The Complexity Envelope of Languages

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1   What is meant by complexity?

A system is complex when it contains many elements which interact with each other in manifold ways. To judge whether a language is complex one must consider different levels. For instance, German is morphologically complex but lexically more transparent and consistent than English.

1.1   Quantitative complexity

There is <u>quantitive complexity</u> – for instance, the amount of morphology a language may show or the number of sound contrasts it utilises. Example: Finnish has a huge array of morphological cases. However, it does not have a distinction between masculine and feminine for the third person singular. The question to be answered here is whether certain categories count as contributing more to complexity than others.

1.2   Structural complexity

There is <u>structural complexity</u> which depends on the manner in which a language organises its formal contrasts. Structural complexity increases when a language goes against preferences in language in general. For instance, there would seem to be a preference favouring lexical stem constancy and this is borne out by the acquisition of weak verbs before strong with children acquiring a Germanic language. Thus a language which has grammatical categories indicated by the alteration of lexical stems can be classified as structurally complex, e.g. *sing ~ sang ~ sung* alongside *talk ~ talked ~ talked*. Another example of this phenomenon would be the use of umlaut to indicated plurality, so *Sohn ~ Söhne* in German, rather than *son ~ sons* in Egnlish, is structurally more complex as the lexical stem *Sohn* 'son' is altered (apart from the fact that the plural is doubly marked by the umlaut and the affix -*e*).

      In sound systems, one might be tempted to count the number of contrasts and develop a complexity metric on that. However, this is quantitative complexity. A language can have a large number of sound contrasts but if these are arranged symmetrically then the value for structural complexity is low. For instance, if a language has arrays of sounds based on a voiced ~ voiceless (English, German) or palatal ~

non-palatal (Russian, Polish, Irish) or a plain ~ emphatic (Arabic) distinction then it has a high value for symmetry and hence a lower value for structural complexity than a language with mixed types of distinctions.

Symmetry diminishes structural complexity as it contributes to the organisational regularity of a language. Examples form other levels of language are, for instance, transparent word-formational elements or sets of distinctions such as perfective and imperfective verb forms in Russian.

1.3   Cognitive complexity

There is cognitive complexity – when structures present difficulties in mental processing. However, this is notoriously difficult to determine. One might think from an external perspective that a language is cognitively complex, e.g. Turkish is aggluntinative with lexical stems potentially carrying several affixes indicating morphological categories such as number, person and/or possession. Is this cognitively complex? Not for Turkish native speakers who grasp the principle in early childhood and adhere to it as adults. In fact, agglutinative languages – like Finnish – are very stable across time.

Cognitive complexity can be illustrated by processes which might appear formally simple but which are difficult to process mentally. A well-known example is recursive embedding in syntax. English only really allows one cycle of such embedding as in *The man the girl knew died suddenly*. Already with two cycles speakers have difficulties processing such structures, e.g. *The doctor the patient whose child was sick visited is a physician* (prosodic marking might help here but it is not an infallible solution to the processing issue).

Short-term memory imposes limits on variation and complexity in language. For instance, German allows negators (such as *nicht*) in final position in subordinate clauses. The latter can be quite long, but it is really only in written language (or language read from a written source) that such subordinate clauses are noticeably long, given the limitations of short-term memory, e.g. *Der Dozent behauptet, er kennt den Studenten, der seinen Essay nur unvollständig vorbereitet, fertiggestellt und ausgedrückt hat und diesen auch noch verspätet abgegeben hat, nicht*. 'The lecturer claimed that he did not know the student who had only imcompletely prepared, finished and printed his essay and who had also handed it in too late.'

In more general terms one can maintain that where there is a high degree of correspondence between form and meaning in a language there is a low level of cognitive complexity. Synthetic languages, and to a greater degree polysynthetic languages, are cognitively complex because of the opaque and polyfunctional nature of many of their morphemes. On the other hand, formally unrealised semantic categories would contribute to cognitive complexity as they would rely on auxiliary categories for their indication. For instance, nouns which are indentical in the singular and plural must be separated by different verb forms for singular and plural, e.g. *The sheep are in the pen*. Only where category indication is achieved by a semantically closely related element would there be no increase in cognitive complexity, e.g. with quantifiers and nouns as in *He paid twenty pound for the wood*.

