This is an offprint from:

Joan Bybee and Paul Hopper (eds)
Frequency and the Emergence of Linguistic Structure.
John Benjamins Publishing Company
Amsterdam/Philadelphia
2001
(Published as Vol. 45 of the series
TYPOLOGICAL STUDIES IN LANGUAGE, ISSN 0167-7373)

ISBN 90 272 2947 3 (Eur.) / 1 58811 027 3 (U.S.) (Hb.)
ISBN 90 272 2948 1 (Eur.) / 1 58811 028 1 (U.S.) (Pb.)

Familiarity, information flow, and linguistic form

GERTRAUD FENK-OCZLON

University of Klagenfurt

1. Introduction

"*Geläufigkeit und sprachliche Form*" (Familiarity and Linguistic Form) was the general title of my cumulative habilitation thesis. All of the articles forming this thesis (Fenk-Oczlon 1989a, 1989b, 1990a, 1990b, 1991) deal with the influence of *frequency* on *linguistic form* via "intervening variables" of *cognitive representation*, such as familiarity, accessibility, predictability, and (subjective) information. To contribute to a symposium on "Frequency Effects and Emergent Grammar" ten years later gives me the feeling that this approach is still modern and offers considerable potential for many linguistic questions not yet discussed from this point of view. It encourages me and gives me the opportunity to outline the above mentioned papers which are, with only one exception (1989a), published in German, so that their "familiarity" for a predominantly North American audience is not too high.

This outline will be supplemented with some comments on additional literature. I start with theoretical considerations (Section 2) regarding the role of cognitive mechanisms mediating between frequency and linguistic structure and I illustrate the superiority of frequency-based explanations of certain linguistic structures.[1] Subsequent sections deal with empirical results regarding different levels of linguistic description: phonology (Section 3), morphology (Section 4), and syntax (Section 5). Sections 3 and 4 summarize results (from Fenk-Oczlon 1989b and 1990b) regarding the way in which token frequency affects reduction processes. These results confirm Bybee's (1994: 297) general claim "that differential reduction due to frequency is pervasive throughout the forms of a language . . ." And Section 5 reports results (from Fenk-Oczlon 1989a) concerning effects of frequency on word order. The influence of frequency on reduction processes and therefore on the length

of linguistic forms as well as its influence on word order, seem to contribute to a relatively constant flow of linguistic information.

2. Frequency, "cognitive costs", and the constant flow of linguistic information

2.1 Frequency and cognitive costs

Frequency of linguistic segments (e.g., syllables, words, phrases . . .) does not exert any *direct* effect on language structure, but affects, first of all, cognitive processes: Higher frequency of use of such a segment results in higher *familiarity* of this segment, while the *cognitive costs* necessary for producing and/or perceiving these segments decrease. Cognitive processes are of course involved in all the processes (programming, articulatory, perceptual) of active and passive use of language. The so-called "speaker", for instance, is always also the "hearer" of his own language production. And the vocabulary of a certain subject is not only reactivated in overt language behavior but also in internal monologues, in the internal testing of different drafts of formulations, and in subvocal memorization. Our working memory's "phonological loop" (Baddeley *et al.* 1998) seems to play a special role when we are learning novel phonological forms of new words.

The concept of familiarity is associated with availability and accessibility (e.g., Ertel 1977). High familiarity, including high familiarity within a certain context, manifests itself in faster and more accurate retrieval processes, in faster and more accurate identification and recognition of stimulus patterns, and in higher speed and accuracy of both psychomotor action and anticipation and prediction. Despite a rather afrequentistic conceptualization of *prototypicality* in Rosch (e.g., 1978) these indications of familiarity can be seen as indications of prototypicality too, and higher frequency can be seen as an underlying factor of prototypicality in three respects (Fenk-Oczlon 1987/1988): Frequency of the features determining family resemblance, relative frequency within a certain context; and "frequency of instantiation" (Barsalou 1985: 631), i.e., the frequency in which subjects "have experienced an entity as a member of a particular category". Nosofsky (1988) provided further evidence for a "frequency-sensitive" model of prototypicality.

Familiarity also results in better recall: Immediate free recall after presentation of a list of bisyllabic words is better if these words are more familiar to the subjects, i.e., if their "subjective information" is lower (Fenk 1977). Quantifications of "familiarity" and "cognitive load" are possible in terms of information theory (cf. Fenk 1986, Fenk and Vanoucek 1992), and these terms ("subjective information" and "redundancy") are again closely related with the "(relative) frequency" of elements

and of combinations of elements. Goldinger (1998) mentions, apart from "idiosyncratic" context-specific effects investigated in laboratory tests, other effects in word perception which

> arise across virtually all procedures or participants. Examples of such robust effects are word frequency, semantic priming, and benefits of context . . . .word frequency and semantic priming effects should be supported by a groundswell of all stored traces. By experiencing a word in many contexts, a person will come to appreciate its high-frequency status, syntactic roles, and associative links to other words. A basic assumption in cognitive psychology is that sources of redundant information may trade-off in perception and memory (Neisser 1967). By storing words in variable contexts, a person will amass myriad routes back to those words. (Goldinger 1998: 268)

Obviously, frequency and familiarity are central factors in cognitive performance. It is no wonder that one can find evidence for direct representations of these variables in our cognition. Our cognitive apparatus and its incidental learning show some special sensitivity to frequency. It constructs automatically, without any specific instruction or demand, a representation of the context-relevant relative frequencies of events or elements. The fit between subjective and objective frequency distribution is not really perfect and is characterized by systematic failures (Kahnemann *et al.* 1982). But the fit is higher than was expected in early calibration studies (for a short overview see Fenk-Oczlon 1991: 365 f).

