

Orthography as an Evolving Complex System

The Hierarchy of Emergent Systems

Components of the Orthographic System

Code and Performance

Content and Meaning

Words and Elements

Interrelationships within the System

Orthographic Rules

Tactical Rules

Procedural Rules

Correspondence Rules

The Dynamics of the System

Replication and Instantiation

Metaphor and Metonymy

Metonymic Variation

Emergent Properties and Self-reorganization

Post-Alphabetic Orthography

Just as more than one cynic has viewed history as little more than “one damned thing after another”, many frustrated writers, readers, and teachers of English seem to view English spelling as much the same: little more than one damned word after another. But if we treat it as the evolving and dynamic system that it is, we discover that English spelling – or orthography – does not deserve that cynical damnation. Our orthography is an evolving complex system: It consists of a great number of diverse components that interrelate in complex ways, that interdepend, and constantly adapt to one another and thus change in sometimes surprising ways. It is driven by an immense number of individual agents – spellers and readers – who for the first several centuries worked together with no central authority. Like all complex systems it can generate unpredicted emergent properties and can reorganize itself to adapt to relentless change in its environment.

In his essay “Living Language” Lewis Thomas describes the evolution of language as follows:

Language grows and evolves, leaving fossils behind. The individual words are like different species of animals. Mutations occur. Words fuse, and then mate. Hybrid words

and wild varieties of compound words are the progeny. . . . The way a word is used this year is its phenotype, but it has a deeply seated, immutable meaning, often hidden, which is the genotype.¹

Thomas – speaking in modern, genetic terms– updates Darwin’s pre-genetic description nearly a hundred years earlier in *The Descent of Man*:

The formation of different languages and of distinct species, and the proofs that both have been developed through a gradual process, are curiously parallel. . . . We find in distinct languages striking homologies due to community of descent, and analogies due to a similar process of formation. . . . In the spelling . . . of words, letters often remain as the rudiments of ancient forms of pronunciation. . . . We see variability in every tongue, and new words are continually cropping up; but as there is a limit to the powers of the memory, single words, like whole languages, gradually become extinct. As Max Muller has well remarked: – ‘A struggle for life is constantly going on amongst the words and grammatical forms in each language. The better, the shorter, the easier forms are constantly gaining the upper hand, and they owe their success to their own inherent virtue.’ . . . The survival or preservation of certain favoured words in the struggle for existence is natural selection.²

As Thomas and Darwin say, our English language and its orthography evolve like living, biological systems. This change and growth parallels key aspects of biological evolution – variation, adaptation, competition, selection, extinction, speciation, and emergence – to such a degree that the idea of orthography as an evolving system is more than a figure of speech.

¹ *The Lives of a Cell: Notes of a Biology Watcher* (Toronto and NY: Bantam, 1981) 158.

² *Great Books of the Western World*, vol. 49 (Chicago: Encyclopædia Britannica, 1955) 300-01.

The Hierarchy of Emergent Systems. English orthography is a cultural-symbolic system, high on a hierarchy in which each system has emerged from the system immediately below it. Early Earth's physical-chemical system provided the substrate, and in time that chemistry became complex enough for life to emerge, thus leading to a higher-order system: the biological. In time the biology of certain living creatures evolved to a sufficient complexity that a very primitive form of consciousness emerged, probably little more than an awareness of an environment. In time the neural structure of some of these aware creatures grew sufficiently complex that there emerged a true intelligence and a higher form of consciousness: awareness within that environment of a self and of other selves. This higher form of self-aware consciousness led to true symbolism, and thus true language.

The emergence of different systems parallels the psychologist H. C. Plotkin's discussion of the evolution of knowledge and information-processing in biological creatures: In the beginning was the genotype, providing what Plotkin calls the *primary heuristic*, controlled by Darwinian variation and selection. In time, for creatures who had evolved mobility and thus faced more demanding space and time and causal relationships, the primary heuristic proved too slow to handle the increasingly complex problems of the unpredictable future. Thus there evolved a *secondary heuristic*, individual intelligence, which is primed and predisposed by the primary heuristic to handle certain kinds of information-processing and knowledge-gaining. The evolution of individual intelligence opened up new vistas: The rate of change, and thus the unpredictability of the future, increased. And so there evolved a *tertiary heuristic*, culture, marked primarily by the capacity to store information and knowledge outside the biological creature, as in books and other cultural artifacts.³

