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What *is* duality of patterning, anyway?

Abstract: The notion of duality of patterning (henceforth DoP), at least for readers of this special issue, is probably most closely associated with Charles F. Hockett's project of identifying the 'design features' of language in order to characterise the ways in which human language is unique among biological communication systems (Hockett 1958: chapter 64; Hockett 1960; Hockett and Ascher 1964). Roughly speaking, DoP refers to the fact that the meaningful units of language – words or morphemes – are made up of meaningless units – phonemes or features – whose only function is to distinguish the meaningful units from one another. Stated this way, the idea seems quite straightforward, and to have it explicitly stated as a property of language seems a useful insight. In fact, though, of all the design features discussed by Hockett, DoP seems to have engendered the most confusion. The idea that meaningful units are composed of meaningless ones seems simple enough, but many complications arise when we look more closely. The goal of this short paper is to document some of the complications and perhaps alleviate some of the confusion.

Keywords: duality of patterning, double articulation, design features of language, productivity, Charles F. Hockett, André Martinet, Louis Hjelmslev

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1 'Duality of patterning' vs. 'double articulation'

The explicit identification of DoP as an interesting property of language seems to have taken place twice, largely independently, in Hockett's work and in that of André Martinet. Martinet's version of the idea, under the name 'double

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articulation', was first presented in a well-known paper published in 1949, and elaborated in Martinet's book *Eléments de linguistique générale* (1960, revised 1980). Hockett's thinking about what he originally called 'duality' developed slightly later, first appearing in print in his 1958 textbook *A course in modern linguistics*. The two versions are by no means identical, despite the fact that 'double articulation' is usually treated as synonymous with 'duality of patterning', and it is worth taking the time to explore the similarities and differences between them.

The first thing to note is that both versions appear to be linked, at least indirectly, to Hjelmslev's work on language structure (most accessible in English as Hjelmslev 1953), specifically to his distinction between the 'content plane' and the 'expression plane' of language. Hjelmslev saw lexicon and morphosyntax (on the content plane) and phonological structure (on the expression plane) as two completely separate aspects of language structure, each with its own set of units and its own set of relationships between underlying and surface categories. In order to abstract as far as possible from the physical nature of spoken language, he coined the terms *plereme* and *ceneme* (based on Greek words for 'full' and 'empty' respectively) to refer to the basic units on the two planes. The cenemes of spoken language are phonemes, while the pleremes are morphemes or words, but (as Hjelmslev noted) the cenemes of alphabetic writing are the letters and the pleremes are the words, and the plereme/ceneme distinction can be applied to other types of symbolic systems as well.

It is certain that Hjelmslev's work was known to both Martinet and Hockett, but the extent of his actual influence on either is unclear. Martinet was personally well acquainted with Hjelmslev, and the 1949 paper appeared in a volume dedicated to Hjelmslev, but he seems to have found the degree of abstraction in Hjelmslev's work misguided, and if anything he saw the double articulation notion as standing in opposition to Hjelmslev's idea of two 'planes' (Martinet 1993: 239). Hockett adopted Hjelmslev's terms *plereme* and *ceneme*, and in many ways shared Hjelmslev's taste for the pursuit of structural abstractions, but his interest was focused on the essentially anthropological question of how human communication differs from other biological communication systems.

Regardless of the source of the basic idea, what is perhaps more interesting are the differences of emphasis between Hockett and Martinet. In particular, the difference between the terms 'double articulation' and 'duality of patterning' is potentially revealing, because the two versions suggest different things about the dimensionality of the speech signal. Martinet's version idealises the stream of speech in strongly linear or sequential terms, and asks what kinds of units it is built from: an utterance can be viewed either as a string of words/morphemes or as a string of phonemes (hence '*double* articulation'), but in both cases it is thought of as a one-dimensional string, a succession of units in time. Hockett's

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version emphasises the fact that the meaningful elements of language (the pleremes, or morphemes in the classical structuralist view) are composed of distinctively contrasting but otherwise meaningless elements (cenemes or phonemes); morphemes and phonemes are two different kinds of elements that pattern according to two different kinds of rules or principles (hence 'duality *of patterning*'). Hockett's version thus allows for the possibility that more than one dimension is involved.

