z/, preconsonantly (i.e. in clusters), in native German words, only /š/. These facts make us rather turn for an explanation to the phonological system of present-day English, and the distinctive feature oppositions operative within its framework.

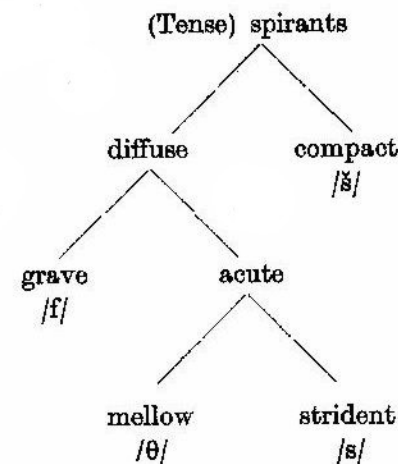
In present-day English there are (apart from /h/), four pairs of spirants, the pairs being based on the tense-lax (or voiced-voiceless) opposition. This set can be described in terms of the Jakobsonian distinctive features; however, in order to make the picture more transparent, we will neglect those features which are common to the whole set as such. Thus all members of the spirants set are -vocalic, +consonantal, -nasal and +continuant. And since the clusters in question are all voiceless (tense) we will also disregard the voiced (lax) half of the set (i.e. /v, ð, z, ž/). The remaining pertinent features of the tense spirants set are compact-diffuse, grave-acute and strident-mellow. (At this point we prefer to use these non-committant objective labels, since we are not yet in a position to decide upon the marked or unmarked (positive or negative) values of the particular features, which will have to be settled on distributional grounds.) The full (redundant) assignment of these features (after Halle 1964 : 328) is:

/f/	/θ/	/s/	/š/
[ diffuse ]	[ diffuse ]	[ diffuse ]	[ compact ]
[ grave ]	[ acute ]	[ acute ]	[ acute ]
[ strident ]	[ mellow ]	[ strident ]	[ strident ]

As can be seen from the above tabulation, the position of /s/ is unique among the spirants in English. It is the only spirant that does not possess any feature not shared with some other spirant; in fact it shares each of the three features with two other spirants. On the other hand, each of the other three spirants possesses one feature exclusive to itself, viz. only /š/ is compact, only /f/ is grave, and only /θ/ is mellow. It follows that these three spirants may be regarded as marked, while /s/ is unmarked (neutral) — non-compact, non-grave and strident, stridency being a regular feature in spirants (cf. Jakobson-Fant-Halle 1952 : 25). We can now, tentatively, assign the plus value to the features compact, grave and mellow; of course 'diffuse' will equal 'non-compact' or '-compact', etc.

The same distribution of features characterizes the lax (voiced) spirants /v, ð, z, ž/. But lax turbulents do not cluster initially: /ž/ does not occur initially in English at all, /ð/ does not cluster with anything, /v/ and /z/ are found only marginally in clusters (*vraic, zouave*).

The marked character of the spirants mentioned can also be seen from a partial (non-redundant) specification of features arranged in a certain order (cf. e.g. the tree in Hultzen 1965 : 6). The feature compact-diffuse precedes grave-acute (cf. also Scholes's optimum phonotactic grammar PG 2, Scholes 1966 : 88 and 94), mellow-strident comes last. The compact spirant need not be further specified, only diffuse being either grave or acute. Again the grave spirant need not be specified any further, only the acute spirants being either mellow or strident (the latter, as mentioned above being unmarked). The tree can be represented as follows:



This is what Hultzen (1965) does, only he marks diffuse as a plus feature obtaining the final phonetic ordering /f, θ, s, š/, with the slit spirants (fricatives) to the left and the grooved spirants (sibilants) to the right, from a consistent treeing of all pluses to the left. The partial assignment of features is also normal practice: 'grave' is more often 'labial' than 'peripheral' (cf. Scholes 1966 : 84), while the other peripherals are referred to sufficiently as 'compact', etc.

