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ON THE PHONOSTATISTICS OF ENGLISH ONOMATOPOEIA

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O. INTRODUCTION

Onomatopoeia is *different*. That much is agreed upon by those who would rather disregard the difference, like Saussure, and those who may have overemphasized it, like Jespersen (1933). The semiotic and pragmatic uniqueness of onomatopoeia and sound symbolism have received ample treatment in the last 60 years or so. From the early 1930's experimental studies (Bühler 1933, Newman 1933, or Bentley & Varon 1933) to Wescott (1987) or Fordyce (1988) the subject has attracted attention of both linguists and psychologists. While the dominant scientific paradigms have been changing — from structuralism to generativism; from mentalism to behaviorism to cognitivism — the flow of writings on sound symbolism (phonetic iconism, ideophony, phonosymbolism, phonosemy, phonaesthemia) has remained steady and abundant. The issues most often studied were mostly psycholinguistic in nature. What are the pragmatic ('light or heavy'), aesthetic ('nice or ugly') and ethical ('good or bad') values that people assign to nonsense phonetic strings? To what extent does synaesthesia play a role: 'is this sound round, soft and dark or rather pointed, harsh and bright'? Is sound symbolism universal or language-specific? The time-honoured issues of linguistic arbitrariness and motivation have been addressed again and again, with opinions now as divided as ever.

In the whole tradition of phonosymbolic study, however, onomatopoeia proper (or 'primary' in Ullmann's 1963: 178 parlance) has received relatively little attention. In fact, as discussed at length in Pharies (1979), most researchers have problems defining it. For example, Pharies points out (rightly so, to my mind) that words like *tran-tran* or *zig-zag*, while commonly regarded as onomatopoeic, "cannot be qualitatively similar to their meanings, since those meanings lack acoustic qualities. They are therefore nononomatopoeic" (Pharies 1979: 12). This terminological confusion is quite common with concepts which have fuzzy borders, like onomatopoeia. Is *ding-dong* properly speaking onomatopoeia, or is it an ablauting reduplicative compound — also referred to as *freeze*, *fixed conjunct* (Cooper & Ross 1975), *irreversible binomial* (Malkiel 1959), or *onomatopoeic apophony* (Grammont 1901)? Does the suggestiveness of *clang*, *claw* and *cluck* come more from the phonaestheme /kl-/, or from their inherent 'onomatopoeicness'? Where do we draw the line between conventional onomatopoeia and the myriad more or less idiosyncratic creations uttered (and forgotten) every day by countless speakers of all languages? And how do we operationalize the underlined terms in the following definition?

> An onomatopoeia is a word that is *considered by convention* to be *acoustically similar* to the sound, or the sound produced by the *thing* to which it refers (Pharies 1979: 84).

But leaving the terminological issues aside, it must be pointed out that, paradoxically, the one aspect of onomatopoeia which has so far received least attention in linguistics is its phonetic structure vis-à-vis that of ordinary speech. To my knowledge, there have been no studies specifically concerned with the phonetic differences between onomatopoeia and the rest of the speakers' active vocabulary. To some extent, this is not surprising. The defining characteristic of onomatopoeia is that its form is motivated by the content. *Prima facie*, then, why should one expect anything phonetically unsual in the former, if the latter is quite ordinary? In other words, there is no reason to expect that the vocabulary used to refer to one particular field of human experience will be formally different from that used in reference to any other fiield (but cf. Thorndike 1945 and the ensuing controversy). The virtual lack of extraordinary phonotactics in onomatopoeia (at least in the conventional kind) might be taken as an immediate proof of this hypothesis. And yet, as I will show below, there are interesting differences between the phonetic structure of onomatopoeia and 'ordinary' vocabulary.

This paper is written in a predominantly descriptive vein, and so I will have rather little to say about *why* the null hypothesis of no significant difference fails for most of the data. There is of course plenty of room for speculation and experiments. If this paper fosters either of these, it will have fulfilled its function.