Certain parameters of event-related potentials (ERPs) in our EEG can be regarded as representations of familiarity too. In conditioning experiments the amplitude of the contingent negative variation (CNV) covaries with the relative frequency in which a first (indicative) stimulus is followed by a second (imperative) stimulus (Walter 1964; see also Rockstroh *et al.* 1982: 14). It varies, in other words, with the transitional probability between the two stimuli. And late components of evoked potentials do again vary with the predictability of stimuli: In highly unpredictable stimuli the P300 component of the wave pattern—a "wave trough" appearing circa 300 milliseconds after the (onset of the) presentation of the stimulus—is more pronounced, corresponding to the lower subjective probability or higher information of the stimulus (Rockstroh *et al.* 1982: 8) The amplitude of this component is often interpreted as a measure of the amount of attention allocated especially to unexpected and rather surprising events. The N400 component—a negative component with a latency of about 400 milliseconds—seems to be specific for language processing and seems to co-vary with "lexical access".[2] In a study by Kutas and Hillard (1980), ERPs were recorded for subjects as they read seven-word sentences, presented one word at time. Some of the sentences were completed with words that were either "physically deviant" (bold-faced) or semantically inappropriate, as in "*He spread the warm bread with socks.*" These two types of deviations were associated with distinctly different ERP components—a late negative wave (N400) for

semantic deviations and a late positive complex for "physical deviations" (Kutas and Hillard 1980: 99). Moreover, words which elicit large N400s are more poorly remembered than those with smaller N400s (Neville *et al.* 1986). And in lexical decision experiments low frequency words yielded a larger N400 component than high frequency words (Smith and Hallgren 1987).

But frequency is not only reflected by amplitudes of event-related potentials. Osterhout *et al.* (1997: 143) tested the hypothesis that differences in the latency of negative components of ERPs are attributable to word-class effects against the hypothesis that they "are attributable to quantitative differences in word length and frequency." They concluded from their results "that the latency of these negativities is a function of word frequency and length, rather than word class . . . ." (Osterhout 1997: 163). I would like to add here that one of these two "independent" variables, the length of words, can for its part be described as dependent on the variable "frequency" (see Section 4).

Figure 1 illustrates the indirect connection between frequency and linguistic form. In our diagram (Figure 1) illustrating the indirect influence of token frequency on linguistic form, the mediating instance is called "cognitive costs" in order to indicate that these dependencies are governed by economy principles in cognition and communication. All the findings to be reported in the following sections can be understood from the point of view of such economy principles.

But terms like *cognitive costs*, *difficulty*, *ease*, *familiarity* and *subjective information* are *relative* concepts. They refer to a relation between certain items on the one hand and certain (populations of) subjects on the other hand. A certain item which is unfamiliar (or difficult, or surprising, or informative) for a person X may be just the opposite (easy, expected, redundant) for a person Y or for person X at a later point in time. Such concepts can be operationalized only in psychological investigations with restricted numbers of subjects. If the aim is to investigate linguistic form

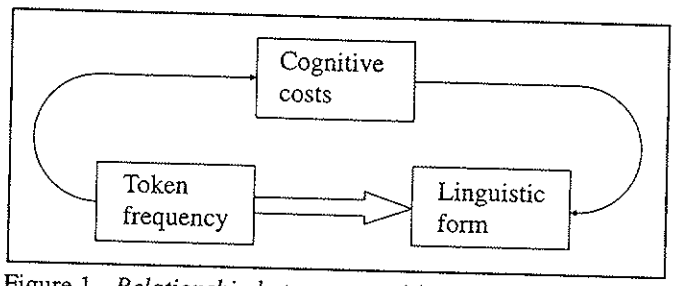

Figure 1. *Relationship between cognitive costs, token frequency, and linguistic form*

as dependent on frequency, we have to neglect these cognitive variables. The only available and quantifiable *independent* variable is frequency (see the short and direct arrow from frequency to linguistic form in Figure 1). But it would be a mistake to exclude the cognitive view from our modeling of the interrelationships and from generating empirical hypotheses about the quality of these interrelationships.

Markedness Theory and Naturalness Theory are also approaches of theoretical linguistics which refer to concepts such as cognitive costs (Mayerthaler 1982) and cognitive ease. As to the extralinguistic foundations of linguistic (e.g., morphological) naturalness, proponents of this approach (Dressler *et al.* 1987) mention (neuro)psychological limitations of perception and limitations of memory. "At this point 'more or less natural' (with respect to universals) corresponds to 'more or less easy' for the human brain" (Dressler *et al.*: 1987: 11f). But for some reason, these authors do not take into account (or even deny) that the *frequency* of a construct is a relevant factor determining its *cognitive costs*.

"Heuristic sources" that are assumed to indicate "naturalness/markedness" are, for example, that the *less marked* is in aphasia normally affected later than the more marked, is earlier acquired in language acquisition, is more frequent in type and token, and is the first element in freezes, i.e., in conventionally ordered pairs (Dressler *et al.* 1987: 11f).

I attempted to turn this line of argumentation upside down and demonstrate that in the "sources of markedness" the term "markedness" can easily be replaced by "frequency". In cases where markedness and frequency diverge, frequency proved to be the better predictor variable, (Fenk-Oczlon 1991). Again, the authors mentioned above did not consider frequency as a relevant factor for those anomalies, which they call "markedness-reversals". But these phenomena are not anomalies and are nothing more than "frequency-reversals" (cf. also Greenberg 1966 and Tiersma 1982).

Frequency is, moreover, a tangible empirical variable whereas markedness is a theoretical construct. So we may say that relatively independent of its degree of markedness, that which is more frequent because of its natural salience and/or cultural importance:

a. is earlier acquired by children
b. is less affected in aphasia
c. is perceived and decoded more easily
d. survives better in neutralization
e. survives better in paradigm regularization
f. is more irregular
g. is encoded in shorter morphological form
h. occupies initial position in freezes

Empirical results regarding the morphological rule (g) and the word order rule (h) are discussed in Sections 4 and 5.