Having elucidated the particular position of /s/ among the spirants in English, we now proceed to an analysis of the situation among the stops forming the other part of the close-knit clusters. Again, we will neglect the features common to all stops. All stops, like spirants, are -vocalic, +consonantal and -nasal. Unlike the spirants, they are of course -continuant. Out of the eight English stops we will, similarly as with the spirants, consider only the tense four, since only tense stops cluster with /s/.

The system of English stops, in terms of the three pertinent distinctive features, is different from that of spirants, viz.

	/p/	/t/	/č/	/k/
Compact	—	—	+	+
Grave	+	—	—	+
Mellow	+	+	—	+

Exceptional among the four stops is /č/ which is strident; all other stops are mellow, which is the neutral ("optimum") feature of a stop (cf. Jakobson-Fant-Halle, l.c.). This feature permits to single out the strident stop (affricate), and correlates with the fact that the affricate /č/ does not cluster with /s/ (or anything else) initially. The remaining two features — unlike in the spirants — are distributed evenly (2 by 2) over the four stops, each being shared by two of them, yielding all possible combinations. After the elimination of /č/, however, using our previous procedure of ordering features, we can univocally define /k/ as compact and /p/ as grave; /t/ will then remain as unmarked, but in comparison with the unmarked /s/, it will contrast as mellow with its stridency.

Thus in the series /sp, st, sk/ each of the stops supplies one of the three essential differentiating distinctive features negatively manifested in the spirant, compare:

/s/	/k/	/p/	/t/
non-compact	[compact]		
non-grave		[grave]	
non-mellow			[mellow]

This may be an explanation for the strict parallelism and the very strong cohesion of these clustres. The essential bond that holds them together seems to be the attraction within the turbulents class between the unmarked continuant and a contrastively marked non-continuant in each case.

The nature of this bond is seen also from the marginal clusters of /s/ with other spirants (fricatives in the narrow sense mentioned above, called 'pseudo-stops' by Vogt 1942: 18); parallel to /sp-/ we get /sf-/ (*sphere*), where /f/ is grave, and parallel to /st-/ — /sθ-/ (*sthenic*), where /θ/ is mellow. There is nothing parallel to /sk-/ because of the lack of a corresponding compact spirant /x/ in English; it is true that /š/ is compact, but it is also strident, its array of features making it exactly parallel with /č/; and thus the lack of \*/sš-/ parallels the lack of \*/sč-/ in English. As is well known, no clusters of strident acute consonants (i.e. the sibilants /s, š, č, z, ž, ʃ/) are possible in English, either initially or finally, in whatever sequence (cf. the morphophonological rules requiring /-iz/ after these consonants, Halle 1961: 90).

One more general observation that also emerges and may deserve atten-

tion in further considerations is that the features non-compact non-grave tend to mark the neutral member of a class of phonemes. /s/, /z/, /t/, /d/ and /θ/, thus all the live consonantal inflexional endings of English share these features. So does also /n/ among the nasals, /l/ among the non-nasal resonants, /j/ among the semivowels, and the high front vowel /i/ (cf. the occurrence of the latter in the endings /-iz, -id/ and the freedom of clustering of the former three).

We have remarked above that in German there are no clusters with initial /s/. It might be interesting to see how the German facts could be elucidated against the background of the system of that language. In German there are also four tense fricatives /x, f, s, š/ (Trubetzkoy 1939: 64), the allocation of the three pertinent distinctive features (after Ross 1967: 50) being as follows: (/f/, /s/ and /š/ as in English)

	/f/	/s/	/š/	/x/
Compact	—	—	+	+
Grave	+	—	—	+
Mellow	—	—	—	—

All of the spirants are strident, so that feature cannot make a difference. The remaining two features are very evenly distributed (cf. the situation within the English stops class above). No cue to the structure of clusters can be found in them, and it is therefore to be sought in the stops system which (with the omission of the affricates which do not cluster with spirants) is:

