

## SEGMENTING NATURAL LANGUAGE BY ARTICULATORY FEATURES

David Shillan  
Cambridge Language Research Unit,  
ENGLAND.

1. For many purposes it is necessary to segment text into units convenient for handling. The sentence has been generally accepted as the natural unit, since there was no obvious alternative other than the word - which by itself tells us too little - or the paragraph - which is a vague and shifting unit, unless redefined. But the sentence is not satisfactory either: it is very variable in length; studies of speech show that in its conventional form it is not always recognizably present<sup>1</sup>; it may depend semantically upon its context up to at least paragraph-length; and in any case what constitutes a sentence is not consistently defined (Fries<sup>2</sup> indicates more than 200 definitions).

2. There is another way of segmenting text, which does not suffer from these limitations, being based upon the rhythmical features of articulated speech. This use of the term "articulated" results from a view of language as basically speech, that is as skilled bodily movement. We have found it possible to bridge the gap between spoken language and written language by using features which both the writer and the reader of language tend to adopt from speech.

3. Studies of spoken language, particularly in relation to foreign language teaching, show agreement on at least the terminal boundary of the "tone group" which Crystal & Quirk<sup>3</sup> call "the most striking prosodic unit in English speech", and on which they have found experimentally a high rate of agreement by informants. Many different teaching books<sup>4</sup> exemplify this agreed feature, despite the lack of satisfactory instrumental evidence on continuous speech (into which research is now being planned).

4. Less agreement is found on the configuration of the whole unit which terminates in the "nucleus". Some authors refer to "tone groups" or "tone units", some to "sense groups", some use both terms: this overlapping category of tone and sense suggested a field for further study, which has been proceeding at C.L.R.U. for some time. Syntax is not usually brought into the treatment of this subject, since the approach is phonological; but among the authors

---

\* Work supported by Canadian National Research Council.

referred to<sup>4</sup>, MacCarthy does indicate that syntactic criteria determine the structure of his "intonation groups". Our studies support the work of those who suggest that what is commonly called "stress" has a semantic function<sup>5</sup>, and what can be analysed in terms of intonation is the syntactic feature<sup>6</sup>, - a kind of audible syntactic bracketing.

5. It is common practice in the teaching of English as a foreign language (see Baird<sup>7</sup>) to use tone groups of two stresses (head and nucleus) as examples, but this configuration is not usually formalized. In my own use of such drill material for the foreign learner, I have for many years adopted this unit, marked it with a musical phrase-mark, and called it, since my 1954 publication<sup>8</sup>, a "phrasing". My drill use of this unit gives a minimal context of not less than one sentence - a sentence being segmentable into one or more phrasings, the phrasing being thus a unit between the word and the sentence but not necessarily coterminous with the clause or grammatical phrase. (The musical analogy shows phrasing as a category distinct from the note, the bar, and the section.)

6. Ten years after publication of these drills, my work was called upon by Margaret Masterman<sup>9</sup> in relation to her own semantic approach, for which the two stress-points of the phrasing were seen to correspond to two information points. In the meantime I had been led by teaching experience to consider the difficulty of foreign learners with adequate vocabulary and adequate syntax but no adequate speech-experience of English. They were unable to read a piece of current English (e.g. a "Times" leading article) with understanding, whereas the native English reader, even if momentarily puzzled by perhaps a hastily-worded sentence, would immediately feed back into his reading of it (i.e. "in his mind's ear") the natural speech form (i.e. the phrasing) with which the writer had written it.

7. From this the conception of "stress-point" became differentiated from precise syllabic location of stress (which is itself a complex of amplitude, frequency, and duration) and was defined as the word or words centred, in stress-and-tone prominence, on the nuclear tone, and the word or words centred (in the same sense of "prominence") on that head tone which predominates above any other head or heads which might follow the preceding nucleus.

This method of dealing with tone groups which apparently have more than one head proves to be operationally satisfactory. It gives us a consistent phrasing of two beats, the second of which consists, in certain cases, of a "silent stress" (a phenomenon vouched for by many phoneticians<sup>10</sup>). It also helps to meet the difficulty of differently timed languages, referred to in para. 13 below.

8. It follows from the treatment of stress-points indicated in para. 7 above, that spread stress will occur in regular compounds, such as "semi+readiness", and it also occurs very frequently in cases of a noun with its qualifier, whether true adjective or noun acting as adjective, e.g. "political+requirements", or "staff+planning", and in general where we find intimately associated words on which the stress falls with virtually equal emphasis.