2.2 *Frequency and the constant flow of linguistic information*

If communication is to be effective, an upper limit on the information transmitted per unit of time, determined by the constraints of cognitive resources, should not be exceeded. On the other hand a very high degree of redundancy would not only waste cognitive capacity, but would also mean an uneconomical expenditure of signs, time, and energy. From this results a lower limit. In an effective and economical communication system, the changes in the flow of information should not be too pronounced and the average level of information transmitted should be adapted to our capacity limits.

"The more frequent, the shorter" is a regularity which contributes to our languages' tendency toward a relatively invariant flow of linguistic information. High frequency means, in terms of information theory, low informational content. An element carrying a small amount of information can be processed within a shorter time. Thus we expected that there would be a proportionality function between the information contained by a word and the length of this word. This hypothesis could be confirmed on the basis of Fucks' (1956) statistical data about relative frequency of various word-lengths in 9 different languages (Fenk and Fenk 1980): The more information the longer and, therefore, a relatively constant flow of linguistic information. A set of crosslinguistic correlations (Fenk and Fenk-Oczlon 1993, Fenk-Oczlon and Fenk 1999) between four variables—size of syllables measured in phonemes, size of words measured in syllables, and size of clauses measured in syllables and in words -computed across 34 languages shows the tendency of all these languages to a restricted variation of the duration of clauses, of the information of clauses, and of the information flow within clauses.

3. Word frequency as a determining factor in phonetic reduction

The observation that frequent words reduce faster than infrequent words has been documented in numerous works (e.g., Bybee 1994, Fidelholtz 1975, Hooper 1976, Mańczak 1980, Phillips 1984, Zipf 1929).

Natural Phonologists (e.g., Donegan and Stampe 1979, Dressler 1984) however argue that phonological lenition or backgrounding processes, such as vowel reduction, lenition and deletion of consonants, monophthongization, and assimilation processes that ease articulation are typical for casual or rapid speech and are phonostylistic variants. Again, frequency arguments are not taken into consideration.

In Fenk-Oczlon (1989b) the attempt was made to show that backgrounding affects frequent words first and that token frequency is a key-factor for backgrounding processes. In casual or rapid speech, reduction is again restricted to the most frequent words. Examples from the literature on lexical diffusion were analyzed in terms of frequency. When for instance analyzing the examples which Kypriotaky (1973) gave for aphaeresis in rapid speech by American students, a clear correspondence between the lexical item's frequency and its "deletion proneness" could be found. In words which belonged to the 1000 most frequent words in English like *about*, *because*, *around*, *suppose*, *remember*, *American*, *enough*, *before*, *almost*, *expect*,*except*, *instead*, *escape*, *explain* the initial syllable tends to be deleted in rapid or casual speech far more often than in less frequent words. The same holds for Russian. Barinova's (1971) examples for deletion of vowels, consonants or even syllables show that although reduction processes occur first in casual speech, not all items are deletion-prone to the same extent. Again, the most frequent words reduce first. For example, *tebja* [t'ia] you (Acc.), *chodit* [choit] he, she walks, *vidit* [v'iit] he, she sees, *nič ego* [n'čo] nothing, *segodnja* [s'odn] today. All these words belong to the 204 most frequent words in Russian (Josselson 1953).

Other empirical results concerning the role of frequency in phonetic reduction are a by-product of an investigation analyzing the word order in freezes. In Fenk-Oczlon (1989a, see also Section 5) arguments were presented and empirically tested to support the view that the principle "more frequent word before less frequent word" is superordinate to older phonological rules proposed e.g., by Malkiel (1959), Cooper and Ross (1975), and Ross (1980), such as "the first word has fewer syllables than the second word", "the first word has fewer initial consonants and fewer final consonants", "the first word has less obstruent (more sonorant) initial consonants but more obstruent final consonants", and "the first word has shorter vowels".

For Ross (1980) these phonological rules are an expression of the length contrast

Table 1. *The relative frequency of initial consonant clusters (CC, CCC) as dependent on word frequency. (Frequency data for Russian from Josselson 1953: 43–124, and for English from Thondike and Lorge 1944: 267–70)*

Russian		Frequency list 1 (the 204 most frequent words)	Frequency lists 2–5 (the 1993 next frequent words)
	CC	36 words, 17.6 %	555 words, 27.8%
	CCC	2 words, 1%	49 words, 2.5%
English		Frequency class 1–500	Frequency class 500–1000
	CC	37 words, 7.4%	86 words, 17.2%
	CCC	2 words, 0.4 %	6 words, 1.2%

"short/long". Fewer syllables, shorter vowels, and fewer initial and final consonants all contribute to a shorter word. But the phonological rules can also be an expression of the higher frequency of the first word as compared to the second word. Lesser obstruency of the initial consonant may be associated with frequency as well. Some examples from Fenk-Oczlon (1989a) are figured in Table 1. It illustrates that initial consonant clusters are relatively rare within the class of the most frequent words.

3.1. Frequency and consonant weakening: Why does the first word in freezes, at least in English, tend to have a less obstruent initial consonant?

As far as the lesser obstruency of the initial consonants in the first word is concerned, Ross (1980) admits that he could not find any link to shortness. Again, frequency can be introduced as an explanatory factor. An analysis (Fenk-Oczlon 1989a, 1989b) of the relationship between the degree of obstruency (using Ross's 1980 obstruency scale) and the frequency of initial consonants in English, which I carried out on the basis of frequency data from Thorndike and Lorge, gave the following results (1989a: 524): If we take all the words that begin with one of the glides [y], [w], [h] as our basis for 100%, then their share in the highest frequency grouping of Thorndike and Lorge—'AA' (100 or more per million)—is 11.5% (see Table 2) For the words beginning with a liquid, a nasal, or a fricative, the percentages calculated in the same way are noticeably lower, namely 6.3% (=5.5% for liquids, 6.5 % for nasals, and 6.6% for fricatives; within the fricatives, [θ] and [ð] are conspicuous by their percentage of 15.5%). Of the words that begin with a stop, that is, with the most obstruent sound, only 4.5% are to be found in the highest frequency stage. Thus, in the highest frequency class the frequency distribution of initial consonants (Table 2) differs considerably from the overall distribution: In the class AA the share of obstruents is much lower and the share of non-obstruents much higher than in the overall distribution.