This difference can be illustrated with an abstract example. Imagine a symbolic string – an 'utterance' – consisting of three meaningful pleremes each consisting of three ceneme-like symbols. If the utterance is a string XABYEVXEN, we can follow Martinet and segment it either into pleremes (XAB, YEV, XEN) or into cenemes (X, A, B, Y, E, V, X, E, N). However, suppose the utterance takes the following form:

(1) XA $_{Y}$E X
B V EN

Here we can segment the utterance into three pleremes along a single dimension, but we cannot, along the same dimension, segment it into cenemes. The arrangement of cenemes within each plereme involves two dimensions. This is not a problem for Hockett, where the principles governing the arrangement of phonemes within a word are assumed to be different from those governing the arrangement of words within an utterance. But for Martinet, the key idea is that we are dealing with a one-dimensional string, which can be segmented into two different kinds of units. The difference between the two versions is most salient with respect to phonemic tone. For Hockett, tone is no problem, because his version of DoP says only that pleremes have to be composed of cenemes, not anything about how the cenemes have to be arranged. For Martinet, tone is a puzzle, because it conspicuously does not fit the one-dimensional idealisation (see especially Martinet 1980: 83ff).

The terms 'duality of patterning' and 'double articulation' also reflect another difference between Hockett and Martinet. Martinet draws a distinction between the 'primary' and 'secondary' articulations of a symbolic string, the primary articulation being the segmentation into words or morphemes, and the secondary articulation the segmentation into phonemes. This suggests that Martinet regarded the segmentation of the speech stream into meaningful elements (morphemes) as being in some way prior to or more important than the segmentation into meaningless elements (phonemes). No such notion appears in Hockett's work, and nor does Martinet's idea seem to based on anything in Hjelmslev, who – like Hockett – treats the arrangements of pleremes on the 'content plane' and

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the arrangements of cenemes on the 'expression plane' as completely parallel and of equal status. We might paraphrase the difference between the two views in the following subtly different definitions: for Martinet, an utterance is an arrangement of pleremes, which are themselves arrangements of cenemes; for Hockett (and Hjelmslev), an utterance is *simultaneously* an arrangement of pleremes and an arrangement of cenemes[1]. We return to this point in Section 3 below.

2 Duality of patterning and other properties of language

2.1 Productivity

The idea that the articulation into pleremes might take precedence in some way over the articulation into cenemes is relevant to the most important point of confusion and contention in the literature on DoP, namely the relationship between DoP and what Hockett called productivity. Productivity (which Hockett also referred to as 'pleremetic complexity') is the ability to combine meaningful units into new messages with approximately predictable meanings based on the principle of compositionality; this is what gives language the ability to make 'infinite use of finite means'. Hockett is careful to distinguish DoP from productivity, and provides examples of communication systems with one property but not the other. For a system with DoP but without productivity, he imagines a system of visual signals in which a message is composed of a display of five lanterns, each of which can be one of three colours. This makes possible a maximum number of 243 (3^5) distinct messages. The system is closed and therefore has no productivity, but it does, according to Hockett, have DoP: " 'red light in first position' would

1 Hockett states this idea very clearly (1958: 574): "Any utterance in a language consists of an arrangement of the phonemes of that language; at the same time, any utterance in a language consists of an arrangement of the morphemes of that language, each morpheme being variously represented by some small arrangement of phonemes." Martinet does not, so far as I can determine, explicitly reject this Hjelmslevian view, but he does clearly treat one 'articulation' as subordinate to the other: "It is . . . important to make more precise this notion of the articulation of language and to note that it is manifested on two different levels: each of the units that result from a first articulation is actually articulated in turn into units of a different type" (1980: 13, my translation); or again: "Each of these units of the primary articulation, as we have seen, has a meaning and a vocal (or phonic) form. . . . But the vocal form is itself analysable as a succession of units, each of which contributes to distinguishing [one primary unit from others]. This is what we will term the secondary articulation of language." (1980: 14f, my translation).