Richard Dawkins, an ethologist and biologist, has proposed the meme, a unit of evolution for cultural-symbolic systems and a counterpart to the gene in biological systems. "Just as genes propagate themselves in the gene pool by leaping from body to body via sperms or eggs," he says, "so memes propagate themselves in the meme pool by leaping from brain to brain via a process which, in

³ *Darwin Machines and the Structure of Knowledge* (Cambridge, Mass.: Harvard UP, 1994).

the broad sense, can be called imitation” – that is, through instruction and learning.⁴

Unlike Plotkin’s primary heuristic, which is strictly Darwinian and driven by genetic variation and natural selection, the secondary and tertiary heuristics are driven by imitation, instruction, and learning. They are Lamarckian – or at least something much like Lamarckian – based on the passing on of learned abilities. However, there is considerable plasticity as the genes interact with the environment to determine various phenotypes. The biologist Mary Jane West-Eberhard argues that

recurrent phenotypes . . . can be subject to genetic variation, selection, and genetical evolution. Learning . . . is just one among many environmentally responsive regulatory mechanisms that coordinate trait expression and determine the circumstances in which they are exposed to selection.⁵

After the emergence of individual intelligence and culture, systems continued to emerge at even higher levels: Human sociality and dependence on technology led to the development of symbolic systems in which humans participate as creators and users. Of the symbolic systems the most pervasive is language, and some languages have developed writing systems, or orthographies, to extend the powers engendered by speech and to provide one of the most powerful strategies for storing information and knowledge outside the biological creature. Thus it is that English orthography is a cultural-symbolic system high in the hierarchy of emergent systems.

Like biological systems, higher-level symbolic systems have self-replicating processes that allow their components to replicate or have themselves replicated. Symbolic systems have the ability to adapt to changing environments both within and beyond certain limits. To regulate and maintain themselves within those limits, they have feedback loops that provide the negative feedback that informs self-regulation. These feedback

⁴ *The Selfish Gene*. new edn. (Oxford and NY: Oxford UP, 1989) 192.

⁵ *Developmental Plasticity and Evolution* (Oxford and NY: Oxford UP, 2003) 338. See also Luigi Luca Cavalli-Sforza, *Genes, Peoples, and Languages*, trans. Mark Seielstad (New York: North Point Press, 2000) esp. chap. 5 “Genes and Languages” and chap. 6 “Cultural Transmission and Evolution.”

loops also provide the positive feedback that informs their self-reorganization to adapt to relentless change that pushes them beyond their normal limits – in short, to adapt and evolve. Replication leads to competition among variant forms, and differing degrees of adaptation lead to the selection of privileged variants.

At certain points in a system's evolution, new and unpredictable qualities can emerge, just as life emerged from dead chemistry and as consciousness emerged from an a-conscious biology. Complexity theorists like Stuart Kauffman argue that the emergence of such global qualities is not driven by pure chance but is rather an expectable, though unpredictable and unpredetermined, occurrence brought on by a combination of a system's natural tendency towards order and its having achieved a sufficiently high level of complexity.⁶

Components of the Orthographic System

The most important components of orthography are its agents – that is, its spellers and readers, a fact that brings into play the whole realm of pragmatics and phenomenology. English orthography is an open system – open to sources of outside energy that sustain it. In orthographic systems that outside energy is the information transduced into the system by its agents. After its agents, for our analysis the most important orthographic components are three contrasting pairs: code and performance, content and meaning, and words and elements.

Code and Performance. *Code* is the complex of abstract categories, distinctions, and relationships that structure the orthography; it is the set of rules of the orthographic game. *Performance* is the pragmatic, phenomenological game itself, the agents' putting-to-use of that code and those rules in concrete and particular acts of writing and reading.

To understand the mode of existence of code, it's useful to appeal to Karl Popper's notion of the three worlds: In Popper's scheme human reality consists of three worlds that are separate but equally real: World 1 is the physical world – the outer world of physical objects and the events and

⁶ *At Home in the Universe: The Search for the Laws of Self-Organization and Complexity* (NY and Oxford: Oxford UP, 1995) 23-28.

processes involving those physical objects. World 2 is the psychological world – the inner world of psychological states and responses. It is the world of feelings, volitions, perceptions, the world of the individual human mind. World 3 is the world of abstract ideas, of cultural values, principles, laws. It is the symbolic world, the product of the human mind, where reside such things as mathematical laws, logical principles, esthetic standards – and the enduring aspects of linguistic codes, including orthographic codes. Popper's World 3 is not a Platonic ideal realm, for it is constantly under construction and revision through a process of trial and the elimination of error.⁷

Linguistic code exists in World 3, as the enduring, highly abstract, and as yet rather mysterious, set of rules and patterns that inform, say, English. In addition to the highly abstract and objective World 3 code, there are the particular versions of the code in the minds of the individual users of English. These individual codes reflect whatever the genetic basis of language-learning may prove to contribute, plus the amount of the enduring World 3 code that individuals have been able to internalize from their particular experiences with the language, its users, and the world. These individual codes are clearly of World 2. I will speak of the enduring and objective code of World 3 as *code*³ and of the phenomenological and subjective codes held by individual users as *codes*².