Table 2. *The percentage of words beginning with glides, liquids, nasals, fricatives and stops in the highest frequency grouping of Thorndike and Lorge -'AA' (Percentage which occurs 100 or more times per million).*

For words beginning with:	
glides	11.5% (16.7 % for [y] 10.7% for [w] and 7.1 % for [h])
liquids	5.5%
nasals	6.5%
fricatives	6.6% (but: [θ] and [ð] 15.5%)
stops	4.5%

Table 3. *The distribution of weak initial consonants in the two highest frequency classes (from Fenk-Oczlon 1989b, slightly modified)*

Initial consonant	Frequency class 1–500	Frequency class 500–1000
[y]	1.4%	0.8%
[w]	5.0%	3.0%
[h]	7.4%	3.4%
[θ]	4.0%	1.4%
[ð]	2.6%	0.5%

And if one looks at the 1000 most frequent words in English, it can be seen in Table 3 that the share of the weak initial consonants [y], [w], [h], [θ], [ð] drastically decreases from the frequency class 1–500 to the frequency class 500–1000 in Thorndike and Lorge.

There is a clear correspondence between weak initial consonants and frequency in English: the more frequent a word, the weaker its initial consonant. Bybee (1994) argued that theories of weakening should include among the language-specific phonetic factors the distribution of consonants in frequent versus infrequent words.

It might also be interesting that the number of words beginning with a vowel decreases within the 1000 most frequent words in English (1–500 = 16.8%; 500–1000 = 13.2%). It is at least conceiveable that the words start with a vowel because formerly initial consonants have already been deleted. Similarly, in modern English, the deletion of /y/, /w/, /ð/ is observed in words like *yesterday*, *woman*, *wood*, *the*, *them* . . . (cf. Hughes and Trudgill 1979, cited in Alexander 1988)

It is striking that initial [ð], which is weaker than [θ], appears only in extremely frequent pronominal words such as *they*, *the*, *them*, *their*, *that*, *this*, *these*, *then etc.* despite the fact that these words had a former initial [θ] (Jespersen 1933: 550).

In some Austrian dialects weakening of initial /s/ to /h/ can be observed. Although the process is not very productive, again it is observed only in high frequency words such as *san* (*sind*) to [*han*] : [*Mir han gwen*] *wir sind gewesen* ("we have been").

4. Frequency and the length of forms: Is the length of morphological forms motivated by economy or iconicity?

In Natural Morphology it is explicitly stated that frequency is only an epiphenomenon of "semantic markedness", i.e., less semantically marked units are more fre-

quent, but it does not have any explanatory power concerning the length of morphological forms (Mayerthaler 1981). The decisive factor for the length of morphological forms is "semantic markedness". The "more semantically marked" a form, the longer.

Haiman (1985: 150) however feels ". . . from even the briefest consideration . . . that morphological complexity is not only an iconic measure of semantic complexity, but an economically motivated measure of pragmatic familiarity." Based on the economy principle, frequently used words should be shorter, and less used forms longer.

4.1 Length of aspect forms in Russian

In order to shed more light on the issue of whether the length of words is motivated by economy or iconicity, an attempt was made to determine which of the two relevant dimensions—*semantic markedness* versus *usage frequency*- is the more capable predictor of the length of aspectual forms and case forms in Russian (Fenk-Oczlon 1990). For this purpose, 67 Russian aspectual pairs were first characterized in terms of their frequency (frequency data from Šteinfeld and Zasorina, cited in Breu, 1980) and then for word length based on these findings. In 50 out of the 67 aspectual pairs the more frequent partner, perfective or imperfective, was also the shorter one. In six cases the inverse relationship held, in eleven cases no decision could be made. In (1) are some examples (from Fenk-Oczlon 1990b: 58f.).

(1) Perfective shorter

	Imperfective	*Perfective*	*Gloss*
a.	davat'	dat'	'give'
b.	načinat'	načat'	'begin'
c.	pokupat'	kupit'	'buy'
d.	ložit'sja	leč'	'lay down'
e.	stanovit'sja	stat'	'become'
f.	sadit'sja	sest'	'sit down'

(2) Imperfective shorter

	Imperfective	*Perfective*	*Gloss*
a.	moč'	smoč'	'can'
b.	igrat'	sigrat'	'play'
c.	dumat'	podumat'	'think'
d.	slušat'	poslušat'	'listen'
e.	starat'sja	postarat'sja	'try'
f.	videt'	uvidet'	'see'

In (1) the perfective form is more frequent, in (2) the imperfective form. In all these examples the more frequent form is also the shorter one. In the examples (d)–(f) in (1) the more frequent partner does not even show the reflexive affix *-sja*. This reminds us of Haiman's (1983: 804) postulate that the more predicted reflexive tends to be reduced: e.g., Russian sebja > -sja. In our examples this could mean that the most predictable suffix even has zero expression. The historical data show that, for instance, the verb *sedati—sesti*, "sit down", did not have the reflexive affix on either aspect in the seventeenth century (time of the Smuta, Mayo 1985), but developed only in the less frequent imperfective.

In addition, the often stated correspondence between irregularity and frequency can be documented in our examples. In 32 pairs out of our 67 aspectual pairs, one aspect partner belonged to an unproductive verb class and this was, in 30 of the 32 pairs, the more frequent one. Only in two cases does the opposite hold. Lack of productivity of flectional types is, according to Isačenko (1968: 25), closely connected to irregularity and high frequency. Thus, the unproductive verb classes in Russian seem to be comparable with the Strong Verbs in English or German.