2   The complexity envelope of languages

When considering complexity across languages a major issue is determining what the

limits of complexity are, both upwards – how complex can a language be – and downwards – how simple can a language be. Examining cross sections of languages shows that there are no pre-set limits. For instance, there is no language with just three phonemes and none with 300. But the limits are not set by some formal criterion but probably determined by the necessity to differentiate words formally. With three phonemes this would be an impossible task, but Hawai'ian can make do with as few as eight consonant phonemes (depending on how one interprets t ~ k and w ~ v) by extending the lengths of words to realise lexical differentiation. The upper limit to sound contrasts is given by the limited number of places and manners of articulation, but also by what is sufficient to achieve unique sound shapes for the 20-30,000 words (types) which a language would typically have.

Trade-offs in complexity

Sometimes there would appear to be trade-offs in phonology: Castilian Spanish has significant consonant lenition, chiefly for word-internal and -final /b, d, g/, but no vowel reduction and little if any vowel liaison. Portuguese, on the other hand, does not have this kind of consonantal allophony but has much more vowel variation and many more vowel contractions.

Physical limits to phonological complexity

There are limits posed by what humans can articulate. For instance, consonant clusters typically have two elements, sometimes three with certain phonotactic restrictions, e.g. in English initial clusters the first element must be /s/ followed by a stop and a sonorant as in *split* or *strong*. However, phonotactics tends to be language-specific, e.g. clusters of labial nasal and sonorant are not allowed in English but common in Slavic languages, e.g. *mleko* 'milk' in Polish. Whether a language can get by without vowels is an issue which was discussed some decades ago with reference to Kabardian, a Caucasian language for which all vowel values would appear to be predictable from consonantal environment. There would also seem to be built in preferences in languages for the sound structure of words: the obligatory contour principle has been applied to segmental phenomena to show that the sucession of unlike elements is favoured cross-linguistically.

Memory effects again

Native speakers master three genders effortlessly. Speakers of German and Russian, for instance, know without consciously reflecting which of three genders any object of their world belongs to. This means that humans have the ability to store this type of information with each noun during first language acquisition. So humans can remember one of three genders for any noun, but could they remember any of five or 10 or 20 genders? To answer that question one must consider the rise of gender diachronically. There are probably no grammaticalisation processes which might give rise to 10 different articles for nouns in a language so the situation never arises. So the statement should not be, '10 genders are impossible in a human language' but rather 'no known diachronic process could lead to the rise of 10 distinct gender markers in any language'.

3 The social determinants of linguistic complexity

Language contact

In his discussion of simplification and complexification during language contact Trudgill (2012: 33f.) stresses the important fact that simplification is not a characteristic of contact during childhood for speakers because young learners can master complex linguistic systems they may be exposed to whereas adults do not show mastery of complex grammatical categories to any like the same extent. It is perhaps not valid to claim that long-term contact involving children always leads to complexification but it is true to say that it does not lead to simplification. Trudgill's reference to the critical threshold for language acquisition (2012: 35) is very pertinent in this context.

The distinction between first and second language learners is crucial to both structural and cognitive complexity. For instance, the acquisition of categories such as grammatical gender which is not semantically motivated proves difficult for second language learners but not for children acquiring such a system. Anything which is within the complexity envelope of human language is acquired by children effortlessly, irrespective of whether it is semantically motivated or not.

Language isolation

Trudgill maintains (2012: 116-146) that langauges which exist in low-contact situations for long periods of time tend to develop 'spontaneous complexification'. This is carried by the dense networks existing in long-term stable communities and would seem apply to geographically isolated regionsl like the Caucasus or Papua New Guinea. But of course there are cases where this is not the case, such as the many islands of Polynesia. Some languages on these islands, for instance Hawai'ian, have actually reduced the already simple phoneme inventory of Proto-Polynesian. Trudgill (2012: 124-129) seeks to explain this by maintaining that reducing the sound contrasts in a language increases complexity in terms of the effort required to process words and of the high degree of (near-)homophones. But surely it is not necessary to resort to such explanations. The necessary observation would be that complexification, at least an increase in quantitative and/or structural complexity, can occur in low-contact isolated communities but it does not need to (Trudgill 2012: 146). Such complexification would be permissible within the complexity envelope of human languages but it does not have to occur.