I. THE DATA

In what follows I will analyze phonetically the onomatopoeic vocabulary of English and compare it with the phonetic structuring of the vast remainder of the lexicon. Considering what has been said about the difficulty of formulating an operational definition of onomatopoeia, the selection of data will inevitably be open to the criticism of arbitrariness. The conventional solution to this is of course delegating the responsibility to an authoritative source,

like a dictionary. I have picked Kloe's (1977) *Dictionary of onomatopoeic sounds, tones and noises in English and Spanish*, not because it is flawless but because it is the only dictionary of this kind. By adding some rather unequivocal examples of onomatopoeia from other sources, some of which Kloe regards as controversial[1], I have arrived at a corpus of 255 tokens, which is itemized in the appendix. This collection could doubtless be augmented, which would be statistically desirable, but would have the disadvantage of necessarily including some less clear-cut cases, especially those branching off from onomatopoeia proper to phonosemy and reduplicatives, as mentioned above.

All the entries were transcribed phonemically[2] as pronounced in Standard Southern English (RP) and subjected to computer-assisted statistical analysis. While theoretically the same procedure could be followed in the case of 'ordinary' English vocabulary, this would obviously be unnecessarily laborious. Instead, what suggested itself, was selecting one frequency analysis of an existing, machine-readable, corpus of data and extracting phonetic data from it. While there are a number of such analyses now available, most are not appro-

Table 1

STUDY BY	PHONEMES	TYPE	DIALECT	MODE
Caroll	10784	text	American	written
Carterette	48708	text	American	spoken
Denes	72210	text	British	written
Dewey	365419	text	American	written
Fowler	10194	text	American	written
French et al.	135548	text	American	spoken
Fry	17000	text	British	written
Hayden	65122	text	American	spoken
Hultzen et al.	20032	text	American	written
Mines et al.	103887	text	British	written
Roberts	66534	tex/lex	American	written
Tobias	133460	text	American	spoken
Trnka	23653	lexicon	British	written
Voelker	409506	text	American	spoken
Whitney	6371	text	American	written

[1] This is a full list of words which, according to Kloe, have "doubtful onomatopoeic characteristics": caterwaul, grunt, low, pant, peck, shriek, screech, snort, squeal, toot, trumpet, whine, boo, drone, groan, gulp, huff, jabber, jargon, pant, pow, prate, whisper, yodel, sputter, swish, swoosh, whir. For computational reasons I excluded *cock-a-doodle-doo* from my corpus.

[2] Syllabic laterals and nasals (/n/) were transcribed as schwa+C for reasons of computational convenience. There were 29 such cases. Affricates and diphthongs were treated as unitary sounds.

priate for the task at hand. Table 1 presents 15 studies of varying character, frequently used for statistical research in linguistics.

Only five of them are based on corpuses of *spoken* data, only four investigate British English, and only two analyse the lexicon, rather than a running text. This last distinction is particularly important for the purpose of comparing the phonetics of onomatopoeia with that of non-onomatopoeia. The sound statistics of a running text are completely different from those of a lexical inventory, due to the effect of word frequencies present in the former, but not in the latter. Naturally, the corpus of onomatopoeia collected for the present paper has the character of the lexicon. Thus, the only count appropriate for purposes of comparison is that of Trnka.

Trnka analyzed all monomorphemic bisyllabic words in the *Pocket Oxford Dictionary of Current English*, tabulated sounds and clusters in various word positions, and to some extent also dealt with syllable structure. His study is one of the most detailed and accurate treatments of English phonostatistics to date. It is also well-suited for the purpose at hand: only a handful of onomattopoeic words in English are more than two syllables and one morpheme in length, so the data may be considered length-normalized (more about length later). Trnka's painstaking breakdown of sound and cluster frequencies into position-defined categories allows a one-to-one comparison with no indeterminacies, at least in most cases. While Trnka's analysis is not without faults (e.g., only stressed vowels were taken into account, and the syllable structure received less attention than it could have), most of the contrasting in this paper is based directly on his work.

