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Intersegmental cohesion and syllable division in Polish.

(Extended version)

An experiment with Polish participants was devised in order to shed light on 'intersegmental cohesion hierarchy', with special regard to CC intervocalic sequences. This hierarchy regulates the strength of the segments' mutual attraction, obeying both universal and language-specific tendencies. The results show that Polish speakers, as contrasted to Italian ones, exhibit a finer cohesion scale due to the richer phonotactics to which they are attuned. In the authors' approach, syllabic structure is assumed to emerge as an epiphenomenon from this hierarchy.

1. *Introduction*.[1]

Word games are an established tradition as a research tool in (psycho-)linguistics. They consist in the application of specifically devised alterations to (pseudo-)words, deliberately chosen in order to shed light on a particular phonological behavior. The rationale is to gauge the varying degrees of difficulty that participants meet in applying the same game to different stimuli. Syllable structure, in particular, has been intensively studied in a number of languages: English (Derwing et al. 1987, 1988; Treiman and co-workers, see the references), Italian (Agonigi et al. 1992; Bertinetto 1987, 1999a; Bertinetto et al. 1994), Spanish (Bertinetto et al. 1999), German and Finnish (Berg & Niemi 2000), Korean (Derwing et al. 1993); see also Derwing et al. (1991) for a cross-linguistic comparison.

This paper presents the results of an experiment concerning intersegmental cohesion in Polish, namely the degree of attraction between adjacent segments. Polish was chosen for its highly complex syllable structure. There exist different cohesion coefficients for the various categories of intervocalic two-consonant (henceforth, C_1C_2) sequences. This is reminiscent of the traditional notion of 'sonority scale' (or, equivalently, 'consonant strength'): however, these notions should not be confounded. The 'sonority scale' should be understood as a perceptual-articulatory effect, brought about by manner of articulation (MoA), place of articulation (PoA) and voicing distance (Lx). As it is typically defined, the 'sonority scale' is an acontextual notion that takes the single segment-types as its proper domain, arranging them in a rigid order. In other words, it applies to the single phoneme-types to be found in the given language independently of the specific position they may occupy in a word. Intersegmental cohesion, by contrast, crucially depends on the relationships between particular distances (cf. Dziubalska-Kołaczyk 2002, 2003; Dressler & Dziubalska-Kołaczyk 2006) and thus results from the complex interplay of adjacent segments, as allowed by the language-specific phonotactics, also obeying to a large extent the universal constraints. As opposed to the 'sonority scale', intersegmental cohesion is position-sensitive: it provides a measure of the local attraction/repulsion that each phoneme-type shows with respect to any other such element(s) preceding or following it. Finally, and most importantly for our purposes, intersegmental cohesion determines syllable structure, rather than being determined by the latter.

2. *Method and materials*

The materials used in the experiments were (phonotactically legitimate) nonsense disyllables. The three 'games' consisted in syllables inversion or repetition. In the instructions given to the participants, however, the word 'syllable' was never mentioned, in order not to bias the responses: the participants could thus freely construct their own interpretation of the particular task at hand. Each task comprised a training phase, where the participants heard a stimulus immediately followed by the intended alteration, uttered by the same voice. In the test phase, the participants themselves had to apply the just learned alteration procedure, by pronouncing the intended stimulus. The responses were recorded for further analysis.

There was one major difference between training and test. The 10 training stimuli presented disyllabic items with single intervocalic consonants; the test sequence, by contrast, contained 'recall' items (as a matter of fact, exact repetitions of the training items) plus the

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actual 'targets', presenting C_1C_2 clusters. Crucially, the latter clusters could be modified in more than one way. Consider, for instance, the stimulus *gopli* in the syllable inversion task. In principle, the answer could be either ••*pligo* or •|•*ligop*, depending on whether the cluster is PRESERVED or SPLIT, as iconically shown by the symbols. Something quite similar applies to the tasks involving syllable repetition. First syllable repetition: ••*gogopli* / •|•*gopgopli*; second syllable repetition: ••*goplipli* / •|•*goplili*. Note that the distribution of response types should be seen as a measure of intersegmental cohesion, rather than as a syllabification procedure in the strict sense: •• indicates that C_1 is more strongly attracted by C_2 than by the preceding vowel (thus acting as a word- and syllable-initial cluster), while •|• shows the reverse.