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not have any separate meaning of its own, but would merely serve to distinguish some messages from others" (1958: 575). The opposite case, says Hockett, is exemplified by the dance of the honeybee: "bee dancing is productive, in that a worker can report on an entirely new source of nectar, but . . . [t]he smallest independently meaningful aspects of a given dance are not composed of arrangements of meaningless but differentiative features . . ." (ibid.: 577).

Despite Hockett's clear examples, the distinction between DoP and productivity is elusive, and various authors have confused or conflated them in some way. In extreme cases they have apparently simply missed the point. For example, in a recent introductory linguistics textbook (Denham and Lobeck 2010: 5) we find the following:

> Duality of patterning: A large number of meaningful utterances can be recombined in a systematic way from a small number of discrete parts of language. For example, suffixes can be attached to many roots, and words can be combined in numerous ways to create novel sentences.

This is difficult to interpret as anything other than an outright misreading: the definition and exemplification it provides refer to productivity, not DoP. But other discussions are less obviously mistaken. For example, Fitch's summary gloss of DoP reads as follows (2010: 19):

> Duality of patterning: Meaningless units (phonemes) are combined into meaningful ones (morphemes), which can then be combined into larger meaningful units (sentences).

Here the final clause could be taken either as providing additional information about morphemes (in which case the definition seems broadly consistent with Hockett's), or as suggesting that the combination of meaningful units into larger meaningful units is itself part of DoP (in which case the definition may conflate DoP and productivity). Similar statements are found in other recent works on the origins of language; for example, Pinker and Jackendoff (2005: 212) define DoP as "the existence of two levels of rule governed combinatorial structure, one combining meaningless sounds into morphemes, the other combining meaningful morphemes into words and phrases."

This apparent linking of DoP and productivity is strongly rejected by Rosselló in her recent extended exegesis (2006) of Hockett's work and its relevance for Chomskyan 'biolinguistics'. She regards any such linkage as a misinterpretation of Hockett, stating that for Hockett, DoP "did not include syntax: it referred to the way sound combines to make words and . . . was conceived just as a lexicalization procedure" (2006: 164). This claim (which is central to Rosselló's defence of Chomsky's views on the evolution of language) seems to be contradicted by a

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passage from Hockett (1958: 574) that she quotes a few paragraphs later: "This is what we mean by 'duality': a language has a phonological system and also a grammatical system." Yet she simply goes on to assert: "Although it is true that the 'grammatical system' could be taken as referring to the arrangements of the morphemes that constitute the utterances, Hockett did not intend this reading" (Rosselló 2006: 165).

It seems clear, therefore, that the distinction between DoP and productivity is not as straightforward as it might appear, and I believe that the nature and extent of this distinction is precisely what is at issue in the difference between Hockett's 'duality of patterning' and Martinet's 'double articulation'. If, with Hockett, we take DoP to mean that utterances can be analysed both as arrangements of meaningful units (words or morphemes) and as arrangements of meaningless units (phonemes), then the link to productivity is tenuous. If, by contrast, we take inspiration from Martinet's notion of a primary and a secondary articulation, we are likely to join Fitch or Pinker and Jackendoff in emphasising that the meaningless units of phonology are composed into meaningful units such morphemes and words, which *in turn* are built into larger phrases and sentences.

2.2 Redundancy and arbitrariness

Productivity is not the only design feature that is sometimes linked to (or confused with) DoP. This can be seen from Eco's references to DoP in the context of his discussion (1995) of the universal philosophical language proposed by the 17th-century English philosopher John Wilkins. Wilkins designed a language based on a supposedly universal set of categories and sub-categories, in which the words of natural languages could be re-encoded in a systematic way. For example, "starting from the major genus of Beasts, after having divided them into viviparous and oviparous, and after having subdivided the viviparous ones into whole footed, cloven footed and clawed, Wilkins arrives at the species Dog/Wolf" (Eco 1995: 239).