	/p/	/t/	/k/
Compact	—	—	+
Grave	+	—	+
Mellow	+	+	+

All the stops are mellow, but if mellow were taken as the basis of the spirant-stop opposition, there would be no explanation for the non-existence of \*/šk-/. The fact that /š/ does not cluster with /k/ in German makes us assume that the decisive bond in the /šp-, št-/ clusters is the contrast compact—diffuse (compact spirant+diffuse stop). This contrast rather than the contrast strident—mellow would also be responsible for the admissibility of /šf-/ (/šv-/) and the exclusion of \*/šx-/, \*/šs-/ is excluded on the same basis as \*/sš-/ in English. In foreign words, however, /s/ is found with the full array of stops (*Spektrum, Stop, Skandal*).

It seems that, while in English it was the unique status of /s/ that was decisive, in German the use of /š/ rather than /s/ is determined by the non-occurrence of /k/.

It is also interesting to note that in the case of inclusion of /h/ in English and of /ç/ in German (the latter is postulated as a separate phoneme by Adamus

1967: 175), the neutral spirant occupies the middlemost position in the phonetically ordered series in both languages, cf. English: /f, θ, s, š, h/, German: /f, s, š, ç, h/. The main difference between the turbulent clusters in the two languages then is that in English the initial spirant is non-compact /s/, in German — compact /š/. This can be generalized to cover all clusters with initial sibilant with one notable exception in English, i.e. /šr/, cf.

English	German
/sp-/ <i>spade, spin, spur</i>	/šp-/ <i>Spaten, spinnen, Sporn</i>
/st-/ <i>staff, star, stork</i>	/št-/ <i>Stab, Stern, Storch</i>
/sk-/ <i>skipper, school, scum</i>	
/sm-/ <i>small, smear, smith</i>	/šm-/ <i>schmal, Schmiere, Schmied</i>
/sn-/ <i>snail, snow</i>	/šn-/ <i>Schnecke, Schnee</i>
/sw-/ <i>swallow, swan, swim</i>	/šv-/ <i>Schwalbe, Schwan, schwimmen</i>
/sl-/ <i>slot, slay, sleep</i>	/šl-/ <i>Schloß, Schlag, Schlaf</i>
/šr-/ <i>shrill, shriek</i>	/šr-/ <i>Schrill, schreien</i>

It is striking that though in English even such well known German proper names as *Spitzenburg, Stahl, Steinmetz, Stieglitz* are invariably pronounced with /sp-, st-/ (spelling pronunciation?), there is no \*/sr-/, only /šr-/.

The problem why /sr-/ is impossible requires again the procedure of considering both /s/ and /r/ against the broader background of their respective classes of spirants and resonants. The distinctive features of the English spirants have been given above; they will be repeated here for convenience's sake with the now established plus and minus assignment of features:

	/f/	/θ/	/s/	/š/
Compact	—	—	—	+
Grave	+	—	—	+
Mellow	—	+	—	—

The resonants — in terms of the same features — can be represented as follows:

	/w/	/l/	/r/
Compact	—	—	+
Grave	+	—	+
Mellow	+	+	+

(The assignment of the features diffuse to /l/ and compact to /r/ follows Halle's latest classification, cf. Kučera 1967: 1119, note.) The clusters of spirants with /r/ are:

	/fr/	/θr/	*/sr/	/šr/
Compact	[—+]	[—+]	[—+]	[++]
Grave	[++]	[—+]	[—+]	[—+]
Mellow	[—+]	[++]	[—+]	[—+]

In each of the clusters /fr-, θr-, šr-/ there is one feature in common between the two members; \*/sr-/ is the only cluster that has none. (Historically, of course, the compactness of /š/ in /šr-/ continues the compactness of the cluster /sk-/.) At least one feature in common is found also in clusters of /s/ with other resonants (the nasals /m/ and /n/ have the same features as /w/ and /l/ respectively), i.e.