Needless to say, the participants were also expected to produce other response types. Besides sheer mistakes, due to slips of the tongue or hesitation, we did indeed find responses such that the learned procedure, although correctly performed, was accompanied by an additional minor change (e.g., one of the vowels was changed). In the analysis, we initially adopted two measures: one where these 'innocent' mistakes were counted as correct responses ('broad' analysis) and one where they were counted as errors ('fine' analysis). Since the two analyses coincided almost completely in statistical terms, in what follows we shall only report the 'fine' analysis.

Exploiting Polish phonotactics, we used the following C_1C_2 cluster classes (and subclasses), all embedded in a CV**C_1C_2**V frame: (1) **OL** 'obstruent + liquid' [subclasses: **PL** 'plosive + liquid' and **FL** 'fricat. + liquid']; (2) **LO** 'liquid + obstruent' [subclasses: **rO** '/r/ + obstruent', **lO** 'l + obstruent']; (3) **NC** 'nasal + C [subclasses: **NC+** (legal Polish initials), **NC-** (illegal Polish initials)]; (4) **FO** 'fricative + obstruent' [subclasses: **FO=** (usually morpheme-internals), **FO≠** (usually across a morpheme boundary), **sC** 'dental fricative + C]; (5) **GO** 'glide + obstruent' [subclasses: **wO** '/w/ + obstruent', (b) **jO** '/j/ + obstruent' (illegal Polish initials)].

3. *Method and materials*

Appendix A provides the list of the experiment stimuli. We used 12 stimuli in each subclass, the same for all tasks. All sequences were legitimate medial clusters in Polish. With the exception of NC- and jO (contrasting with the phonotactically legal cognates NC+ and wO), all the clusters can also occur word-initially, which in most cases makes PRESERVED a distributionally viable option. It comes as no surprise that C_1C_2 sequences are the most common clusters in Polish. As far as the word-initial position is concerned, they account for 53,2% of all consonantal combinations (i.e., 245 out of a total of 460) in the Polish cluster inventory (Dunaj 1985). $C_1C_2C_3$ comes second with an impressive 200 types, the remaining 15 being four-member sequences ($C_1C_2C_3C_4$). In Dunaj's corpus,[2] however, the advantage of C_1C_2 over the other clusters is even more marked, with figures rising up to 65,8% and 92,9% in terms of type- and token-frequency. The clusters chosen for this study represent thus only a selection of the permissible word-medial and word-initial combinations, for Polish offers a "formidable array of possibilities" (Cyran & Gussmann 1999: 219).[3] Our aim was simply to cover a wide spectrum among the most common cluster type (C_1C_2), ranging from sequences universally considered to be tautosyllabic (e.g., OL) to sequences expected to be heterosyllabic (e.g., GO), with the intermediate types possibly representing grey areas in terms of syllabification.

Although the possibility of occurring word-initially is widely regarded as evidence of tautosyllabicity, it is reasonable to assume that not all phonotactically legal word-initial clusters display an equal cohesion's degree, for this may be influenced not only by universal preferences, but by language-specific factors such as frequency. Wróbel (2001: 43) states that syllable boundaries may be blurred by the speaker's uncertainty as to whether a given consonant sequence is permissible word-initially, which may arise with rare clusters. Frequency can thus be identified as a factor contributing to intersegmental cohesion. The following section offers a brief overview of the cluster types used in the present experiment.

- **OL** (PL 'plosive + liquid', FL 'fricative + liquid'): In Dunaj's corpus, OL clusters account for 16,8% of all word-initial C_1C_2 in terms of type-frequency (total number of OL types: 137), and 20,3% in terms of token-frequency (total number of word-initial C_1C_2 clusters: 2785).[4]
- **LO** (rO '/r/ + obstruent', lO '/l/ + obstruent'): Whereas initial /r/ can be followed by a dental plosive (e.g. 'rtęć', 'rdest'), a voiced dental affricate ('rdza') or one of the fricatives /v/ and /ʒ/ ('rwa' /rva/, 'rżeć' /rʒetɕ/), initial /l/ can only precede one of the two latter sounds (as in

[2] Dunaj analysed the spoken standard language of Kraków inhabitants.
[3] Needless to say, this yields a severe challenge for children acquiring Polish. As Łukaszewicz (2005) shows, the full mastering of Polish phonotactics goes through several steps and involves a number of intermediate repairing strategies.
[4] The percentage figures quoted in this section derive from Dunaj (1985: 18-21).