Eco seizes on a typographical error in one of Wilkins's examples in order to make a point about a shortcoming of the whole philosophical language project. Wilkins, illustrating a technical point (not relevant here), describes a difference in the way the concepts *tulip* and *ramsom* (garlic) would be encoded in his proposed philosophical language. Because of a typographical error he actually uses the form that means *barley*, not *tulip*. This, says Eco, reveals a fundamental problem:

> in common English, the words *Tulip* and *Barley* are phonetically dissimilar, and thus unlikely ever to be confused with each other. In a philosophical language, however, members

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> of the same species are easy to muddle either phonetically or graphically. The problem is that *in a characteristic language, for every unit of expression one is obliged to find a corresponding content-unit*. A characteristic language is thus not founded – as happens with natural languages – on the principle of double articulation [i.e. DoP], by virtue of which meaningless sounds, or phonemes, are combined to produce meaningful syntagms. This means that in a language of 'real' characters any alteration of a character (or of the corresponding sound) entails a change of sense. (Eco 1995: 249; emphasis in original).

In my view, Eco is only partly right in his diagnosis of the problem. He correctly observes that the immediate cause of the ambiguity is the fact that "any alteration of a character (or of the corresponding sound) entails a change of sense." Expressed in different terms, the problem is therefore a *lack of redundancy*. This lack of redundancy does indeed seem to be built into Wilkins's design; every possible combination of elements is a possible message. But Eco is wrong to suggest that this is because the language lacks DoP. DoP, by itself, is no guarantee of sufficient redundancy to avoid ambiguity. One can perfectly well imagine a language with DoP in which every possible string of meaningless cenemes is associated with some meaning, and hence has no redundancy. Hockett's signalling system with coloured lanterns is one such case: any error in the colour or placement of any lantern will result in a different message, even though the individual combinations of colour and placement are meaningless in themselves.

It is of course true, as Eco (ibid.) says, that "in common English, the words *Tulip* and *Barley* are phonetically dissimilar, and thus unlikely ever to be confused with each other." This might seem to be a consequence of DoP, but in fact it should more properly be attributed to Hockett's 'arbitrariness' – the fact that there is no necessary link between sound and meaning. The phonetic dissimilarity of semantically related words is not a necessary consequence of DoP; it is only facilitated by it. That is, DoP certainly makes it easier and more efficient to operate a large lexicon based on arbitrary sound-meaning links, but the existence of malapropisms like *flaunt/flout* or *anecdote/antidote* (and of course the existence of word families like *glint/glimmer/glisten/glow*) shows that similarity of sound is not completely irrelevant to similarity of meaning. Arbitrariness must be regarded as a design feature in its own right, not merely something that arises because of DoP.

2.3 Linearity

We saw earlier how Hockett and Martinet differ on the treatment of tone and other simultaneous phonological elements. For Hockett, tone raises no obvious contradiction with his definitions of DoP, the essence of DoP being that the arrangement

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of cenemes and the arrangement of pleremes are subject to different principles. For Martinet, though, anything that is not part of a one-dimensional string of elements poses a problem. It is easy to attribute this to Eurocentric and/or alphabetic bias, and no doubt such biases play a role in shaping Martinet's ideas. Yet there may be more to it than that: Martinet emphasises that the linear nature of language results from the fact that it is based on vocal signals: "vocal utterances necessarily unfold in time and are necessarily apprehended by the sense of hearing as a succession. This is very different from the situation with pictorial communication apprehended by the sense of sight. . . . A visual communication system . . . is not linear but two-dimensional." (Martinet 1980: 16f, my translation). Martinet thus attributes much significance to the fact that a (bracketed) one-dimensional string provides a close approximation to *both* phonological and grammatical structure.

The intuition that linearity is a significant property of language seems to be behind the diversity of views about the applicability of the DoP notion to visual communication systems. This diversity can be seen in the literature on both manual signed languages and the Chinese writing system. In both cases, it is clear that the pleremes (signs in the case of signed languages, characters in written Chinese) follow one another in one-dimensional strings, like pleremes in spoken language. In Chinese writing, the one dimension is a physical dimension on the page; in signing, the dimension is that of time. But that single dimension is insufficient for describing the internal structure of the pleremes; the cenemes – assuming we accept that there are cenemes – are bundled into pleremes in multidimensional ways. This has led to widely different views about whether or not these systems exhibit DoP.