II. WORDS

In Table 2 the most important data is collected concerning the phonetic structure of words in three corpuses of data: onomatopoeia, Trnka, and Roberts. Roberts used Horn's count of over 5 million printed words, had a speaker read 10065 most frequent words from there in a contrived context of one sentence each, and then reisolated the words for phonetic analysis. His is a larger corpus than Trnka's and while the speaker's pronounciation was American, the word-structure data are not likely to be severely affected. The advantage of this corpus is that it avoids the self-imposed Trnka's restriction on word length and morphemic structure, and so can be used as a useful double-check to complement the comparison.

As will be seen from Table 2, 0-words are significantly shorter than either in Trnka or in Roberts, both in terms of the number of syllables and that of sounds. The ratio of monosyllables to bisyllables is twice as high in onomatopoeia as it is in Trnka, and nearly four times as high as it is in Roberts.

In terms of word length measured in sounds, the mode is at 3 for onomatopoeia, at 4 for Trnka, and at 6 for Roberts, with the difference between onomatopoeia and Trnka reaching significance at $p<.05$ for 2- and 6-sound long words. The χ^2 test yields 17.3 at 5 df for the series of word lengths between 1 and 8 sounds. Thus, we can be more than 99% certain that the word-length distribution observed in onomatopoeia could not have originated by chance.

Table 2

	Onomatopoeia		Trnka		Roberts	
Parameter	N	%	N	%	N	%
# words	255		5654		10065	
# syllables	327		8105		22078	
# sounds	998		23653		66534	
syll/word	1.28		1.43		2.19	
st. dev.	0.52		0.50		1.47	
=% mean	40.62		34.97		67.12	
sounds/word	3.91		4.18		6.61	
st. dev.	1.15		1.18		2.17	
=% mean	29.50		28.10		32.83	
sounds/syll	3.05		2.92		3.02	
monosylls	180	70.6	3203	56.7	2747	27.3
bisylls	69	27.1	2451	43.3	3969	39.4
mono/bisyll	2.60		1.30		0.69	
3 syllables	6	2.2	0	0.0	2247	22.3
4 syllables	0	0.0	0	0.0	874	8.7
5 syllables	0	0.0	0	0.0	213	2.1
6 syllables	0	0.0	0	0.0	14	0.1
7 syllables	0	0.0	0	0.0	1	0.0
1 sound	0	0.0	11	0.2	1	0.0
2 sounds	21	9.2	242	4.3	59	0.6
3 sounds	82	32.2	1542	27.3	569	5.7
4 sounds	78	30.6	1714	30.3	1321	13.1
5 sounds	52	20.4	1372	24.3	1624	16.1
6 sounds	17	6.7	617	10.9	1753	17.4
7 sounds	4	1.6	137	2.4	1516	15.1
8 sounds	1	0.4	16	0.3	1192	11.8
9 sounds	0	0.0	3	0.1	831	8.3
10 sounds	0	0.0	0	0.0	562	5.6
11 sounds	0	0.0	0	0.0	319	3.2
12 sounds	0	0.0	0	0.0	172	1.7

It appears that this characteristic shortness of 0-words may be fostered by the abruptness and brevity of the motivating referent. In fact, most 0-words describe short, sudden sounds or actions, and when these are prolonged, the appropriate effect is achieved by repeating the words rather than inventing new, long ones. Some of the apparent reduplicatives are created this way, e.g., *choo-choo* or *ratatat*. This, coupled with the historical shortening of frequently used, everyday vocabulary[3], may account for the general shortness of the 0-words.

III. SYLLABLES

Trnka divided his data into three categories: A — monosyllables, B — bisyllables stressed on the penult, and C — bisyllables stressed on the final syllable. There are 14 syllable types in the first category, from V alone to CCCVCC; 34 types in the second category, from VCV to CCVCCCVCC ([trænsjənt]), and 18 types in the third. It would be pointless to compare the frequency of every one of the 66 types with its equivalent in onomatopoeia, due to the relative paucity of my corpus, where most Trnka's types would be represented by only very few words, if at all. Instead, I selected 14 types relatively well represented in both corpuses, additionally collapsing those of the same segmental pattern, like CV́CVC and CVCV́C. The results are shown in Table 3.