Markedness theory has many more problems with defining which aspect should be shorter. According to e.g., Jacobson (1939/1971) and Maslov (1958), the perfective is the marked aspect and the imperfective the unmarked aspect. According to the principle of iconicity the perfective should therefore be morphologically more complex. As we have seen, this does not hold. "Languages do not show one aspect as clearly unmarked and the other marked . . ." (Bybee 1985: 147). The more a grammatical category is bound to a word in terms of meaning components, the more difficult it is to determine universal markedness weights. (cf. also Tiersma 1982) The use of a certain aspect depends to a great extent on the meaning of the verb. The more dynamic a verb, the more it tends to be used in the perfective aspect (Breu 1980). And the more frequently it is used, the more likely it is to be shorter. Semantic unmarkedness and high frequency usually will converge. But when they diverge, frequency is the factor determining the length of forms. Frequency also seems to be a better predictor of the length of caseforms than universal markedness assignments. The more frequent a case in a particular language, the more it tends toward zero coding.

4.2 The Russian genitive plural

It is often claimed, for instance by Greenberg (1966), that direct cases (nominative, accusative) have, as compared to oblique cases, zero expression. This suggests "that direct cases comprise an unmarked category" (38). Similarily Haiman states: "In no language will the morphological bulk of a direct case affix *exceed* that of the oblique case affixes, as a general rule. There will be languages, however, in which

the morphological bulk of oblique case affixes exceeds that of direct case affixes" (Haiman 1985: 137).

An exception to this general rule is the Russian genitive plural of the feminine and neuter, which has zero expression:

Nominative singular	*Genitive plural*	*Gloss*
ruka	ruk	'hand'
komnata	komnat	'room'
nedelja	nedel'	'week'
selo	sel	'village'

The zero expression of the genitive plural cannot be explained by its semantic markedness, but could be explained by its high frequency. The Russian genitive plural has many functions and is therefore an extremely frequent case (cf. Šteinfeld 1963). Great length would be uneconomical with signs that are used so frequently. Thus, contraiconic zero-coding of the Russian genitive plural is in any case an economical coding.

One could ask why the masculines have lost the zero-coding they had in Old Russian. A possible *functional* explanation being, there are always competing tendencies in language change, for instance the tendency to be clear and the tendency to be economic. After the emergence of the "genitive/accusative", the animate accusative got a genitive ending, a process which was complete by the end of the 18th century, the zero coding of the genitive plural would have made no distinction between male animate accusative objects in the plural and male animate subjects in the singular. And it was about this time that the marked coding *-ov* of the genitive plural arose. But the morphologically marked coding of the genitive plural with *-ov* did not extend to all masculine forms. Again, the exceptions are found in words in which the genitive plural form is used very frequently (Fenk-Oczlon 1990b: 66).

Similar problems of universal markedness assignments become apparent when attempting to explain the different morphological coding of the agent in nominative/accusative vs. ergative languages. In nominative-accusative languages nominative subjects (e.g., agents) are prototypically morphologically unmarked (Givón 1984: 149) while in ergative languages ergative subjects (agents) are prototypically morphologically marked. How could this be explained by semantic markedness? For Mayerthaler (1981) the universally less marked subject is the agent. But why should the agent (subject) be semantically unmarked in nominative-accusative languages and marked in ergative languages? Again it can be seen that universal markedness definitions are quite difficult and frequency arguments can offer a simpler explanation for these facts: the most frequent cases are the morphologically unmarked ones. In nominative-accusative languages the most frequent case is the nominative, because every complete sentence with a nominal subject contains, whether the sentence is transitive or intransitive, a nominative subject. In ergative languages, on the other hand, the absolutive is found in every complete sentence (transitive or intransitive) and is therefore more frequent than the ergative, which occurs only in transitive sentences. Frequency explains why nominative and absolutive case forms tend to be morphologically unmarked and ergative subjects are prototypically morphologically marked.

5. More frequently used units tend to be placed before less frequently used units

There are several mechanisms contributing to a relatively constant flow of linguistic information. For instance, as already mentioned in Section 2, the regularity notion of "the more frequent the shorter". Another mechanism seems to compensate for the successive reduction of information within clauses and sentences. In general, as a sentence continues, the remaining words get more and more predictable—the number of possible and plausible continuations decreases, and so does the (subjective) information. Thus, the first positions of sentences—particularly of isolated sentences and of the first sentence of a longer text—are associated with the lowest predictability or highest information. To place informationally rich elements in a position which is per se characterized by high information, would produce peaks of cognitive overload. An appropriate strategy to avoid such peaks is the tendency to begin a sentence with those words having a higher predictability in this context. For instance with (groups of) words referring to (groups of) words of the preceding sentence, and with terms coding concepts activated by this preceding sentence.

This tendency would explain, among other things, the rule "old before new" or "topic before comment". This doesn't exclude the possibility that there exist tendencies running in opposite direction, such as Givón's principle of the "more important or urgent" to be placed first in the string (cf. Givón 1984, 1990). From the debate (e.g., Chafe 1994, Siewierska 1988) evoked by Givón's suggestion, I would conclude that both tendencies are involved in the programming of speech acts and writing: Cases supporting "old before new" are longer strings of sentences, especially when "programmed" and produced by the very same person. Cases supporting Givón's principle may be impromptu speech, as in a vehement dispute or in rather isolated sentences.

5.1 Word frequency and word order in freezes

In the context of "freezes", the above stated tendency to place informationally poorer elements at the beginning of a string means placing more frequent words

before less frequent words (Fenk-Oczlon 1989a). In freezes, i.e., frozen conjoined expressions or binomials, such as *knife and fork*, *peak and valley*, *salt and pepper*, convention lays down the order of the words. Many rules and principles have been suggested to explain the word order in freezes. The suggestions range from those based on the particular language in question to universal principles (e.g., Cooper and Ross 1975, Malkiel 1959, Sobkowiak 1993).