In the case of Chinese writing, there are clear claims (e.g. Carstairs-McCarthy 1999: 14f) and implicit suggestions (e.g. Hewes 1973: 11) that Chinese characters do not exhibit DoP. There are equally clear statements that they do (Hansell 2003: 156: Coulmas 1989: 98) – though these authors cite different structural properties as evidence! It is also worth mentioning that there are extensive discussions of the structure of Chinese writing that simply do not raise the matter of DoP at all (e.g. Sproat 2000). Reviewing the issues could constitute a paper in itself and would unfortunately take us too far afield here[2], but what is clear is that there is a complex set of structural elements and principles that govern the internal structure of characters, and that these elements and principles are unrelated to the principles according to which whole characters are assembled into grammatical strings. This would seem to meet the criterion that Hockett suggested in his infor-

2 The whole question is discussed at greater length in my forthcoming monograph.

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mal definition quoted earlier: "This is what we mean by 'duality': a language has a phonological system and also a grammatical system."

As for signed languages, some writers have argued that, because they occur simultaneously, the elements of sign phonology ('cheremes', in the explicitly phonological terminology originally proposed by Stokoe 1960) are more analogous to features than to phonemes. Researchers from outside linguistics seem especially ready to conclude that, because signed language apparently lacks a set of phonological elements that succeed one another in time like segmental phonemes in speech, it lacks some crucial property of 'true' language. For example, in an early response to attempts to teach non-vocal languages to chimpanzees, Healy (1973: 168f.) argued that "cheremes are not entities themselves, but rather, like distinctive features, are attributes or features of the basic linguistic units which are entities" and that therefore "it is still plausible to defend the position that the phonemic aspect of language is unique to humans, and that chimpanzees have not yet been taught and could not learn any phonemic language." For similar reasons, Hewes (1973: 10f) takes it for granted that signed languages lack DoP, and argues that this places limits on the size of the signed lexicon.

To be sure, sign language research within linguistics has discovered and discussed various ways in which sign language phonology does appear to involve linear structure. Liddell (1984) and Liddell and Johnson (1989) noted that signs often involve a hold-move-hold sequence, which can be likened to the basic consonant-vowel-consonant or onset-nucleus-coda structure of a spoken syllable. Broadly similar structural analyses have subsequently been put forth by others (e.g. Sandler 1986; Perlmutter 1992; van der Hulst 1993; Brentari 1998), though the explicit analogy to spoken segments is not universally accepted (e.g. Wilbur 1993). As for the specific question of whether signed languages exhibit DoP, this has been raised (and answered in the affirmative) by Sandler et al. (2011). Yet it seems fair to say that researchers' attention has been directed to these issues precisely because of the force of the sceptics' argument that, if sign phonology lacks linear structure, then signed languages must be different in some essential way from spoken languages. Implicitly, that is, everyone accepts that linearity is a crucial property of phonology.

3 Is one-dimensionality special?

The issue of linearity gives rise to a paradox. If we follow Hockett's view rigorously, we are led to conclude that Chinese writing and signed languages exhibit DoP, because they both have something analogous to a phonological system and a grammatical system. If we follow Martinet in emphasising that DoP involves

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two different ways of segmenting a one-dimensional string, we are likely to conclude that in these visual symbol systems DoP is absent. The paradox is this: the more we tend towards Hockett's definition, the more we acknowledge the primacy that Martinet implicitly grants to the primary articulation into pleremes. That is, the more we accept that cenemes and pleremes may be arranged according to different principles and in different dimensions, the more useful it becomes to distinguish primary and secondary articulation, and to treat cenemes as the building-blocks of *pleremes*, not directly of utterances. It is certainly possible to regard a signed utterance as an arrangement of cheremes or a written Chinese sentence as an arrangement of strokes, but it is perversely uninsightful to do so. Because the organisational principles are so different, it is much more useful to separate the two levels of description. There is something about the fact that Martinet's one-dimensional idealisation of language *almost* works that also makes it plausible to entertain Hockett's contention that a whole utterance is simultaneously an arrangement of phonemes and an arrangement of morphemes. Where the one-dimensional idealisation is obviously inapplicable – as it seems to be for sign and Chinese writing – the very idea of DoP is cast into doubt.