As will be seen in Table 3, the 14 syllable types constitute over 94%

Table 3.

Word Type	Onomatopoeia		Z-Score[4]	Trnka	
	N	%		N	%
1 CV	18	7.1	3.69	175	3.1
2 CVC	67	26.3	0.94	1346	23.8
3 CCV	10	3.9	1.85	124	2.2
4 CVCC	12	4.7	−1.89	445	7.9
5 CCVC	47	18.4	2.79	714	12.6
6 CCVCC	10	3.9	0.84	169	3.0
7 CCCVC	12	4.7	4.79	76	1.3
8 CVCV	18	7.1	−0.36	433	7.7
9 CVCVC	19	7.5	−2.69	747	13.2
10 CVCCV	2	0.8	−2.29	190	3.4
11 CCVCV	9	3.5	1.87	105	1.9
12 CVCVCC	0	0.0	−2.10	96	1.7
13 CVCCVC	10	3.9	−0.81	281	5.0
14 CCVCVC	7	2.7	0.20	143	2.5
15 1 - 14	241	94.5		5043	89.2
16 TOTAL	255	100.0		5654	100.0

[3] Most word frequency lists are based on printed material and do not reflect the ubiquity of onomatopoeia in everyday discourse.

[4] Z-score in table 3 (except for syllables/word and sounds/word) and in all further tables and text was calculated from $Z=\frac{p-q}{\sqrt{\frac{q*(1-q)}{N}}}$, where p is probability of the given entry in onomatopoeia, q — in the corpus of comparison, and N is the onomatopoeia-corpus size (in words, syllables or sounds, as the case may be).

of the onomatopoeia corpus and 89.2% of Trnka's corpus. The overall frequency distribution of the fourteen syllable types in onomatopoeia is significantly different from what might be expected as a chance fluctuation of sampling ($\chi^2=55.81$ at 11 df, $p<.01$) to be able to claim that (at least for the most frequent types) the syllable structure of 0-words differs from that of the lexicon. The syllable types represented significantly (at $p<.05$) more often in onomatopoeia than in the lexicon include CV, CCVC, and CCCVC. The reverse situation obtains with CVCVC, CVCCV and CVCVCC. This is of course partly an effect of the overall preference for monosyllables in onomatopoeia, as was remarked above. But notice that CVCC, a monosyllable, is close to being significantly underrepresented in my corpus, compared to the lexicon. This is the only coda-heavy type among the seven monosyllables. While a much larger corpus would be needed to verify this hypothesis, I believe the two facts are causally related. Word- (and syllable-) initial consonants are particularly salient, as noticed in studies of tip-of-the-tongue phenomena (Brown & McNeill 1966, Yarmey 1973, Rubin 1975, Browman 1978, Schachter 1988), speech errors (MacKay 1970, Shattuck—Hufnagel 1987), malapropisms (Fay & Cutler 1977, Zwicky 1978, Hurford 1981), and speech play (Schourup 1973: 592, Geller 1985: 38). It stands to reason that the sound-symbolic connection in onomatopoeia tends to be located in the onsets, with the vocalic element(s) only acting as syllabic support(s). Notice that there are cases where this support is dropped altogether: *bzzz* or *zzz* (these were classified as vowelless for the purposes of computation). This onset preference thus ensures the most prominent representation of the acoustic similarity between the 0-word and its referent (cf. Taylor & Taylor 1965: 426 for similar conclusions).