	/sw-/	/sm-/	/sl-/	/sn-/
Compact	[—+]	[—+]	[—+]	[—+]
Grave	[—+]	[—+]	[—+]	[—+]
Mellow	[—+]	[—+]	[—+]	[—+]

/sq-/ is inadmissible simply because of the non-occurrence of /ŋ/ prevocally. Very marginally clusters of /š/ + resonant occur: *schmelz, schnáp(p)s, schloop, schwa*.

We must not, however, put the clusters of spirant+resonant on the same footing with the clusters of spirant+turbulent (stop). The cohesion of the former is much looser, since the two classes involved are rather different. The most important difference seems to be that the resonants (unlike the turbulents) do not possess the tenseness-laxness (or voice) opposition. On the other hand, some other features may come into play, which had been neglected as not pertinent in discussing the turbulent clusters /sp-, st-, sk-/, but which become important, because capable of providing contrasts, now, i.e. +vocalic, —consonantal and +nasal.

It is not intended in this paper to discuss these features, but the method that has been used above may throw some light on certain other facts of clustering in English. For example, the positive assignment of the features compact, grave, and mellow singles out /k/ among the stops and /r/ among the resonants as phonemes with three pluses. It is worth noting that either phoneme combines without restrictions with members of the other class; we have on the one hand the clusters of /k/ with /w, l, r/, and on the other hand, all stops /p, t, k/ combine with /r/. This is not the case with either the stops /p/ and /t/ or the resonants /w/ and /l/: English lacks the clusters \*/pw-/ and \*/tl-/.

The lack of \*/pw-/ which is paralleled not only by the lack of \*/bw-/ but also of \*/fw-/ obviously cannot depend on the mellow—strident feature. The two features involved are compact and grave only. With our above assignment of these features the stop+resonant clusters present the following picture:

	/pr-, br-, fr-/	/tr-, dr-, θr-/	/kr-, gr-/
Compact	[—+]	[—+]	[++]
Grave	[++]	[—+]	[++]

	/pl-, bl-, fl-/	*/tl-, dl-, θl-/	/kl-, gl-/
Compact	[--]	[--]	[+-]
Grave	[+-]	[--]	[+-]
	*/pw-, bw-, fw-/	/tw-, dw-, θw-/	/kw-, gw-/
Compact	[--]	[--]	[+-]
Grave	[++]	[-+]	[++]

The non-existent clusters are conspicuous by either all minuses or minuses and no contrast. It is worth noting that the all minuses clusters \*/tl-, dl-, θl-/ are absolutely inadmissible (no example in Hultzén's very liberal and well documented list, Hultzén 1965), while the partially negative, 'no contrast' clusters /pw-, bw-, fw-/ may occur marginally (*pueblo, bwana*, cf. also *moivre*).

Analogous restrictions are found in the ternary initial clusters which also differ between them by the features compact and grave only, since their first element is always the same /s/, and all have the same sequence of [- + +] mellow.

But the stridency feature, though not operative in the stop+resonant clusters, is very important in clusters of two turbulents. It is a remarkable thing, for example, that Jones's unique assignment of the features compact, grave to /θ/ (Jones 1956), aiming at obtaining a very neat if counter-phonetic scheme does not influence the situation within the spirants class, if the strident-mellow opposition is taken into account. Without this opposition the system is unworkable, since its perfect symmetry does not provide any *point d'appui* for an evaluation of the features, cf.

	/f/	/θ/	/s/	/ʃ/
Compact	-	+	-	+
Grave	+	+	-	-

(The double negative assignment of features of /s/ does not prove anything, since it is quite arbitrary with this kind of perfectly even 2 : 2 distribution). If, however, the stridency opposition is added (which has been neglected by Jones), it removes the symmetry and provides a starting point for an analysis. In the table

	/f/	/θ/	/s/	/ʃ/
Compact	-	+	-	+
Grave	+	+	-	-
Mellow	-	+	-	-

/θ/ is the only spirant that is mellow, which then is enough to define it (cf. the analogous, but opposite situation of /č/ among the stops). Among the strident spirants it is now easy to define /ʃ/ as compact and /f/ as grave,

which leaves /s/ as the neutral (non-compact, non-grave, non-mellow) spirant.