9. The silent beat may or may not be a perceptible pause, but tends to occur in certain typical locations, e.g. where some expression of significant semantic content is about to follow. It would also be possible in many cases to imagine the phrasing re-written using relevant syllables instead of the silent beat, e.g. "in a review of progress" instead of

"in a review ()".

In marking phrasings on text two symbols are used in addition to the + sign for spread stress and the () sign for silent beat. They are the well-known tonetic marker ` (originally representing a high falling tone) used for the nuclear stress, and the stress-mark ' used for the head stress. These may also be referred to as primary and secondary stress-points, the nucleus being primary because in general it indicates the topic of the utterance and the head being secondary because in general it indicates the comment. Thus reading down all the nuclear stress-points of a text printed as a series of phrasings one below the other, we have an index of the topic of the whole text.

10. A piece of text reading  
"Politically Canada is divided into ten provinces and two territories" can be phrased-up either as

"Politically () 'Canada is 'divided into 'ten 'provinces  
and 'two 'territories" or as

Politically ()  
'Canada is 'divided  
into 'ten 'provinces  
and 'two 'territories.

The "quatrain" form into which this falls proves to be very frequent, particularly at the beginning of a passage. This passage continues in two more quatrains:

'Each+province is 'sovereign  
in its 'own 'sphere  
and 'administers its 'own  
'natural 'resources,

and upon 'such 'resources  
as 'related to 'topography,  
'position and 'climate  
is 'based the 'economy+of+the+province.

A straightforward text of this kind offers if not a word-for-word, at least something like a phrasing-for-phrasing possibility in translation. But the translation correspondence, for French for example, is often not direct but expanded (e.g. 2 or more French for 1 English), or transposed in order. Apart from these considerations, there are many cases in which the phrasing structure resolves syntactic or semantic uncertainty. Here is a case where the lack of such a means of segmentation led to a serious mistranslation:

It 'may be 'assumed  
that an 'international 'force  
on a 'standby 'basis  
will 'take+shape as a 'development  
out of 'practice which has already 'begun.

The published translation has turned the last two lines into

"prendra une forme assez singulière, ce qu'elle a déjà commencé à faire".

11. Passages of text in various styles and of various lengths have been analysed by hand, and show a consistent tendency for this rhythm to be found. There may be physiological reasons for this. Neurological studies\* show persistence of tone and rhythm in cases where normal articulation is impaired<sup>11</sup>. Good reasons for this rhythm to be binary include the fact that the

---

\*For neurological literature I am indebted to Dr. Violet MacDermot.

rhythm of the mother's heart-beat is present even to the unborn child, and the in/out rhythm of respiration and the left/right rhythm of walking are basic to human life in general. Studies in articulatory phonetics<sup>12</sup> support the belief that some form of kinaesthetic activity is involved in silent reading, as well as in listening to live speech, which is why we can legitimately refer to "the rhythm of the prose" in spite of the lack, up to the present, of acoustic instrumental documentation of this.

12. Though intonation supplies the contour on which the phrasing is founded, the rhythm of stress is the more essential factor. As Tibbitts<sup>13</sup> says: "The correct basic stressing is mandatory while the intonation is variable within as yet undefined limits". This is the reason why the phrasing hypothesis is unaffected by differences of dialect or accent. The question of isochronicity in English prose has a literature stretching back to Joshua Steele in 1775, through Coventry Patmore in 1856, and on to its thorough experimental (though not instrumental) examination by André Classe<sup>14</sup> in 1939 and discussion by Abercrombie in 1951<sup>15</sup>. There is evidence for at least a strong tendency towards a normal regular periodicity of stress-points. Our observations suggest that a speaker tends to select and order his words so as to distribute them about these pulsations of stress in such a way that points of emphasis fall naturally upon them.

13. The question of whether the phrasing can be equally well observed in languages other than English is not included in the present paper, except by the observation that when parallel texts in English and French are analysed in this way, the French equivalent of the English phrasing, as clearly delimited by the French nuclear tone (and notwithstanding the difference between a syllable-timed and a stress-timed language<sup>16</sup>) supplies a form of "translation unit"<sup>17</sup> with a measurable rate of correspondence with the English<sup>18</sup>.