In a former study (Fenk-Oczlon 1989a) arguments were presented to support the view that the rule "more frequent before less frequent" represents a principle that is superordinate to rules previously proposed by others. Cooper and Ross for instance emphazise the importance of a semantic "me first" principle: concepts and qualities that describe the prototypical speaker, or best apply to him, tend to occupy first position in freezes. Freezes, for which no semantic explanations seem to apply, are explained by Cooper and Ross on the basis of phonological constraints. But the phonological rules are, as shown in Section 3, an expression of the higher frequency of the first word as compared to the second. And the prototypical speaker is the statistically normal case, i.e., the more frequent one. (Although it is very interesting to discover the reasons for the greater frequency of particular speaker characteristics, be they of a biological, psychological, or sociocultural nature).

I tested the new rule "more frequent before less frequent" on 400 freezes from English, Russian and German, using statistical data and comparing it with four other rules that have been proposed: "short before long", "the first word has fewer initial consonants than the second", "front vowel before back vowel" , and "semantic principles" (such as the me-first principle). The frequency rule was found to achieve the highest predictive accuracy, with 84% correct predictions. The next best rule (rule "semantic") failed to apply to more than 60% of the freezes, and this despite the fact that this rule actually stood for a whole group of rules ("semantic principles"). The rule "short before long" was even less successful, although it is closely connected with our rule in that the more frequent is mostly encoded as the shortest. The rule "short before long" could not even be applied to 244 freezes since the first word and the second word, measured in terms of the number of syllables were equally long. The rule "front vowel before back vowel" applied to 28% of the freezes, and the rule "the first word has fewer initial consonants than the second" to 17.5%. To explain freezes that represent exceptions to the frequency rule, such as *rise and fall*, *birth and death*, *past and present*, *upstairs and downstairs*, *ascending and descending* recourse was taken primarily to the iconic coding of spatial–temporal relationships.

According to Cooper and Ross words which are "easier to process" tend to occupy the first place in freezes. The results outlined above specify those conditions under which a unit is "more easily processed": it is above all more easily processed if it has—at least in similar contexts—become familiar as a result of frequent use.

6. Conclusion

Relative frequency—overall token frequency as well as relative frequency within specific contexts—has strong effects on cognitive processes which on their part influence diachronic changes such as phonetic reduction and linguistic variables such as length of morphological forms or word order in freezes. These wide ranging effects have in common that they contribute to a rather even distribution of information over the time, i.e., to a relatively constant flow of linguistic information. An upper limit on the fluctuation of the information flow seems to result from cognitive capacity limits (e.g., the psychological present) of language users, and a lower limit from economy principles avoiding too much redundancy in communication. Thus, the effects and regularities described underscore the economy and efficiency of linguistic communication.

Notes

1. These theoretical considerations, including the examples illustrating the explanatory power of frequency arguments, are, with the exception of a paragraph concerning neurophysiological arguments, a synopsis of relevant passages in Fenk-Oczlon (1990a and 1991).
2. In the technical jargon of EEG-studies the "wave crests" appearing in EEG-recordings are referred to as "negative components", and the "wave troughs" as "positive components".

References

Alexander, J. D. 1988. "Aphesis in English". *Word* 39: 29–65.

Baddeley, A., Gathercole, S. and Papagno, C. 1998. "The phonological loop as a language learning device". *Psychological Review* 105(1): 158–73.

Barinova, G. A. 1971. "Redukcija vypadenie intervokal'nych soglasnych v razgovornoj reči". In *Fonologič eskie podsistemy*, S. S. Vygotskij *et al.* (eds.), 117–27. Moskau: Nauka.

Barsalou, L. W. 1985. "Ideals, central tendency, and frequency of instantiations as determinants of graded structure in categories". *Journal of Experimental Psychology: Learning, Memory, and Cognition* 11: 654–92.

Breu, W. 1980. *Semantische Untersuchungen zum Verbalaspekt im Russischen*. München: Sagner.

Bybee, J. L. 1985. *Morphology*. Amsterdam/Philadelphia: John Benjamins.

Bybee, J. L.1994. "A view of phonology from a cognitive and functional perspective". *Cognitive Linguistics* 5(4): 285–305.

Chafe, W. (1994). *Discourse, Consciousness, and Time*. Chicago/London: University of Chicago Press.

Cooper, W. and Ross, J. R. 1975. "World order". In *Papers from the Parasession on Functionalism*, R. E. Grossman, *et al.* (eds.), 11–63. Chicago: Chicago Linguistic Society.

