Languages Evolve in Punctuational Bursts

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American English emerged abruptly when Noah Webster introduced his *American Dictionary of the English Language*, insisting that "as an independent nation, our honor requires us to have a system of our own, in language as well as government" (*1*). Punctuational or rapid bursts of change associated with the emergence of new languages, or at later language contact, have been proposed as an important feature of language evolution (*2*, *3*), echoing a long-standing parallel debate in biology (*4*, *5*). Webster's actions illustrate how the desire for a distinct social identity may cause languages to change rapidly (*6*, *7*), but whether such punctuational change is a regular feature of human language evolution has never been demonstrated (*2*). With use of three of the world's major language families comprising over one-third of all the world's languages, we found that punctuational bursts of change at the time of language splitting are an important and general process in language evolution and account for 10 to 33% of the total divergence among these languages in their fundamental vocabularies.

We studied punctuational evolution in phylogenetic trees of language families inferred from vocabulary data (*8*). These trees describe the separate paths of evolution leading from a common ancestral language to the set of observed extant languages at the tips of the tree (Fig. 1A). The lengths of the individual branches of the trees record the amount of lexical divergence (replacement of words) between an ancestral and a descendant language. If lexical divergence is a gradual process that is not affected by the emergence of a new language, then the path length or total distance from the root of the tree to the languages at the tips should be independent of the number of language-splitting events or nodes found along that path. If language-splitting events produce punctuational bursts of evolution, however, we expect to find more total lexical divergence (longer path lengths) along paths through the tree that record more language-splitting events (*4*, *8*, *9*).

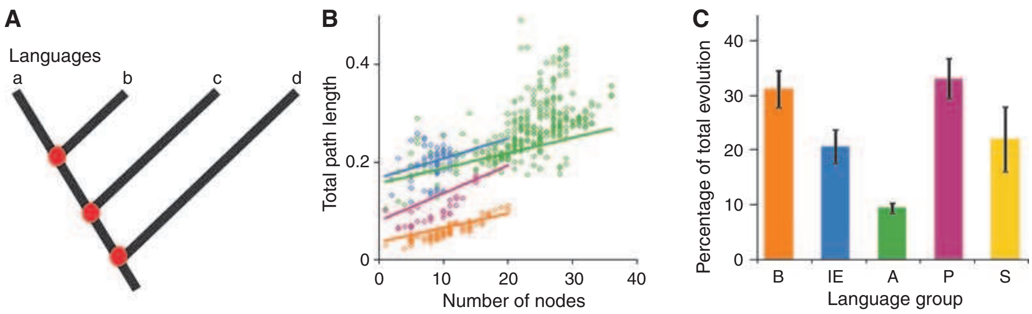

Fig. 1. Inferring punctuational language evolution. (**A**) Tree of four languages. If language-splitting events (red nodes) cause bursts of change, the paths from the root to a and b should be longest, followed by c then d (*8*); here, they are all equal. (**B**) Root-to-tip path length plotted against number of nodes along each path for punctuational trees in Bantu (orange), Indo-European (blue), Austronesian (green), and Polynesian (purple). Fitted lines show the relationship between path length and nodes after controlling for phylogeny (*8*). A positive slope is indicative of punctuational evolution. Path lengths for each data set were scaled to account for the number of characters examined. (**C**) Histogram showing the percentage of lexical evolution attributable to punctuational bursts at language-splitting events (mean ± SD) for Bantu (B, orange), Indo-European (IE, blue), Austronesian (A, green), and Polynesian (P, purple) (*8*). For comparison, the percentage of molecular evolution attributable to punctuational effects in biological species is also shown (S, yellow) (*4*).

In each language family, we found significantly more lexical change along paths in which more new languages have emerged, the signature of punctuational evolution (Fig. 1B). These results take into account the phylogenetic relationships among languages, control for a well-known artifact of phylogenetic reconstruction (*10*), and cannot be attributed to borrowing of vocabulary (*8*). The punctuational effects account for a surprising amount of the total lexical divergence among the languages (Fig. 1C): 31% of vocabulary differences among Bantu language speakers arose at or around the time of language-splitting events, 21% among Indo-European languages, and 9.5% in Austronesian (*8*). In the settlement of the Pacific, successive founder events (a small group colonizing a new location) by Polynesian language speakers may have caused increased rates of language change (*11*). Consistent with this, we inferred a stronger punctuational effect in the Polynesian subclade of the Austronesian tree, contributing to about 33% of lexical differences among these languages (Fig. 1C, purple bar). These effects are comparable in size to punctuational genetic changes observed among biological species (~22%; Fig. 1C, yellow bar) (*5*).

Our results, representing thousands of years of language evolution, identify a general tendency for newly formed sister languages to diverge in their fundamental vocabulary initially at a rapid pace, followed by longer periods of slower and gradual divergence. Punctuational bursts in phonology, morphology, and syntax, or at later times of language contact, may also occur. Linguistic founder effects could cause these rapid changes if newly formed languages emerge in small groups, such as in Austronesian. Alternatively, as the example of American English illustrates, speakers often use language not just as a means of communication but as a tool with social functions, including promoting cohesion and group identity (*6*, *7*). Punctuational language change may thus reflect a human capacity to rapidly adjust languages at critical times of cultural evolution, such as during the emergence of new and rival groups.

References and Notes

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References

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