13. Examination of given phrasings in a text of 377 phrasings, followed by another of over 900 phrasings, led Dolby<sup>19</sup> to say: "Phrasing length, as measured by the number of syllables, appears to be a reasonably behaved statistic when viewed in isolation with routine statistical tools". (See Appendix I)

14. A method of observing the phonological configuration of phrasings is to turn written text into spoken prose on magnetic tape, pass this through a suitable pitch detector and intensity detector (such as that of

the University of Grenoble or the University of Copenhagen), and record the result on mingograph scrolls. Research now being started at C.L.R.U. is comparing the output of these two sets of apparatus with that of apparatus developed in England, with a view to finding the best selection of acoustic data by which to observe the terminal point of the phrasing (frequently a steep fall or rise in pitch), and the two stress-points as peaks of frequency-plus-amplitude-plus-duration.

15. An extension of the usefulness of this unit of segmentation can be seen in algorithmic production by computer of a form of phrasing, based on observation of the criteria used in making articulatory phrasings. This has been done at C.L.R.U. by J.E. Dobson<sup>20</sup> in a form which while not in every single case identical with hand-marked phrasings nevertheless provides a new and operational segmentation of continuous text. As part of the work done under contract to the National Research Council of Canada, this programme is now being applied to the phrasing of a text of 20,000 words from the Canada Year Book of 1962.

16. The normal rhythmical stress can also be provided algorithmically. This makes possible a computerized ordering of the phrasings of a text alphabetically according to four different valuations, i.e.

- (i) the primary (nuclear) stress;
- (ii) the secondary (=head) stress;
- (iii) pendants (= unstressed strings attached) to primary stress;
- (iv) pendants (= unstressed strings attached) to secondary stress.

This gives a semantic concordance (called SEMCO) from which statistical and other information can be derived. The computer can process text in this way as it could not do using the sentence as a unit, and both more economically and with more information than it could by merely cutting the text into lines of the length of the computer print-out.

17. The patterning of stressed and unstressed words, i.e. of stress-points and unstressed words can be expressed as a calculus of ordered pairs, on which research is proceeding.