This hypothesis is strengthened by the comparison of types 2, 3 and 6, which — although failing to reach significance — show the same tendency for heavy-onset overrepresentation compared to the lexicon. For bisyllables, compare 8 with 11 and 13 with 14. I believe that in a larger corpus the tendency would be even clearer. It is not possible at this moment to compare the two corpuses on the truly syllabic basis, however, as Trnka did not break down the data into syllables, contenting himself with analysing *word* syllabic structures. The way his data is presented does not lend itself to actual syllabic reanalysis. Some more insight into the syllable-onset clusters of the English lexicon, however, can be gained from another source, namely Dewey 1923 (cf. Table 1). This will be done in the next section.

IV. CLUSTERS

The onset-heaviness of onomatopoeia suggested to me that it would be a good idea to have a closer look at the details of word- and syllable-initial consonant clusters. As Trnka only provides information on the former, I used

Dewey's analysis to obtain data on the latter. While Dewey's is a corpus of running written English (mostly newspapers and magazines; transcribed according to Funk & Wagnall's Standard Dictionary), and not a lexicon, he did provide data on syllable type-frequency, as well as token-frequency. The difference between the American and the British accent can be disregarded for present purposes, as it hardly shows up on the phonemic level of analysis in the syllable-onset position. Thus, Dewey's data is compatible with the corpus of onomatopoeia, although at some points the details of syllable-division algorithms used in both corpuses may be different. There was no way, however, to extract pertinent information from Dewey's work.

Table 4

Cluster	Onomatopoeia		Z-Score		Dewey	Trnka
	word	syll	syll	word	(syll)	(word)
b	8.6	9.9	4.50	1.12	4.4	6.8
kl	5.3	4.6	6.08	4.88	1.0	1.5
kr	4.1	3.5	4.62	2.70	0.9	1.8
k	2.0	2.8	−1.82	−2.89	5.2	6.6
fl	1.6	1.4	3.38	0.27	0.3	1.4
f	1.2	1.1	−3.51	−2.49	6.1	4.5
v	0.4	0.4	−2.73	−1.85	3.3	2.1
skr	2.0	1.8	9.03	2.83	0.1	0.6
skw	1.6	1.4	6.91	2.97	0.1	0.4
sl	1.2	1.1	5.31	−0.14	0.1	1.3
sn[5]	4.1	3.5		7.08	0.0	0.6
sw	1.2	1.1	5.31	0.50	0.1	0.9
s	2.9	2.5	−3.32	−1.83	7.8	5.6
z	1.2	1.1	−0.15	3.50	1.2	0.2
tʃ	4.1	4.3	3.61	2.90	1.6	1.7
l	1.6	1.8	−2.73	−2.34	5.5	4.8
w	7.4	7.1	2.21	3.06	4.4	3.7
total N	255	327			4400	5654
sample N	244	282			1155	4789
sample %	96.2	86.2			26.2	84.7
table %	50.5	49.4			42.1	44.5

In Table 4 only those clusters are listed whose frequency (expressed as a percentage here) is significantly (at $p<.01$) different from that on either Trnka' or Dewey's counts. It must be remembered that the comparison is carried out in terms of word-initial clusters between onomatopoeia and Trnka, but in terms of syllable-initial clusters between onomatopoeia and

[5] [sn] was not attested in Dewey's corpus. Thus, while this cluster is more frequent in onomatopoeia, sampling distribution fails to reach normality, and z-score would be statistically meaningless.

Dewey. Thus, both counts are provided for onomatopoeia. Percentages, to be comparable, had to be calculated with respect to the original sample of 39 clusters[6], rather than relative to the gross total. The size of this sample vis-à-vis the total is provided under 'sample N' and 'sample %' at the bottom of the table.

Overall, the distribution of cluster frequencies in the 244/282-item corpus of onomatopoeia is very significantly different from that of the lexicon, relative both to word- and syllable-onsets. The χ^2 test yields 87.62 for the word comparison, and 182.02 for the syllable comparison, both at 20 df and $p<.01$.