The choice between Martinet's and Hockett's versions of DoP need not, of course, be made solely on the basis of evaluating the insightfulness of descriptions; there is solid empirical evidence that can be brought to bear on the issue as well. In particular, modern psycholinguistics makes it questionable to accept to Hockett/Hjelmslev view that whole utterances are simultaneously arrangements of pleremes and arrangements of cenemes. Rather, the conception of the relation between phonology and syntax implicit in Martinet's distinction between 'primary' and 'secondary' articulation is much more consistent with current widely accepted psycholinguistic theories of speech production (e.g. Levelt 1989), which sharply distinguish phonological encoding from the assembling of words into sentences. Modern psycholinguistic theories also seem to make sense of word-specific phonetic effects (e.g. Pierrehumbert 2002), which are difficult to reconcile with Hjelmslev's rigid dichotomy between the content plane and the expression plane. In short, the structuralist idea that an utterance is both an arrangement of cenemes and an arrangement of pleremes is quite at odds with what we know about how language works in the brain: there is much more justification for saying that an utterance is an arrangement of pleremes, and pleremes are arrangements of cenemes. It appears that we should define DoP as the property of language whereby pleremes have internal structure that is generally based on different elements and different organisational principles from the plerematic structure of phrases and utterances.

However, we still need to address the issue of linearity – the intuition that whatever Chinese writing and signed languages have, it somehow does not quite

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amount to DoP. It is certainly noteworthy that, even though there are aspects of phonological structure that cannot be fitted into a purely one-dimensional model, phonology in all human languages – like syntax – does involve bracketed strings. That is, cenematic structure and pleremetic structure in spoken language, though based on different elements and to some extent on different principles, nevertheless share the crucial formal property of linear or sequential structure. This does not seem to be true of Chinese writing, and is, at best, of limited applicability to signed languages. It may thus be that there is something special about the kind of DoP that spoken language actually exhibits.

If so, this may be explainable in evolutionary terms. It now seems fairly clear that one of the cognitive abilities that evolved as a prerequisite for language is the ability to do complex combinatorics and sequential learning. This ability is certainly needed for compositional syntax, but can also be put to good use in providing a phonological framework for the internal structure of words in a system with DoP. Sequential structure is especially suitable for any communication system based on acoustic signals, which, as Martinet noted, have an inherent linearity along the dimension of time. Human listeners can of course learn to make very fine perceptual distinctions between one brief sound and another (e.g. between different vowel qualities), but if as part of the early growth of language in the species we were also evolving the ability to discriminate sound *sequences*, this would provide an obvious avenue for developing the cenematic organisation of a system with DoP. In signed languages, the visual medium imposes fewer constraints on the discriminability of pleremes, and sequential DoP therefore plays a less important role.

Both Hockett and Martinet have something to tell us. On the one hand, DoP needs to be defined in such a way as to incorporate a hierarchical relation between pleremetic and cenematic structure: here we follow Martinet, not Hockett and Hjelmslev. On the other hand, we also need to allow for the possibility that cenematic structure *can* have patterns of organisation and dimensionality that are markedly different from pleremetic structure, as in signed languages and Chinese writing; here we follow Hockett and Hjelmslev, not Martinet. Yet in integrating these two viewpoints, it is important to acknowledge that in spoken language, the one-dimensional structure characteristic of syntax is extensively exploited for phonology. Cenematic structure, formally defined, need not mimic pleremetic structure, but it is an empirical fact that in spoken language it does so.

For this reason it may be that the emergence of DoP in the evolutionary history of language involves no essentially new type of organisation, but is merely the application of complex combinatoric principles at different levels in a hierarchical structure. If that is true, then we would have reason to view human combinatoric abilities as a unified evolutionary advance that could underlie both

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phonology and syntax. In any case, a better understanding of what DoP is and is not should eventually lead to a better understanding of how our species acquired language in the first place.

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