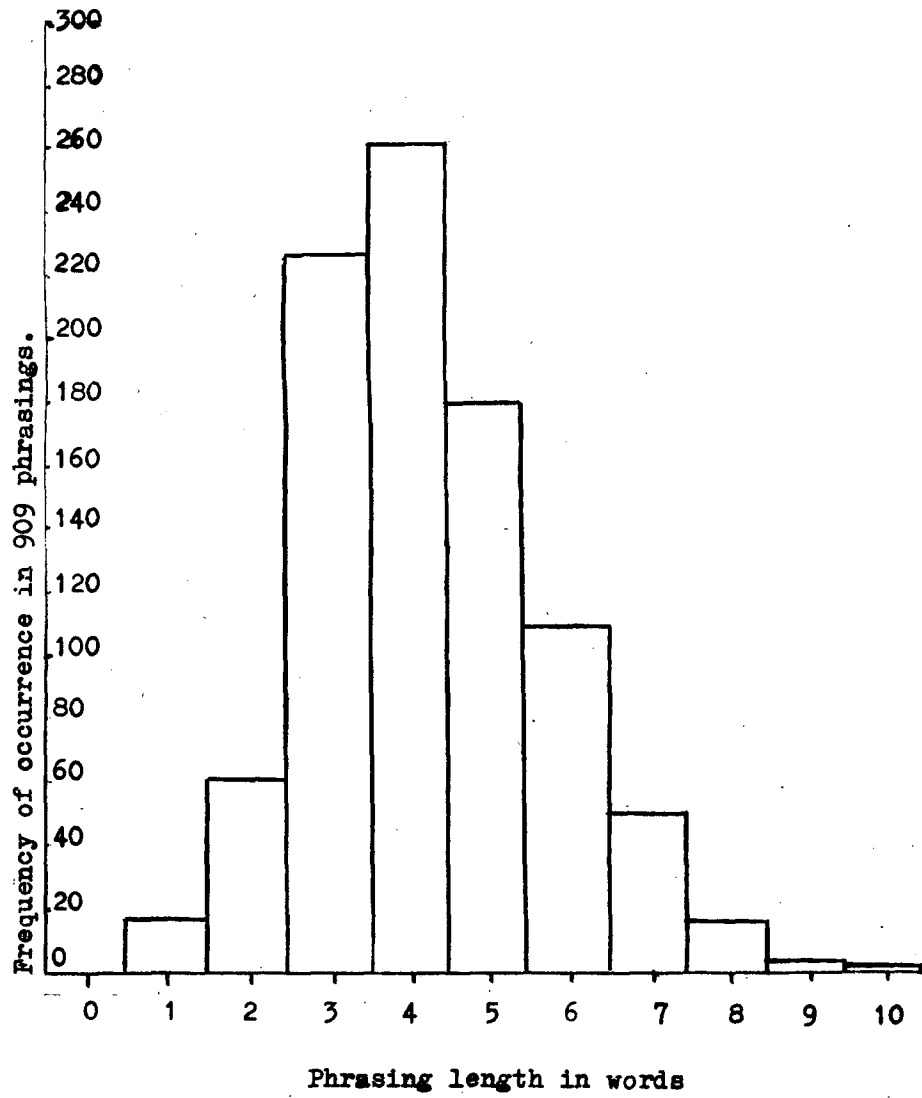
## REFERENCES

1. C.C. Fries: "The Structure of English"; Harcourt  
Brace, 1952, Longmans Green, 1957.  
R. Quirk, A. Duckworth, J. Svartvik, J.P.L.  
Rusiecki, A.V.T. Colin: "Studies in the corres-  
pondence of prosodic to grammatical features in  
English"; IXth International Congress of Linguistics  
1962.
2. See 1.
3. D. Crystal & R. Quirk: "Systems of prosodic and  
paralinguistic features in English"; Mouton, 1964.
4. Armstrong & Ward: "Handbook of English intonation";  
Heffer, 1931.  
W. Stannard Allen: "Living English Speech"; Long-  
mans Green, 1954.  
O'Connor & Arnold: "Intonation of colloquial  
English"; Longmans Green, 1961.  
Arnold & Gimson: "English Pronunciation Practice",  
London Univ. Press, 1965.  
J.T. Pring: "Colloquial English Pronunciation",  
Longmans Green, 1959.  
R.A. Close: "Patterns of Spoken English"; Kenyusha  
(Tokyo), 1954.  
R. Kingdon: "The Groundwork of English Intonation";  
Longmans Green, 1958.  
Lado & Fries: "English Pronunciation"; Ann Arbor,  
1954.  
L.A. Hill: "Stress and Intonation step by step";  
Oxford, 1965.  
W.R. Lee: "An English intonation reader"; Macmillan,  
1963.  
P. MacCarthy: "English Pronunciation", Heffer,  
1944/50.  
D. Shillan: "Spoken English", Longmans Green,  
1954/65.
5. e.g. R. Gunter: in Journal of Linguistics 2,  
2 Oct. 1966.
6. M.A.K. Halliday: "Some aspects of the thematic  
organisation of the English clause"; Rand  
Memorandum, Jan. 1967.
7. A. Baird: "Transformation and sequence in pro-  
nunciation", English Language Teaching XX, 2, Jan.  
1966.
8. See 4.