'lwa' /lva/ or 'lżyć' /lʒɨtɕ/).[5] Interestingly, the word-initial alveolar liquid can also be followed by /ɕ/ and /g/, but only in $C_1C_2C_3$ clusters, as in 'lśnić' and 'lgnąć'. The discrepancies between double and triple clusters are explained in "beats and binding" phonotactics (Dziubalska-Kołaczyk 2002): the triples include a good CC initial (**C_2C_3**V), so that at least the right-hand requirement for a triple cluster is fulfilled. Note that there is not a single 'liquid + obstruent' cluster in Dunaj's data. On the other hand, the 7,5 million words Polish Language Corpus (*Korpus Języka Polskiego*, henceforth KJP)[6] shows 736 occurrences of word-initial LO, most of which involving /lv/.[7]

- **NC** (NC+ [legal Polish initials], NC- [illegal Polish initials]): Word-initial NC clusters involve /m/ followed either by another sonorant, or by one of three fricatives /ʃ/, /ʒ/ or /x/. '/m/ + plosive' sequences are illegal word-initially (except for /mk/ and /mg/ in $C_1C_2C_3$, as in 'mknąć' and 'mgła'), and so are all clusters with /n/ as the initial nasal.[8] In Dunaj's corpus, NC clusters constitute 2,9%, or 1,8%, of all word-initial C_1C_2, in terms of type and token frequency, respectively.
- **FO** (FO= [usually morpheme internals], FO≠ [usually across a morpheme boundary], sC 'dental fricative + consonant'): The second member of a word-initial FO cluster may be another fricative (as in 'chwała' /xfawa/), an affricate (as in 'wczoraj' /ftʃɔraj/), or a plosive (as in 'zdun'). Remarkably, descriptions of word-initial clusters in Polish traditionally ignore the presence or absence of internal morphological boundaries; this is indeed the case in the descriptions provided by Dunaj (1985),[9] Dobrogowska (1992) and Milewski (2001). Since,

[5] The somewhat special status of /v/ and /ʒ/ is one of the reasons why Cyran & Gussmann (1999) claim that, phonologically speaking, these fricatives behave in a sonorant-like fashion in Polish, unlike their voiceless equivalents /f/ and /ʃ/.

[6] This is a free demo version, available on-line at http://korpus.pwn.pl/. The full version, also available on-line, currently comprises about 40 million words. Most – but not all – of the texts included in the corpus are written.

[7] The two corpora (i.e., Dunaj's and KJP) are not straightforwardly comparable, which is also evident in the substantial discrepancies in terms of relative (token) frequencies of particular clusters. For example, cluster /ʃl/, which does not appear in Dunaj's corpus, generates 1061 hits in the KJP, whereas the /kl/ sequence returns about 11500 tokens in the latter, as opposed to just 4 in the former. On the other hand, one of the most frequent C_1C_2 in Dunaj's corpus is /fʃ/ (rank 6, with 92 tokens), featuring about 22000 times in KJP, i.e., not even twice as frequently as /kl/. Although this matter deserves careful scrutiny, we have to differ it to another paper. This, in any case, will have no consequence for our present analysis.

[8] Actually, *Słownik Języka Polskiego PWN* ('PWN Dictionary of the Polish Language') shows two entries with an initial /n/, i.e. 'ngana' and 'ngunzizm', but these are very recent foreign borrowings.

[9] With the exception of consonant clusters arising in sequences of 'prepositions + lexical morphemes'; indeed, all of the 8 occurrences of initial /vd/ cluster in Dunaj's corpus involve the preposition 'w', as in 'w domu' ('at home').

however, certain word-initial FO clusters predominantly arise as a result of prefixation (e.g., the majority of /fO/ and /vO/), we believe that a comparison between FO≠ and FO= clusters could be insightful, since morpheme boundaries might undermine intra-cluster cohesion. As for sC sequences, they are considered separately, due to the cross-linguistically special status of this cluster type (e.g. Bertinetto 2004).[10] As a whole, FO clusters account for as many as 40,9%, or 29,8%, of all word-initial C_1C_2 in Dunaj's corpus – in terms of type and token frequency, respectively – hence constituting the prevalent type among the 5 major classes considered in our study.