Language shift

When speakers are not only in contact with another language but actively change to it they may transfer categorial distinctions of the outset language to the target language. By doing this they are often adding categories to the target language and hence increasing its complexity. It would be difficult to devise a satisfactory complexity metric for language shift varieties as the latter often involve a neglect of existing grammatical categories in the target language. For instance, in vernacular forms of Irish English there are several additional aspectual distinctions, e.g. an immediate and a resultative perfective as in *He's after crashing the car; She has the dinner cooked*, but these forms of Irish English are noted for their neglect of the present perfect, e.g. *I know her since a long time.*

Irregularity and complexity

(i) lack of isomorphy: the expression of plurals is normally via *-s* in English with a small class of non-conforming nouns: *fish ~ fish, foot ~ feet, child ~ children*. A language with a low degree of isomorphy would be structurally complex.

(ii) increase in polyfunctionality of form: *-en* in present-day German: 1) weak adjectival ending 1a) masculine accusative. *Sie hat einen neuen Wagen gekauft* 'She bought a new car'. 1b) nominative plural *die schönen Wagen* 'the beautiful cars'; 2) plural inflection, usually feminine, *die Frauen* 'the women'; 3) verbal area: 3a) infinitive ending *gehen* 'to go', 3b) third person plural ending, *Sie gingen weg* 'They departed', 3c) ending for past participle of strong verbs, *Er hat ein Lied gesungen* 'He sang a song'.

(iii) unpredicability of grammatical categories/relations (rule exceptions): *-nis* usually signals neuter nouns in German, *das Verhältnis* 'the relationship', *das Verhängnis* 'the disaster', but there are a few exceptions (all feminine): *die Erkenntnis* 'insight', *die Erlaubnis* 'permission', *die Finsternis* 'darkness'.

N.B. This type of complexity is never an issue for native speakers: none of them every gets the gender of a *-nis* word wrong, for example.

Redundant marking and complexity

It is a moot point whether redundant marking is a signal of complexity in a language. Here one must distinguish different levels. On the formal level this is true: if a category like person on a verb is marked twice, e.g. via an affix and a personal pronoun, then formally it is more complex, e.g. in Italian *Parli rapidamente* 'You speak quickly' is less complex than *Tu parli sempre con lui?* 'You always speak to him?' because the ending *-i* already indicates the second person singular present for a verb, hence the use of *tu* is redundant. But it is not necessarily cognitively more complex as the double marking in the verb phrase makes it easier to grasp in less than optimal communication situations and this marking is semantically transparent (the personal pronoun *tu* is known in the language anyway). The same could be said of the many cases of grammaticalisation through phonetic/semantic bleaching, cliticisation and affixation: the formal complexity which this entails can result in less cognitive complexity as the redundant marking of grammatical categories allows for easier reference tracking in discourse.

Complexity during the transition in language type

Over very long periods of time languages can alter their linguistic type. The switch from synthetic to analytic is well-known as it is characteristic of so many modern Indo-European languages. But there are other types, e.g. the switch from an inflectional language to one using initial mutation as the main means to indicate major grammatical categories. At any one point in time one will have a snap-shot in the long-term development of a language and during a period of transition the language will be in a state of relatively high complexity due to the presence of two typological principles. This complexity may decrease later when the new typological principle becomes fully

established in the language as was the case with the development from Continental Celtic to Old Irish and then to Modern Irish.

The social function of complexity?

Complexity is the sense of formal unprectibablity, i.e. distributional irregularity, can often be a feature of a variety which is maintained by a community not wishing to expand to other social groups. In Received Pronunciation there is a split among low *a*'s, known as the TRAP-BATH split, which manifests itself as [æ] or [ɑ:] in certain words, e.g. *trap* [træp] and *bath* [bɑ:θ]. The problem here is that the distribution is largely lexicalised and so cannot be guessed by adult outsiders wishing to emulate RP. Only if one acquires RP natively, i.e. belongs to the community of RP speakers from the beginning, does one master the irregular distribution of the TRAP-BATH split.

A major insight of research on numerically small languages, and highlighted in Trudgill (2012), is that in low-contact, densely-knit communities, language structure can be especially complex, above all on the closed levels, i.e. in phonology and morphosyntax. It would seem that certainly cognitive distinctions, such as duality or evidentiality, are more significant in communities consisting of small, highly integrated numbers of speakers and hence their expression, in the grammatical categories of dual number and evidental affixes, is more likely to be found.

The same would appear to be true of phonological complexity, at least inasmuch as such closely-knit communities have not been subject to the simplifying effect of unguided adult second language acquisition in periods of high contact and so maintain a larger number of sound contrasts which have arisen in small community languages over long periods of time.

References

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