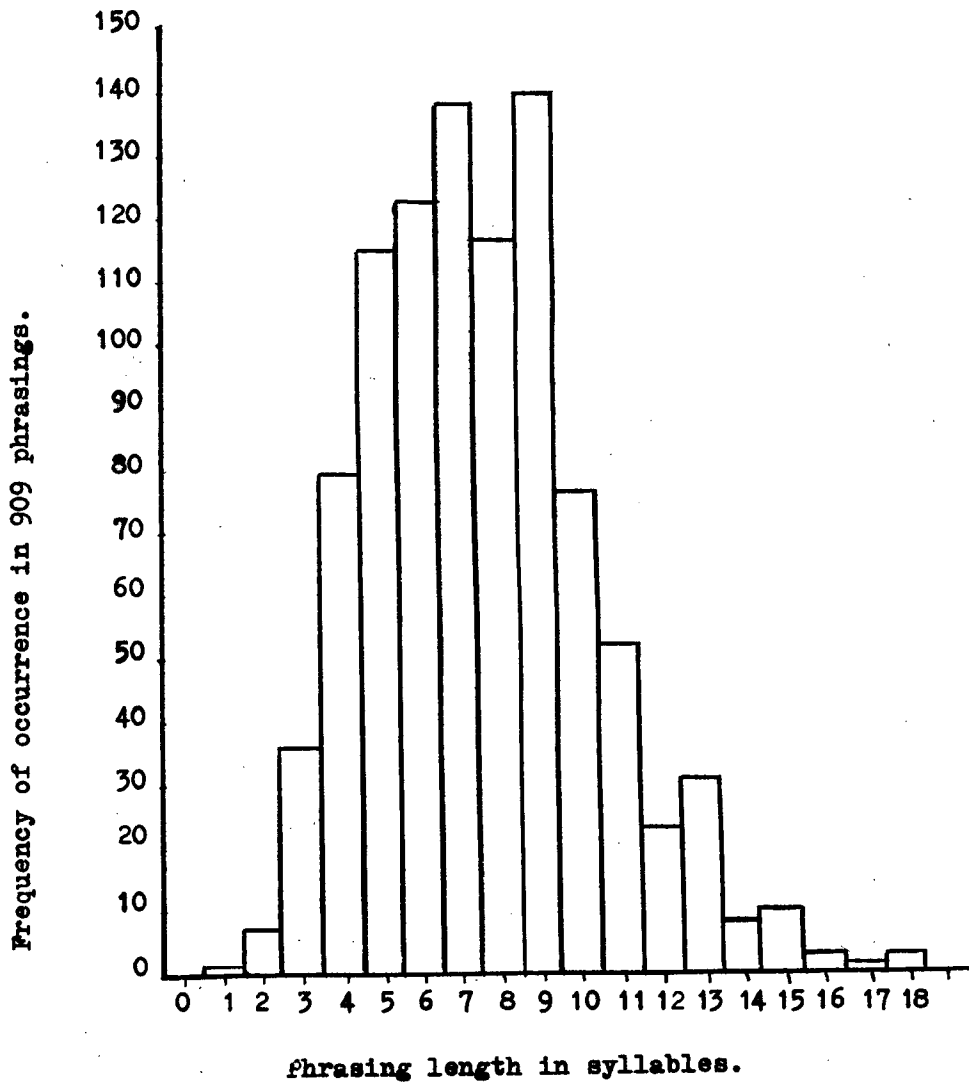
9. Margaret Masterman: "Commentary on the Guberina hypothesis"; *Methodos* 57-58, XV, 1963
10. e.g. D. Jones: "Outline of English Phonetics"; Cambridge, 1932.  
D. Abercrombie: "Studies in Phonetics and Linguistics", Oxford, 1965.
11. e.g. T. Alajouanine: "Verbal realization in aphasia"; *Brain* 79, part I, March 1965.
12. R.H. Stetson: "Motor Phonetics"; Amsterdam, 1951.
13. E.L. Tibbitts: in *English Language Teaching* XXI, 1, Oct. 1966.
14. A. Classe: "The Rhythm of English Prose"; Blackwell, 1939.
15. See 10.
16. K.L. Pike: "The Intonation of American English"; Ann Arbor, 1946.
17. D. Shillan: in *Meta* (Montreal) XI, 3, Sept. 1966.  
D. Shillan: in *English Language Teaching* XXI, 2, Jan. 1967.
18. J.F. Dolby: Reports to C.L.R.U. 1965-66.
19. See 18.
20. J.E. Dobson: C.L.R.U. work paper ML 185, and later developments. (see Appendix II).



APPENDIX IA: Histogram of phrasing frequency versus phrasing length in words.



APPENDIX IB: Histogram of phrasing frequency  
versus phrasing length in syllables.



**APPENDIX II: Computer output from phrasing program.**

WHILE THEY ARE WELL KNOWN AND ESTABLISHED,  
I THOUGHT IT WOULD BE APPROPRIATE  
TO DRAW YOUR ATTENTION  
TO CERTAIN OF THE DEPARTMENTAL PROGRAMMES  
THAT ARE LESS WELL KNOWN  
IN RELATIONSHIP TO SERVICES  
FOR THE AGED,  
BUT WHICH NEVERTHELESS  
CAN CONTRIBUTE SIGNIFICANTLY  
TO THEIR WELL BEING.

ONE OF THESE IS  
THE NATIONAL WELFARE GRANT PROGRAMME  
WHICH WAS ESTABLISHED  
AS LATE AS NINETEEN SIXTYTWO  
WITH CONSIDERABLE SUPPORT AND ENTHUSIASM  
FROM THE PROVINCIAL GOVERNMENTS,  
AND FROM THE NATIONAL AND LOCAL VOLUNTARY WELFARE  
**AGENCIES.**

ONE MILLION DOLLARS  
IS AVAILABLE  
UNDER THIS PROGRAMME  
DURING THE CURRENT FISCAL YEAR  
AND THAT AMOUNT IS TO INCREASE  
AT THE RATE OF HALF A MILLION DOLLARS  
A YEAR