Donegan, P. and Stampe, D. 1979. "The study of Natural Phonology". In *Current Approaches to Phonological Theory*, D. Dinnsen (ed.), 126–73. Bloomington: Indiana University Press.
Dressler, W. U. 1984. "Explaining Natural Phonology". *Phonology Yearbook* 1: 29–50.
Dressler, W. U., Mayerthaler, W., Panagl, O. and Wurzel W. U. 1987. *Leitmotifs in Natural Morphology*. Amsterdam/Philadelphia: John Benjamins.
Ertel, S. 1977. "Where do the subjects of the sentences come from?". In *Sentence Production Developments in Research and Theory*, S. Rosenberg (ed.), 141–68. Hillsdale, N.J.: Lawrence Erlbaum.
Fenk, A. 1977. "Zum Einfluß von Sinnesmodalität und Informationsgehalt von Zeichen auf den Ablauf kognitiver Prozesse". In *Bericht über den 30. Kongreß der DGfP in Regensburg 1976*, W. H. Tack (ed.), 114–16. Göttingen: Hogrefe.
Fenk, A. 1986. "Informationale Beschränkungen der Wissenserweiterung". *Zeitschrift für experimentelle und angewandte Psychologie*, 32(2): 208–53.
Fenk, A. and Fenk, G. 1980. "Konstanz im Kurzzeitgedächtnis—Konstanz im spachlichen Informationsfluß?". *Zeitschrift für experimentelle und angewandte Psychologie* 27: 400–14.
Fenk, A. and Fenk-Oczlon, G. 1993. "Menzerath's law and the constant flow of linguistic information". In *Contributions to Quantitative Linguistics*, R. Köhler and B. B. Rieger (eds.), 11–31. Dordrecht: Kluwer Academic Publishers.
Fenk, A. and Vanoucek, J. 1992. "Zur Messung prognostischer Leistung". *Zeitschrift für experimentelle und angewandte. Psychologie* 39(1): 18–55.
Fenk-Oczlon, G. 1987/1988. "Prototypentheorie und Frequenz". *Klagenfurter Beiträge zur Sprachwissenschaft*, 13/14: 138–50.
Fenk-Oczlon, G. 1989a. "Word frequency and word order in freezes". *Linguistics* 27: 517–56.
Fenk-Oczlon, G. 1989b. "Geläufigkeit als Determinante von phonologischen Back-grounding-Prozessen". *Papiere zur Linguistik* 40: 91–103.
Fenk-Oczlon, G. 1990a. "Ökonomieprinzipien in Kognition und Kommunikation". In *Spielarten der Natürlichkeit—Spielarten der Ökonomie*, N. Boretzky, W. Enninger, T. Stolz (eds.), 37–50. Bochum: Brockmayer.
Fenk-Oczlon, G. 1990b. "Ikonismus versus Ökonomieprinzip. Am Beispiel russischer Aspekt- und Kasusbildungen". *Papiere zur Linguistik* 40: 46–69.
Fenk-Oczlon, G. 1991. "Frequenz und Kognition—Frequenz und Markiertheit". *Folia Linguistica* 25: 361–94.
Fenk-Oczlon, G. and Fenk, A. 1999. "Cognition, quantitative linguistics, and holistic typology". *Linguistic Typology* 3(2): 151–77.
Fidelholtz, J. L.1975. "Word frequency and vowel reduction in English". *Papers of the Chicago Linguistic Society* 11: 200–14.
Fucks, W. 1956. "Die mathematischen Gesetze der Bildung von Sprachelementen aus ihren Bestandteilen". *Nachrichtentechnische Fachberichte* 3: 7–21.
Givón, T. 1984. *Syntax: A Functional-Typological Introduction.* Volume1. Amsterdam/Philadelphia: John Benjamins.

Givón, T. 1990. *Syntax: A Functional-Typological Introduction.* Volume 2. Amsterdam/Philadelphia: John Benjamins.
Goldinger, S. D. 1998. "Echoes of echoes? An episodic theory of lexical access". *Psychological Review* 105(2): 251–79.
Greenberg, J. H. 1966. *Language Universals*. The Hague: Mouton.
Haiman, J. 1983. "Iconic and economic motivation". *Language* 59: 781–819.
Haiman, J. 1985. *Natural Syntax: Iconicity and Erosion*. Cambridge: Cambridge University press.
Hooper, J. L. 1976. "Word frequency in lexical diffusion and the source of morphonological change". In *Current Trends in Historical Linguistics*, W. M. Christie Jr. (ed.), 96–105. Amsterdam: North Holland.
Hughes, A. and Trudgill, P. 1979. *English Accents and Dialects*. Baltimore: University Park Press.
Isačenko, A. V. 1968. *Die russische Sprache der Gegenwart. Teil I. Formenlehre*. München: Hueber.
Jakobson, R. 1939/1971. "Zur Struktur des russischen Verbums". In *Roman Jacobson Selected Writings II*, 3–15. The Hague: Mouton.
Jespersen, O. 1933. "Voiced and voiceless fricatives in English". In *Selected Writings of Otto Jespersen*, 346–426. London: G. Allen and Unwin Ltd.
Josselson, H. 1953. *The Russian Word Count*. Detroit: Wayne University Press.
Kahnemann, D., Slovic, P. and Tversky, A. 1982. *Judgement under Uncertainty: Heuristics and Biases*. New York/Cambridge: University Press.
Kutas, M. and Hillyard, S. A. 1980. "Event-related brain potentials to semantically inappropriate and surprisingly large words". *Biological Psychology* 11: 99–116.
Kypriotaki, L. 1973. "Aphaeresis in rapid speech". *American Speech* 45: 69–77.
Malkiel, Y. 1959. "Studies in irreversible binomials". *Lingua* 8: 113–60.
Mańczak, W. 1980. "Frequenz und Sprachwandel". In *Kommunikationstheoretische Grundlagen des Sprachwandels*, H. Lüdtke (ed.), 37–79. Berlin/New York: Walter de Gruyter.
Mandelbrot, B. 1954. "Structure formelle des textes et communication. Deux etudes". *Word* 10: 1–27.
Maslov, J. S. 1958. *Rol' tak nazyvaemoj perfektivacii i imperfektivacii v processe voznikovenija slavjanskogo glagol'nogo vida*. Moskva.
Mayerthaler, W. 1981. *Morphologische Natürlichkeit*. Wiesbaden: Athenaion.
Mayerthaler, W. 1982. "Markiertheit in der Phonologie". In *Silben, Segmente, Akzente*, T. Vennemann (ed.), 205–46. Tübingen: Niemeyer.
Mayo, P. J. 1985. *The Morhology of Aspect in the Seventeenth Century Russian*. Columbus/Ohio: Slavica Publishers.
Neisser, U. 1967. *Cognitive Psychology*. New York: Appleton-Century-Crofts.
Neville, H. J., Kutas, M., Chesney G. and Schmidt, A. L. 1986. "Event-related potentials during initial encoding and recognition memory of congruous and incongruous words". *Journal of Memory and Language* 25: 75–92.
Nosofsky, R. M. 1988. "Similarity, Frequency, and Category Representations". *Journal of Experimental Psychology: Learning, Memory, and Cognition* 14: 54–65.