- **GO** (wO '/w/ + obstruent', jO '/j/ + obstruent'): While word-initial /jO/ sequences are altogether illegal in Polish, /wO/ clusters are rather infrequent yet permissible. They yield 3 'glide + plosive' initial sequences (/wk/ as in 'łkać' /wkatɕ/, /wg/ as in 'łgać' /wgatɕ/ and /wb/ as in 'łby' /wbɨ/) and 2 'glide + fricative' initial combinations (/wz/ as in 'łza' /wza/ and /wʒ/ as in 'łżesz' /wʒɛʃ/). There is no occurrence of GO in Dunaj's corpus. As for KJP, a search for word-initial /wO/ returns 366 hits, most of them (i.e., 240) derivatives of the word 'łza' ('tear' – noun).

To sum up: relying on Dunaj's (1985) data, we may (as a provisional approximation) arrange the Polish word-initial C_1C_2 clusters in the following decreasing frequency order (for both type and token), supposedly influencing their intersegmental cohesion in some – if only indirect – way: FO > OL > NC > LO, GO. Note, however, that the FO class is not strictly comparable with the other ones, due to its enormous diversity and to a variety of possibly distorting factors, such as presence vs. absence of internal morpheme boundaries, the special status of /s/, etc. The frequency argument might thus not be directly applicable to the whole array of cluster classes considered, although one could speculate that FO would be in any case positioned closer to the frequent extreme of the spectrum. Ultimately, the actual positioning of FO in the above hierarchy is debatable (see also sect. 6).

In Beats-and-Binding phonotactics (Dziubalska-Kołaczyk 2002, 2003) there are universal preferences for clusters in all word-positions. The preferences specify the optimal shape of a particular cluster in a given position, by referring to the 'Net Auditory Distance'

[10] Cyran and Gussmann (1999: 224f) describe /s/, in this context, as a rhymal complement. They observe, however, that in Polish "the relevant rhymal complement can be occupied not only by /s/, but also by its voiced, palatal, and palatalized congeners", i.e. /z/, /ʃ/ and /ɕ/.

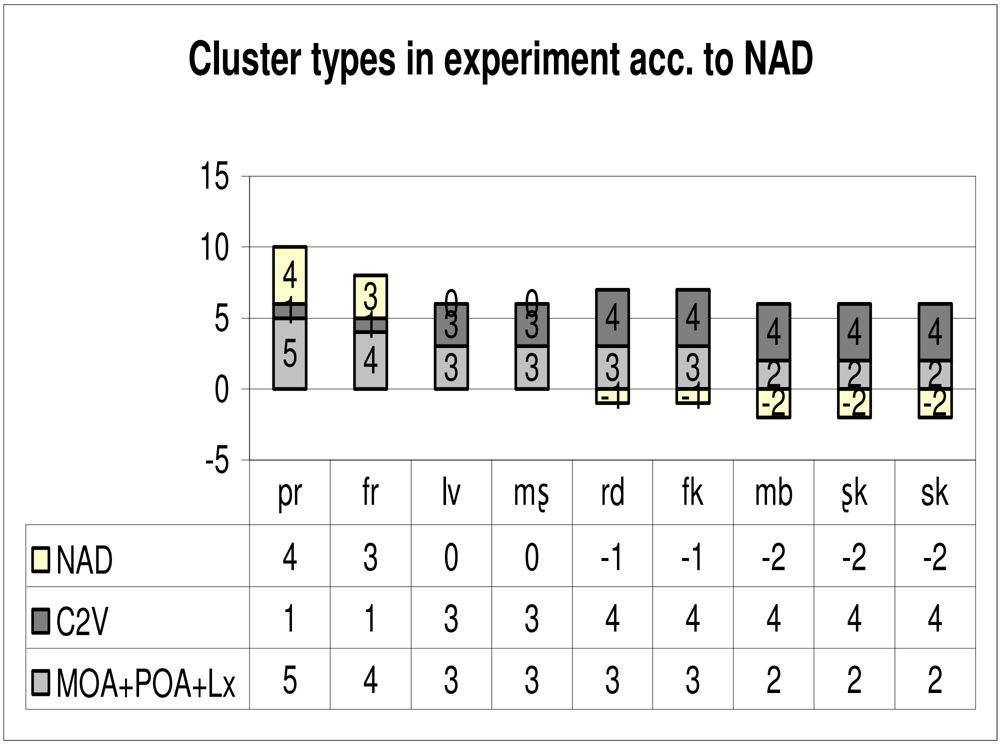
Principle (NAD) (cf. Dziubalska-Kołaczyk forthc., Dziubalska-Kołaczyk and Krynicki forthc.) The latter is computed as a sum of distances in manner of articulation (MOA), place of articulation (POA) and voicing (Lx) between consonants in a cluster, or a consonant and the neighboring vowels. Thus, NAD = MOA+POA+Lx. A specific numerical distance (1, 2, 3, etc.) is assumed between manners (e.g., a distance of 1 between stop and fricative), places (e.g., a distance of 1 between labial and coronal) and the two major glottis states (distance of 1 between vd and vless; cf. Dziubalska-Kołaczyk forthc. for the relevant computation table). The general idea is that the greater the NAD, the better contrasts occur in a segment sequence. A cluster of consonants can only be sustained in a language, if the universal CV preference is counteracted.

