Commentary/Frost: Towards a universal model of reading

Writing systems: Not optimal, but good enough

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Author's note: solecisms introduced by the editors are highlighted in yellow. The erratum (to appear) is appended at the end of this article.

Abstract: Languages and writing systems result from satisfying multiple constraints related to learning, comprehension, production, and their biological bases. Orthographies are not optimal because these constraints often conflict, with further deviations due to accidents of history and geography. Things tend to even out because writing systems and the languages they represent exhibit systematic trade-offs between orthographic depth and morphological complexity.

Frost's article is a discursive tour through some issues about the nature of writing systems, spoken languages, and reading. These issues have been extensively studied from linguistic, behavioral, neurobiological, and computational perspectives (see, e.g., Chomsky & Halle 1968; Daniels & Bright 1996; Hung & Tzeng 1981; Joshi & Aaron 2006; Sproat 2000; Perfetti et al. 2010). The target article achieves the appearance of originality by failing to credit much of this body of work, nor did it benefit from seriously engaging it.

For years, research on reading in different writing systems has focused on the putative advantages provided by more transparent, consistent representations of phonology (the Orthographic Depth Hypothesis; Katz & Frost 1992). For example, researchers have repeatedly demonstrated that children learn to read more quickly in shallow orthographies compared to English, which is notoriously "deep" (Joshi & Aaron 2006). This approach never worked for me (Seidenberg 1992; 2011). If shallow orthographies are easier to learn, why are so many deep ones represented among the highest-scoring countries on the Organisation for Economic Co-operation and Development (OECD), Pisa, literacy assessments? If reading Albanian is "a skill easily acquired" (Hoxhallari et al. 2004), how do the poor Anglos manage? The problem with this research is that it emphasized reading aloud rather than comprehension. People can read aloud with zero comprehension (cf. my Bar Mitzvah), and comprehend texts they cannot read aloud (cf. non-speaking deaf readers). The major limiting factor on reading comprehension is spoken language, not orthography (Hoover & Gough 1990).

In Seidenberg (2011) I have tried to nudge research toward considering both writing systems and the spoken languages they represent. It turns out that they are related in an interesting way. The languages with shallow orthographies (Finnish, Serbo-Croatian, and

others) have complex inflectional morphology. Those with deep orthographies (Chinese, English) do not. This relation suggested to me the notion of "grapholinguistic equilibrium" (Seidenberg 2011). The writing systems that have survived support comprehension about equally well. Reading comprehension is a constant that is maintained via trade-offs between orthographic complexity ("depth," number and complexity of symbols, etc.) and spoken language complexity (particularly morphological). So, in Serbo-Croatian, you, the learner gets the spelling-sound correspondences for free, but then spends years mastering the ferocious inflectional system. English is deep, but the words are shorter, the irregularities are partial and concentrated among the high frequency words, and the inflectional system is trivial. Whereas Serbian would be too hard to learn if it were deep (Seidenberg 2011, pp. 164–65), English would be too hard to comprehend if it were shallow (all that abandoned morphology; Chomsky & Halle 1968). I summarized this conjecture by stating, with some hyperbole, "spoken languages get the writing systems they deserve" (Seidenberg 2011, p. 169).

This is a functionalist argument: The characteristics of both languages and writing systems result from satisfying a varied set of constraints related to our capacities to acquire, comprehend, and produce language for multiple communicative functions in characteristic environments. These constraints arise from different sources and often conflict. For example, elisions that promote fluency in speech production can increase comprehension difficulty. Including the vowels facilitates learning to read Hebrew but interferes with skilled reading, as Frost has shown. Billions of people read Chinese, but the writing system is under pressure because it is ill-suited for keyboarding. Writing systems and languages tend to come into alignment (or are placed there by fiat; see point 3 below), but these competing constraints ensure that the result is a compromise and inherently subject to ongoing modification.

Frost is correct in asserting that writing systems need to be understood in terms of the "full linguistic environment" (sect. 1, para. 5), which was the main point of Seidenberg (2011), a chapter in a book to which we both contributed, resulting from a conference we both attended. My chapter is also the proximal source for the "spoken languages get the writing systems they deserve" epigram (which Frost now attributes to a personal communication with the late Ignatius Mattingly). The wording is identical, but the claims are not. Whereas I think languages and writing systems are probably pretty well matched because they satisfy functional constraints arising from multiple sources, Frost claims that writing systems are optimal, their properties largely dictated by a language's phonological structure.