The comparison of word-onsets reveals that there are eight cases of prevocalic consonantism significantly more frequent in onomatopoeia than in the lexicon: [kl, kr, skr, skw, sn, z, tʃ, w]. One case is significantly less frequent: [k] (but [f] and [l] are close behind). Why should onomatopoeia exhibit preference for the former and disfavour for the latter? It appears that this is at least partly due to the overall frequency distribution of particular consonants constituting the clusters. This will be discussed in the next section. While there are relatively long series of 0-words beginning with the frequent clusters, I find it difficult to explain why the variety of natural nonlinguistic sounds, presumably motivating onomatopoeia, should best be rendered by those particular clusters. The two classes of consonants itemized above do not appear to be particularly natural in the technical sense.

Only four syllable-onsets, [f, v, s, l], are significantly less frequent in onomatopoeia than in Dewey's lexicon. The ones that are more frequent include, in addition to those over-represented relative to Trnka's corpus: [b, fl, sl, sw]. It is at this point that a certain regularity begins to appear which will be substantiated in the next section. Onomatopoeia seems to have a predilection for grave (articulatorily noncoronal) consonants. This tendency may be in part responsible for the pattern of cluster frequency both word- and syllable- initially.

V. SOUNDS

Finally, consider the overall frequency distribution of sounds in onomatopoeia as compared with Trnka's lexicon. The data is provided in Table 5. Because Trnka considered only stressed vowels, the count of my corpus was similarly constrained. This excluded 6.5% of all sounds of my corpus (998), but nearly 12% of his (23653 sounds). Considering the predominance of monosyllables in onomatopoeia, this was to be expected. Percentages in Table 5 are calculated against the total size of either corpus.

[6] This was collected so as to include most frequent clusters on either count. Except for clusters shown in the table, it also comprised: [pl, pr, p, bl, tr, tw, t, dr, d, gr, g, ð, θ, sp, st, ʃ, dʒ, m, n, r, j, h].

Table 5

Sound	Onomatopoeia N	Onomatopoeia %	Z-Score	Trnka N	Trnka %
p	73	7.3	5.78	909	3.8
t	57	5.7	−1.61	1659	7.0
k	78	7.8	3.35	1276	5.4
b	37	3.7	1.30	704	3.0
d	14	1.4	−3.61	830	3.5
g	21	2.1	0.00	495	2.1
f	19	1.9	−0.84	550	2.3
θ	3	0.3	−0.90	119	0.5
s	48	4.8	−2.29	1563	6.6
ʃ	15	1.5	0.87	283	1.2
h	16	1.6	1.91	240	1.0
v	2	0.2	−3.07	305	1.3
ð	0	0.0	−1.73	64	0.3
z	12	1.2	1.00	203	0.9
ʒ	0	0.0	−1.00	31	0.1
w	32	3.2	5.30	315	1.3
j	11	1.1	0.00	249	1.1
l	85	8.5	1.99	1633	6.9
r	48	4.8	0.62	1045	4.4
m	27	2.7	−0.56	715	3.0
n	30	3.0	−3.68	1354	5.7
ŋ	21	2.1	4.61	188	0.8
dʒ	4	0.4	−2.32	275	1.2
tʃ	18	1.8	2.54	239	1.0
e	5	0.5	−3.66	521	2.2
æ	52	5.2	3.59	746	3.2
a:	9	0.9	−0.87	276	1.2
ɔ	16	1.6	−1.29	518	2.2
o:	15	1.5	0.87	284	1.2
u	2	0.2	0.00	42	0.2
u:	27	2.7	4.35	276	1.2
ə:	10	1.0	0.33	221	0.9
ʌ	36	3.6	3.02	526	2.2
i:	19	1.9	1.67	319	1.3
i	45	4.5	3.01	677	2.9
ai	5	0.5	−2.23	309	1.3
ei	7	0.7	−2.08	365	1.5
au	6	0.6	0.00	135	0.6
ou	8	0.8	−1.16	294	1.2
iə	1	0.1	−0.71	49	0.2
eə	1	0.1	0.00	33	0.1
uə	0	0.0	−1.00	34	0.1
stops	280	28.0	2.34	5873	24.8
sonorants	254	25.4	1.65	5499	23.2
fricatives	115	11.5	−2.44	3358	14.2
vowels	236	23.6	3.97	4406	18.7
diphthongs	28	2.8	—3.19	1219	5.0
voiced Cs	344	34.4	—0.73	8406	35.5
v-less Cs	327	32.7	2.65	6838	28.9
less V̆s	935	93.5		20869	88.1
TOTAL	998	100.0		23653	100.0
C=	671	67.1		15244	64.4
V=	264	26.4		5625	23.7
C/V=	2			1.8	