For instance, the preference relating to initial C_1C_2 clusters takes the form of the following well-formedness condition:

C_1C_2V: NAD $(C_1,C_2) \geq$ NAD (C_2,V)

In prose: In word-initial C_1C_2 clusters, the NAD between C_1 and C_2 should be greater than or equal to the NAD between a vowel and a consonant neighboring on it. In other words, the perceptual contrast between the initial C_1C_2 sequence counteracts the preferred CV contrast and, in consequence, preserves the cluster. Figure 1 illustrates the NAD values for randomly selected clusters representing the five classes (including some of the eleven subclasses) used in the present study. Only two of these clusters qualify as optimal initials and are thus expected to be preserved by the experiment participants, as imposed by both universal and language-specific constraints.

Figure 1. *Polish clusters according to the Net Auditory Distance Principle.*



4. *Previous results*.

In a previous experiment on Italian materials (Bertinetto et al. 1994), the use of word games yielded observable consequences on the participants' behavior. Table 1 presents a results' selection. The C_1C_2 clusters under scrutiny were: OL = 'obstruent + liquid', LO = 'liquid + obstruent', GC = 'glide + consonant', sC = 'dental fricative + consonant'. The diacritics •• and •|• stand for the two response types as defined above. The other response types (including errors) were statistically irrelevant: their number may be inferred for each task by inspecting the horizontal sums. The statistical analyses were based on the Wilcoxon test: * and ** stand for 'significant at the .05 and .01 level', respectively, and accompany the prevailing response type. For instance, in task 2, PRESERVED is significantly preferred for OL, while SPLIT is significantly preferred for LO and GC.

Table 1. *Results from an Italian experiment (Bertinetto et al. 1994): Percent results.*
*•• = cluster preserved; •|• = cluster split; * and ** stand for 'significant at the .05 and .01 level', respectively.*

	1st syllable repetition		2nd syllable repetition	
cluster type	••	•|•	••	•|•
OL	99,1 **	0	93,3 **	1,2
sC	70,0 *	26,6	41,2	58,3
LO	59,6	39,5	15,0	83,7 **
GC	50,8	45,0	0,4	92,0 **

Over and above the different results yielded by the two tasks (quite unsurprisingly, considering their metalinguistic nature), Italian C_1C_2 clusters imposed a fairly consistent syllabification strategy, inspired by universal preferences. As it happens, repetition of either the first or the second syllable yields strikingly different results: OL clusters (definitely tautosyllabic in Italian, and possible word-initials) contrasted with LO and GC clusters (heterosyllabic in Italian, and impossible initials), while sC clusters occupied an intermediate position. Indeed, the latter clusters are syllabically undecidable in Italian [Bertinetto 1999b, 2004].

5. *Present results.*

The results of the present experiment are summarized in table 2. The diacritics * and ** should be read as above, while + stands for 'close to significance' (between .05 and .07). As anticipated above, the 10 training stimuli were reused as controls, interspersed as 'recalls' within the task lists. This provided a proficiency measure: of our 12 subjects, one (n.3) was discarded from the statistics of tasks 1 and 2, because of insufficient recall performance.