Among the many problems with Frost's account are the following:

1. The argument proceeds by analogy to a version of evolution whereby natural selection creates movement toward optimality, a basic misunderstanding of the theory (http://evolution.berkeley.edu/evolibrary/misconceptions_faq.php#a3). Orthographies evolved, but there is no magic hand directing progress and the outcomes were not as "inevitable" as Frost repeatedly asserts. Accidents of geography and history are to writing systems as mutation, migration, and genetic drift are to evolution.

2. There are ways to assess whether the solution to a problem is "optimal," but they require formalizing the problem and doing some math, which is what distinguishes Claude Shannon from Dr. Pangloss. Frost hasn't established that any writing system is optimal. To do so would require deciding, optimal for what? Acquisition? Comprehension? Texting? The erudite Mattingly (1992) wasn't careless enough to write that languages get the writing systems they deserve. Rather, he discussed the mismatches between languages and writing systems, and how they tend to diminish over time (because orthography changes the mental representation of spoken language as much as the opposite). This is satisficing, not optimizing.

3. Major changes to writing systems have repeatedly come about through legislative fiat–writing reform. These developments (e.g., Vuk's revision of Serbo-Croatian; the creation of Hangul in 15th-century Korea; character simplification in modern China) were planned rather than "natural," "inevitable" occurrences. Such abrupt innovations (punctuated equilibria?) have often led to great increases in literacy. Many countries have agencies that actively manage their writing systems (e.g., the Turkish Language Association, the Academy of the Hebrew Language).

4. Frost's descriptions of the five writing systems deviate from scholarly treatments (see especially Ramsey [1987, pp. 57–62] on the questionable status of "word" in Chinese; cf. Coulmas 2003; Daniels & Bright 1996). Solecisms abound–here are a few examples: Morphological variations in Serbo-Croatian do result in phonological variations, for example, systematic deformations of stems (Mirković et al. 2011), contrary to Frost's assertion. Writing systems that represent syllables are not alphabets. Frost writes that "nothing is arbitrary when it comes to orthographic structure" (sect. 3.2.3, para. 2), but many things are, starting with the arbitrary association between a visual sign and a pronunciation for many words in languages such as English and French, of which several possible spellings happen to be used).

Regarding Frost's characterization of recent psycholinguistic history, more research is now being conducted on orthographic representation, but there was no "paradigm shift" (sect. 1, para. 3). People did not change their fundamental assumptions about how reading works or how to study it; the science simply expanded. Frost is correct that orthography is shaped by its relations to phonology and meaning (Price & Devlin 2011; Seidenberg 2011, Fig. 9.1). The better accounts of orthographic knowledge that are indeed needed will emerge by taking a neurodevelopmental perspective on how such systems are learned and constraints on what is learnable, as well as differences between writing systems. Finally, the differences in sensitivity to letter

position that Frost emphasizes need to be assessed against statistical properties of writing systems – for example, the frequencies and distributions of letters in words – information that is lacking in most studies. Hebrew roots may resist letter transposition because of their statistical salience, derived from properties of the spoken language, which cause them to be more robustly encoded than most letter patterns in English. Given such statistical differences, the same underlying mechanisms can give rise to different sensitivities to letter position.

Erratum

Writing systems: Not optimal, but good enough – Erratum

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On page 306 of the commentary by Mark S. Seidenberg on the target article by Ram Frost in the October 2012 issue of *Behavioral and Brain Science*, there are two text passages that contain grammatical errors introduced during copy editing. The corrected text is as follows:

Reading comprehension is a constant that is maintained via trade-offs between orthographic complexity ("depth," number and complexity of symbols, etc.) and spoken language complexity (particularly morphological). So, in Serbo-Croatian, you, the learner, get the spelling–sound correspondences for free, but then you'll spend years mastering the ferocious inflectional system.

Frost writes that "nothing is arbitrary when it comes to orthographic structure" (sect. 3.2.3, para. 2), but in fact many things are (e.g., the arbitrary association between a visual sign and a pronunciation; for many words in languages such as English and French, which of several possible spellings happens to be used).

We regret the errors.

Reference

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