As was the case with the data in the preceding tables, the frequency distribution of sounds in my corpus is highly different from that of the lexicon. At 36 degrees of freedom (some classes had to be grouped) and $\chi^2=235.02$, there is less than one chance in a thousand that the observed frequencies may have originated by chance and the sounds of onomatopoeia do not differ significantly from those used ordinarily.

One striking regularity in Table 5 is that all consonants significantly more frequent (at $p<.01$) in onomatopoeia are grave: [p, k, w, ŋ]. While the opposite is not true, notice that consonants substantially less frequent in onomatopoeia (at $p<.05$) include [d, s, v, n, dʒ] ([t] and [ð] are close to reaching significance at this level), all but one of which are coronal (auditorily and acoustically acute; Jakobson, Fant & Halle 1952: 30). As was alluded to above, there appears to be a preference for low-resonance, grave, large-oral cavity consonants in onomatopoeia. If there is any non-arbitrary connection between 0-words and their referents, as appears to be the case, and if we reject the hypothesis that for some mysterious reason natural sounds are statistically more grave or 'dark' than not, the conclusion to be drawn is that either it is easier for listeners to perceive those sounds which are in fact acoustically grave (due to their higher salience, for example), or for speakers to give them linguistic interpretation.

Notice that the celebrated argument in studies of sound symbolism to the effect that labials and velars, but not apicals, connote bigness (e.g., Taylor & Taylor 1962: 347, Ultan 1968) or derogation (Wescott 1980a: 362), cannot be invoked here, as, presumably, the parameter of size or moral value is not applicable to the description of sounds.

In terms of manner-of-articulation classes, stops are significantly more frequent in onomatopoeia than in the lexicon. This is probably due to the predominant abruptness and brevity of onomatopoeia-motivating sounds (and actions), as mentioned above (cf., e.g., Wescott 1971: 10). Plosion appears to be the most suitable rendering of such sounds, which are often themselves characteristically explosive. For the same reason, fricatives are underrepresented. However, I am hard-pressed to explain the frequency figures for vowels and diphthongs. Why these two closely related classes of sound should be so unlike in frequency relative to the lexicon is in fact mysterious.

Voiced and voiceless consonants in onomatopoeia are more or less equally divided, each class accounting for about one third of all sounds. This provides for a relatively higher frequency of the latter, compared to the lexicon. Why should this be the case? If "voicelessness of consonants suggests inaudibility [and] vocal incapacity" (Wescott 1971: 10), then predominance of such sounds appears contradictory to the observed tendency to favour salient features of referents in onomatopoeia, like graveness or abruptness. The result is similarly paradoxical if we assume that "voiced consonants, like *b* and *d*, seem larger than voiceless consonants, like *p* and *t*" (Brown & Nutall 1959: 444), or that they are 'darker' and more 'grave' (Peterfalvi 1978: 84), or softer (Leech 1969: 99), or 'slower, heavier and rounder' (Chastaing 1964: 368) than the latter. In fact, Chastaing (1964: 368) claims that "les sonores doives mieux convenir que les sourdes [...] à l'expression: 1° des sons et des sonneries" thus presumably being ideal for onomatopoeia. Yet the exactly opposite voice/less effect is even more pronounced when onomatopoeia is confronted with Roberts's data. Z-scores are: -5.19 and 5.45 for voiced and voiceless, respectively. It seems that we are dealing with a genuine regularity here, not a coincidence or artifact of analysis.