Table 2. *Percent results. •• and •|• as in table 1.*

	Task 1 **1st syllable repetition**		**Task 2** **2nd syllable repetition**		**Task 3** **Syllables inversion**	
	••	**•|•**	**••**	**•|•**	**••**	**•|•**
PL	80,30**	15,15	39,39	58,33	63,19 *	13,19
FL	77,27 *	21,97	22,73	76,52 *	63,88 +	20,14
sC	78,03 *	17,42	8,33	91,67**	50,00	31,25
FO=	75,76 +	20,45	14,39	83,33**	49,30	30,56
FO≠	74,24 *	25,00	6,06	93,18**	31,95	51,39
NC+	75,76 *	21,97	10,61	87,12**	29,17	50,00
NC-	68,18 +	25,00	0,75	91,67**	8,34	70,84**
rO	68,18 +	26,72	0	92,42**	18,75	60,42 *
lO	69,70	28,03	0,75	96,97**	15,28	70,14**
jO	68,70 +	25,19	1,51	96,21**	5,56	77,08**
wO	69,70	28,79	1,53	97,71**	17,36	64,58 *

Consider first the syllable repetition tasks 1 and 2. While the repetition of either the first or the second syllable produced sharp differential preferences in the treatment of the Italian clusters (see table 1), this happened to a much lesser extent in the Polish experiment. Task 1 yielded a tendential advantage for PRESERVED responses. Task 2, on the contrary, yielded a consistent advantage for SPLIT responses. Polish speakers showed thus a tendency to repeat the first two segments in task 1, and (to an even larger extent) the last two segments in task 2. This indicates a consistent and parsimonious behavior: the participants tended to repeat the shortest possible sequence in both cases. This is only possible because Polish clusters are relatively plastic in terms of syllabification tendencies: most of them may be either preserved or split, depending on the task. The contrasting results emerging in table 1 show, instead, that Italian clusters are inherently rigid: almost irrespective of the specific task performed, they either behave tautosyllabically or heterosyllabically. The notable Italian exception is offered by sC clusters, which exhibit an ambiguous orientation and are indeed syllabically undecidable (Bertinetto 1999b, 2004). This is consistent with the fact that, in comparison to Italian, the (highly complex) Polish phonotactics appears to be very flexible: the speakers are attuned to a fairly variegated range of possible consonant sequences and have developed the appropriate articulatory strategies. As a consequence, the 'bonds' tying adjacent segments are altogether rather tenuous, in comparison to the strong ones operating in the much simpler Italian phonotactics. One plausible prediction, inspired by these results, is that Arabic speakers would show an even more flexible behavior as compared to Polish speakers, due to the even higher degree of phonotactic freedom.

Polish clusters are, however, not all alike. For instance, in tasks 1 and 2 OL clusters stands out as peculiar, in as much as that they even diverge from the structurally similar FL clusters. Task 3 provides clear information as to the individual inclinations of the Polish clusters examined (see again table 2). The syllables inversion task forces the speakers to make a sharp choice: the cluster should be either preserved or split. There is, in principle, a third possibility: namely, the first consonant of the cluster could be repeated in both syllables after inversion. For instance, the stimulus *kiplo* could generate the response *plokip*. This could be interpreted (with a great deal of approximation) as evidence of an ambisyllabic tendency, in the sense that /p/ is treated as belonging to both syllables. This response type was, however, rather marginal: the percent figures ranged from 0 (for NC-) to 9,03% (for OL), and were on the average below 5%. It is thus fair to interpret this response type as 'deviant', rather than as referring to a meaningful syllabification strategy.

The picture emerging from task 3 is the following. OL clusters, as well as (to a lesser extent) FL clusters, exhibited a tautosyllabic inclination; by contrast, the clusters NC-, lO, rO, jO and wO showed the opposite, heterosyllabic tendency. The remaining clusters (sC, FO≠, FO= and NC+) did not exhibit a statistically interpretable trend. Since an ANOVA based on percent data showed the factor 'cluster type' as significant, a series of t-tests – separately performed among either •• or •|• responses for the various cluster pairs – could be legitimately run. This showed that OL and FL diverged significantly from FO≠, NC+, NC-, lO, rO, jO, wO within both •• and •|• responses, just as sC and FO= did with respect to NC-, lO, rO, jO, wO. In addition, FO≠ significantly diverged from jO among •• responses (while the contrast NC+ vs. jO was only close to significance) and NC+ diverged from jO among •|• responses (with the contrast FO≠ vs. jO close to significance).