Osterhout, L. Bersick, M., and McKinnon, R. 1997. "Brain potentials elicited by words: word length and frequency predict the latency of an early negativity". *Biological Psychology* 46: 143–68.

Phillips, B. S. 1984. "Word frequency and the actuation of sound change". *Language* 60: 320–42.

Rockstroh B., Elbert, T., Birbaumer, N. and Lutzenberger, W. 1982. *Slow Brain Potentials and Behavior*. Baltimore and Munich: Urban and Schwarzenberg.

Ross, J. R. 1980. "Ikonismus in der Phraseologie". *Zeitschrift für Semiotik* 2: 39–56.

Rosch, E. H. 1975. "Cognitive representations of semantic categories". *Journal of Experimental Psychology. General* 104: 192–233.

Siewierska, A. 1988. *Word order Rules*. London/New York/Sydney: Croom Helm.

Smith, M. E. and Hallgren, E. 1987. "Event-related brain potentials during lexical decision: Effects of repetition, word frequency, pronounceability, and concreteness". In *Current Trends in Event-Related Potential Research. EEG Suppl. 40*, R. Johnson Jr., J. W. Rohrbaugh and R. Parasuraman (eds.), 417–21. Amsterdam: Elesevier Science Publishers.

Sobkowiak, W. 1993. "Unmarked-before-marked as a freezing principle". *Language and Speech* 36: 393–414.

Šteinfeld, E. 1963. *Russian Word Count*. Tallin.

Thorndike, E. L. and Lorge, I. 1944. *The Teachers Word Book of 30000 Words*. New York: Columbia University.

Tiersma, P. M. 1982. "Local and general Markedness". *Language* 58: 832–49.

Walter, W. G. 1964. "The contingent negative variation. An electrical sign of significance of association in the human brain". *Science* 146: 434.

Zasorina, L. N. 1977. *Častotnyj slovar' russkogo jazyka*. Moskau.

Zipf, G. K. 1929. "Relative frequence as a determinant of phonetic change." *Harvard Studies in Classical Philology* 40: 1–95.

In the series TYPOLOGICAL STUDIES IN LANGUAGE (TSL) the following titles have been published thus far:

18. HAIMAN, John & Sandra A. THOMPSON (eds): *Clause Combining in Grammar and Discourse*. 1988.
19. TRAUGOTT, Elizabeth C. and Bernd HEINE (eds): *Approaches to Grammaticalization, 2 volumes (set)* 1991
20. CROFT, William, Suzanne KEMMER and Keith DENNING (eds): *Studies in Typology and Diachrony. Papers presented to Joseph H. Greenberg on his 75th birthday*. 1990.
21. DOWNING, Pamela, Susan D. LIMA and Michael NOONAN (eds): *The Linguistics of Literacy*. 1992.
22. PAYNE, Doris (ed.): *Pragmatics of Word Order Flexibility*. 1992.
23. KEMMER, Suzanne: *The Middle Voice*. 1993.
24. PERKINS, Revere D.: *Deixis, Grammar, and Culture*. 1992.
25. SVOROU, Soteria: *The Grammar of Space*. 1994.
26. LORD, Carol: *Historical Change in Serial Verb Constructions*. 1993.
27. FOX, Barbara and Paul J. Hopper (eds): *Voice: Form and Function*. 1994.
28. GIVÓN, T. (ed.) : *Voice and Inversion*. 1994.
29. KAHREL, Peter and René van den BERG (eds): *Typological Studies in Negation*. 1994.
30. DOWNING, Pamela and Michael NOONAN: *Word Order in Discourse*. 1995.
31. GERNSBACHER, M. A. and T. GIVÓN (eds): *Coherence in Spontaneous Text*. 1995.
32. BYBEE, Joan and Suzanne FLEISCHMAN (eds): *Modality in Grammar and Discourse*. 1995.
33. FOX, Barbara (ed.): *Studies in Anaphora*. 1996.
34. GIVÓN, T. (ed.): *Conversation. Cognitive, communicative and social perspectives*. 1997.
35. GIVÓN, T. (ed.): *Grammatical Relations. A functionalist perspective*. 1997.
36. NEWMAN, John (ed.): *The Linguistics of Giving*. 1998.
37. RAMAT, Anna Giacalone and Paul J. HOPPER (eds): *The Limits of Grammaticalization*. 1998.
38. SIEWIERSKA, Anna and Jae Jung SONG (eds): *Case, Typology and Grammar. In honor of Barry J. Blake*. 1998.
39. PAYNE, Doris L. and Immanuel BARSHI (eds.): *External Possession*. 1999.
40. FRAJZYNGIER, Zygmunt and Traci S. CURL (eds.): *Reflexives. Forms and functions*. 2000.
41. FRAJZYNGIER, Zygmunt and Traci S. CURL (eds): *Reciprocals. Forms and functions*. 2000.
42. DIESSEL, Holger: *Demonstratives. Form, function and grammaticalization*. 1999.
43. GILDEA, Spike (ed.): *Reconstructing Grammar. Comparative Linguistics and Grammaticalization*. n.y.p.
44. VOELTZ, F.K. Erhard and Christa KILLIAN-HATZ (eds.): *Ideophones*. n.y.p.
45. BYBEE, Joan and Paul HOPPER (eds.): *Frequency and the Emergence of Linguistic Structure*. 2001.
46. AIKHENVALD, Alexandra Y., R.M.W. DIXON and Masayuki ONISHI (eds.): *Non-canonical Marking of Subjects and Objects*. n.y.p.
47. BARON, Irene, Michael HERSLUND and Finn SORENSEN (eds.): *Dimensions of Possession*. n.y.p.

A full list of titles published in this series is available from the publisher.