Finally, consider vowels. [æ, u:, ʌ, i] are significantly more frequent in onomatopoeia than in Trnka's lexicon. [e] goes to extremes in the opposite direction. What can one make of these data? Notice that, with the exception of [ʌ], the frequent vowels are all the peripheral, prototypical elements of vocalic systems in the languages of the world. Pharies (1979: 148) points out that it is such 'hypercharacterized' vowels that take part in synaesthesia. More generally, Brown and Nutall (1959: 445) conjectured that "phonetic symbolism in natural languages may be limited to pairs naming the extremes of sensible continua". Notice also that in highly emotional or expressive speech the said peripheral vowels occur in abundance. For example, in Wescott's collection of American slang they are "out of all proportion" to their frequency in formal speech (Wescott 1977: 111). It is reasonable to extend these observations to onomatopoeia. Speakers will rely on the most primitive and prominent components of the vocalic systems available to them to render the salient features of sound to which they want to refer.

VI. CONCLUSIONS

In phonosemic research the 'semic' aspect has typically been overemphasized to the virtual neglect of the phonic. And yet, as I hope to have shown, onomatopoeic (and presumably also sound-symbolic) words differ from the rest of the lexicon not only in their semantics but also in their phonetic structure. While the details are at times confusing, and the field requires more in-depth study, the phonostatistics of onomatopoeia are clearly unique in that they follow from its nonarbitrariness and extralinguistic motivation.

APPENDIX

Corpus of onomatopoeia used in this study

achoo, arf, baa, babble, bang, bark, bash, bawl, bay, beep, belch, bellow, blare, bleat, blow, bong, boo, boohoo, boom, bowwow, bray, bubble, bump, burble, burp, buzz, bzzz, cackle, caw, chatter, cheep, chink, chirp, chirr, chirrup, choochoo, chuckle, chuff, chug, clack, clamor, clang, clank, clap, clatter, claw, clear, click, clink, cloop, cluck, coo, cough, crack, crackle crash, creak, croak, croup, crow, crunch, crunk, cry, cuckoo, dandle, dash, dingdong, dit, dot, dribble, drip, drivel, drone, drum, eek, fart, fillip, fizz, flap, flip, flop, flutter, gabble, gargle, gasp, gibber, giggle, glug, gnarl, gnarr, gnash, gobble, grind, groan, growl, grr, grumble, grunt, gulp, gurgle, gush, hack, hawk, heehaw, hem, hiccough, hiss, hoarse, honk, hoopoe, hoot, howl, huff, hush, jabber, jar, jingle, klunk, knock, lap, lisp, low, lull, mew, miaow, moan, moo, mumble, munch, murmur, mutter, neigh, nicker, oink, pant, patter, paw, peal, peep, ping, pipe, pitter, plink, plop, plunk, pop, popple, pow, prate, prattle, puff, pule, purr, putt, quack, rant, rap, rataplan, ratatat, rattle, ring, roar, rumble, rustle, scrape, scratch, scream, screech, croop, shoo, shriek, shush, sigh, sing, sizzle, slap, slash, slurp, smack, smooch, snap, snarl, sneeze, snicker, sniff, sniffle, snip, snore, snort, snuffle, sooey, sough, spatter, spew, spit, splash, splat, sputter, squall, squawk, squeak, squeal, stammer, strum, stutter, swat, swish, swoosh, tap, teehee, thud, thump, thwack, tick-tack, ticktock, tinkle, titter, toll, toot, tramp, trickle, trill, troat, trumpet, twang, tweet, twitter, ululate, vroom, wail, warble, waul, whack, whang, wheeze, whiff, whimper, whine, whinny, whirr, whisper, whistle, whiz, whoop, whoosh, whop, woofwoof, yapyap, yawn, yell, yelp, yip, zap, zip, zzz,

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