As for the participants' behavior, there was some variability. Apart from task 2, where PRESERVED significantly prevailed with all participants as a general across-classes trend, tasks 1 and 3 showed a fair amount of individual differences, statistically ranging from no overall preference to either PRESERVED or SPLIT preference. Thus, the data presented in table 2 stem from averaging over a sample population and by no means reflect the intuitions of every Polish speaker. This, however, should be definitely expected with metalinguistic tasks such as these.

6. *Discussion.*

Comparing the Italian and Polish results may not be straightforward, since more diverse cluster classes were considered in the latter case, due to richer phonotactics. Moreover, task 3 was missing in the Italian experiment. The participants' behavior was, however, sufficiently clear as to make this additional type of evidence unnecessary. Since, in addition, Italians and Poles substantially converge in the treatment of the clusters they share, the present experiment may be interpreted as a contribution to a finer intersegmental cohesion hierarchy, filling the gap as for the clusters not appearing in Italian. Needless to say, over and above the universal tendencies, one should consider language-specific ones: in particular, Italians and Poles seem to diverge as for the treatment of sC clusters. With this in mind, we would like to propose the following generalizations, based on the statistical differences between the two main response types (PRESERVED vs. SPLIT).

Let us first look at tasks 1 and 2. OL are obvious onset clusters for Italians, sC less obviously so, while LO and GC are definitely split. Hence, “OL > sC > GC, LO” emerges as the intersegmental cohesion scale for Italian speakers. For Poles, instead, most sequences allow splitting; only PL appears to be a sufficiently good word- and syllable-initial cluster. Hence, “PL > any C_1C_2” stands out, as a first approximation, as the Polish cohesion scale. Needless to say, for both Italian and Polish one should mention CV as the preferred word- and syllable-initial sequence; however, since the present experiment was only designed in order to examine the cohesiveness of intervocalic C_1C_2 clusters, nothing specific could emerge with respect to CV sequences. The strong inclination of the Polish participants towards repeating the first or (respectively) the last CV sequence in tasks 1 and 2 merely indicates that most Polish clusters are flexible enough to be treated as either indivisible or divisible units, depending on the circumstance.

Task 3 (syllable inversion) induced further distinctions in the Polish speakers’ behavior. OL clusters tended to be preserved; NC-, LO and GO were split, while sC, FO and NC+ remained undecided. Hence, a finer scale emerges: “PL > FL > sC, FO, NC+ > NC-, LO, GO”. Considering again figure 1, showing the universally preferred ordering of some of the clusters included in this experiment, the only modification stemming from the present experiment concerns the relative ordering of the /mb/ and /fk/ sequences. The only true word- and syllable-onset clusters (/pr-, fr-/) rank in the first two positions. Then come legal sequences of low type frequency (/lv-, mʂ-/), which still qualify as possible initials. Finally, we find universally disfavored initials (and preferred medial) clusters, according to NAD, among which our participants: (i) split or treated as undecidable the 'fricative+stop' clusters (/fk, ʂk, sk/), which (in Polish) word-initially mostly stem from morphonotactic operations; (ii) definitely split /rd, mb/ (the former a very rare initial in Polish, the latter an illegal initial). The type GO, absent in the figure, was always split in the experiment, being either illegal (/jO/) or a very rare initial (/wO/).

Checked after Śledziński (2005)[11], the above order corresponds with the clusters frequency (see Appendix 2). PL clusters constitute over 14% of all #CC- clusters, FL over 4%, still much above 'liquid + fricative' 0.08%, 'nasal + fricative' 0.03% and 'liquid + plosive' 0.01%. The high frequency of 'fricative + plosive' (over 12%), matching neither the NAD nor our participants' hierarchy, can be explained by their morphonotactic character in Polish, a fact ignored in all available clusters counts.

Summing up, the Polish participants' treatment of C_1C_2 clusters is governed by: (a) language-specific phonotactics (illegal initial clusters are split), (b) language-specific morphonotactics (morpheme boundaries decidedly win over frequency), (c) universal phonotactic preferences (supporting the major break-down into preferred and disfavored initials).