The stridency feature seems in general to be very important for the structure of initial clusters in English. The rule that we would posit, viz. that a strident consonant, if present, must precede mellow initially, covers more instances than the rule that a fricative precedes a stop; it covers not only all clusters of spirant+stop, or resonant, or both, but also marginal clusters of two spirants such as /sθ-/ , /fθ-/ (*phthisis*). The reverse order clusters \*/ps-, ts-, gz-/ are normally simplified to either the strident or the mellow consonant alone, i.e. to /s-, t-, z-/ (*psyche, tsetse, tsar, xylophone*).

This short article does not of course pretend to have exhausted all the problems of English prevocalic consonant clusters. Many have not even been pointed out. Our aim was rather to work out a method of evaluating the importance of the individual distinctive features against the background of whole classes of phonemes. These values are different depending on the class in question.

It has also been shown that with a consistent assignment of certain distinctive features it is possible to justify the exceptional nature of some clusters and the non-existence of others. The reasons, again, will be different depending on the classes of phonemes involved in the structure of the cluster.

The discussion presented here is certainly not without its flaws, but it is believed to have thrown some light not only on the clustering habits of consonants, but also on certain disputed or neglected problems of the distinctive features theory, such as their relative importance, hierarchical ordering and positive or negative assignment.

## REFERENCES

- Adamus, M. 1967. *Phonemtheorie und das deutsche Phoneminventar: Zur Typologie der germanischen Sprachen*. Wrocław: WTN.
- Halle, M. 1961. "On the Role of Simplicity in Linguistic Descriptions". In R. Jakobson (ed.), *Structure of Language and Its Mathematical Aspects, Proceedings of the Twelfth Symposium in Applied Mathematics*. 89 - 94. Providence, R. I.: American Mathematical Society.
- 1964. "On the Bases of Phonology". In J. A. Fodor and J. J. Katz (eds.), *The Structure of Language*. 324 - 33. Englewood Cliffs, N. J.: Prentice-Hall.
- Hill, T. 1966. "The Technique of Prosodic Analysis". In C. E. Bazell, J. C. Catford, M. A. K. Halliday and R. H. Robins (eds.), *In Memory of J. R. Firth*. 198 - 226. London: Longmans.
- Hultzén, L. S. 1962. "Voiceless Lenis Stops in Prevocalic Clusters", *Word* 18. 307 - 12.
- 1965. "Consonant Clusters in English", *American Speech* 40. 5 - 19.
- Jakobson, R., C. G. M. Fant and M. Halle. 1952. *Preliminaries to Speech Analysis: The Distinctive Features and Their Correlates*. Cambridge, Mass.: MIT.

- Jones, L. G. 1956. "English Consonantal Distribution". In M. Halle, H. Lunt, and H. MacLean (eds.), *For Roman Jakobson*. 245 - 53. The Hague: Mouton.
- Kučera, H. 1967. "Distinctive Features, Simplicity, and Descriptive Adequacy". In *To Honor Roman Jakobson*, vol. II. 1114 - 26. The Hague: Mouton.
- Kuryłowicz, J. 1966. "A Problem of Germanic Alliteration". In *Studies in Language and Literature in Honour of Margaret Schlauch*. 195 - 201. Warszawa: PWN.
- Lisker, L. 1963. "On Hultzén's 'Voiceless Lenis Stops in Prevoealic Clusters'". *Word* 19. 376 - 87.
- Ross, J. R. 1967. "Der Ablaut bei den deutschen starken Verben". In *Studia Grammatica VI: Phonologische Studien*. 47 - 118. Berlin: Akademie-Verlag.
- Scholes, R. J. 1966. *Phonotactic Grammaticality*. The Hague: Mouton.
- Trubetzkoy, N. S. 1939. *Grundzüge der Phonologie*. Prague: CLP.
- Vogt, H. 1942. "The Structure of the Norwegian Monosyllables", *Norsk Tidsskrift for Sprogvidenskap* 12. 5 - 29.