7. *Conclusion*

The cohesion scales for Italian and Polish bear strong resemblances, supporting the universal phonotactic scale on the one hand and the epiphenomenal conception of the 'emergent' syllable on the other one (cf. Dziubalska-Kolaczyk 2002, forthc.) The latter should best be viewed as the result of deeper phonotactic forces, rather than as a structural and organizing phonological primitive. As expected, Polish, with its larger variety of permissible consonant clusters, allowed a finer inspection of the possible intersegmental cohesion hierarchy. While OL clusters behaved as preferred word- and syllable-onsets in both languages, the remaining clusters exhibited a varying degree of propensity to be treated as onsets. Indeed, with few exceptions (jO, NC- and, to a large extent, FO≠), most of the experimental clusters may also occur word-initially in Polish.

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APPENDICES

Appendix 1: List of stimuli used in the Polish experiment

Spelling conventions:

- <ch> = <h> = /x/ (voiceless glottal fricative);
- <sz> = /ʃ/ (voiceless retroflex fricative);
- <ż> = <rz> = /ʒ/ (voiced retroflex fricative);
- <ś> = /ç/ (voiceless pre-palatal fricative)
- <ł> = /w/ (voiced labio-velar glide)

TRAINING: klezy, styno, fyla, kfypa, ceda , dazie, frale, chyna, młoza, zeni
OL
PL: lapry, chopra, lokre, jakro, nikry, typro, batle, szykla, chepla, gopli, rytla, tokle;
FL: dyfro, bechry, lichro, kośli, jeśro, łosla, toszle, cefro, beszla, bośla, cufle, gichra
LO
/rO/: zyrde, bordze, murdzo, byrwa, szarwy, sarwe, nyrta, furde, jurte, nerża, borży, warże
/lO/: golwa, dalwi, nelwa, solwi, molże, tolża, falży, wylże, delwa, czalwo, galże, nelży
NC
NC+: somla, lamszo, demry, fumża, bimła, domcha, gamli, famło, symra, jemża, bamni, kamno
NC-: czomwy, rymza, żumba, fumki, wymga, szampy, żando, szunka, zunty, dangi, linza, zandy
FO
FO=: bychfa, choszpa, deżwa, powrza, chazdo, nyszko, gawrzu, lozdy, zechfy, tyszka, wozgi, dowsze
FO≠: mafko, ryfsa, żefta, giwda, łyfka, żofki, kofsy, jafty, łewdy, mafce, rewda, nofsa
sC: chyska, festo, dasty, foski, mispa, jespy, chasto, lusta, żasko, weski, chospa, nespo
GO
/wO/: dułka, chyłga, gałzo, dyłzo, kiłze, giłba, załbo, żołka, niłba, fołże, szułga, fałby
/jO/: żajdy, rojza, wejka, byjta, zejda, gojby, sojpa, pajcy, mejzy, żajgi, lojta, mojce

Appendix 2:
Polish #CC- frequencies after Śledziński (2005)

Zbitka #CCV	*Ilość*	*Odsetek w kat. #CCV*	*Odsetek w słowniku*
#PLV	20258	14,63%	3,8555%
#FPV	16938	12,23%	3,2236%
#FSV	15304	11,05%	2,9126%
#FFV	11744	8,48%	2,2351%
#PSV	11634	8,40%	2,2142%
#PPV	9354	6,76%	1,7802%
#FLV	6459	4,67%	1,2293%
#NSV	5353	3,87%	1,0188%
#FNV	5141	3,71%	0,9784%
#FAV	4409	3,18%	0,8391%
#ASV	2822	2,04%	0,5371%
#NNV	2243	1,62%	0,4269%
#PNV	1529	1,10%	0,2910%
#PAV	846	0,61%	0,1610%
#AFV	545	0,39%	0,1037%
#NLV	399	0,29%	0,0759%
#APV	257	0,19%	0,0489%
#SFV	194	0,14%	0,0369%
#ANV	167	0,12%	0,0318%
#AAV	158	0,11%	0,0301%
#LFV	115	0,08%	0,0219%
#SPV	56	0,04%	0,0107%
#NFV	36	0,03%	0,0069%
#ALV	26	0,02%	0,0049%
#LPV	15	0,01%	0,0029%
#LAV	12	0,01%	0,0023%
#LSV	9	0,01%	0,0017%
#LNV	3	0,00%	0,0006%
#NPV	2	0,00%	0,0004%
#LLV	2	0,00%	0,0004%