Code³ is an evolutionary global property that emerges as the individual codes² engage one another in performance. As a global property code³ then feeds back into the subsequent engagement of codes² so as to regulate and reorganize the codes² and thus the performance based on them. The question of which came first, code³ or codes² is much like the question of the chicken and egg: Code³ emerges from performance and thus codes², but performance and codes² are ordered and controlled by code³. Without code there can be no performance; without performance there can be no code. Each is evolving; each is causally affected by the other.

Content and Meaning. The distinction between code and performance is paralleled by a distinction between content and meaning, which can be laid out quickly and concisely: Content is

⁷ *The Open Universe: An Argument for Indeterminism* (London: Routledge, 1988) 113-22.

what words have; meaning is what people make of that content. Words don't mean; people do. This distinction is almost always collapsed by commentators and ignored, even though it is essential to the phenomenology of linguistic evolution. As Popper says, "we must clearly distinguish between the subjective *thought processes*, which belong to World 2, and the objective *contents* of thoughts, the contents in themselves, as it were, which constitute World 3".⁸

The content of a word is what dictionaries try to describe. Within both codes² and code³, content prescribes a range of conventionalized and acceptable uses – that is, an agreed-upon capacity for a word's being used to create and convey certain human meanings. Content sets the boundaries for the individual acts of meaning. Not surprisingly, content and meaning are bound in the same circular causality that binds code and performance. Content evolves out of acts of meaning, is supported by them, but also controls them.

Content, whether in codes² or code³, is marked by generality and polysemy. It is narrowed down and focused by context when the word is put into a sentence, and it gets narrowed down even more when that sentence is uttered by a particular person in a particular setting. But whether spoken or written and no matter how tight the context, words always have only content, never meaning. For meaning occurs in the minds of the writer and the reader, strictly in Popper's World 2. Meaning is phenomenological, arising from the interaction among a human mind and the word and the world that the word is about. Unlike content, which just is, meaning is a special kind of knowing that requires active comprehension, active contribution or (in the hermeneutist Paul Ricoeur's terms) a bringing-to the word by the user.⁹ Michael Polanyi describes this as "the passionate contribution of the person knowing what is known".¹⁰

⁸ *Open Universe* 119.

⁹ "Language as Discourse," *Interpretation Theory: Discourse and the Surplus of Meaning* (Forth Worth: The Texas Christian University Press, 1976).

¹⁰ *Personal Knowledge: Towards a Post-Critical Philosophy* (Chicago: The University of Chicago Press, 1962) viii.

I use *semiotics* when referring to content and *semantics* when referring to meaning. This usage is based on Ricoeur's distinction between the semiotics of the language system and the semantics of actual discourse. Ricoeur would say that for there to be a true semantics, there must be an act of reference, which involves both the referential and the pragmatic. Without reference there can only be semiotics, which in his usage deals only with the structural interrelationships among the content-bearing entities within the language. Only with the act of reference do true meaning and semantics become possible.¹¹

Ricoeur is speaking here, I believe, not of simple forms of reference, which involve merely pointing at, or indicating, some item in the world. He is speaking rather of full symbolic reference, the capacity that the anthropologist Terrence Deacon argues is the distinguishing feature of human language. In Deacon's analysis symbolic reference, though it does indicate some item in the world, does so by way of complex relationships between the word and other words that make up the language. It is this interrelationship with other words that allows the referential power of a word to persist even in the absence of any matching of it with an external object of reference. Thus, we can use the word *fire* to speak of and reflect on fire, even though no fire is actually present. The word-as-symbol (used, for instance, in reflecting on fire in its absence) is qualitatively different from the word-as-sign (as when one stands up and yells "Fire!" in a crowded theater), which does depend upon and communicate one's belief in the immediate presence of the object of reference.¹²

Words and Elements. Phenomenologically, the most salient components of the code are the words that make up the lexicon. But the orthographer also must be interested in a level between that of the word and that of the

¹¹ *Interpretation Theory* 19-22 and passim.

¹² *The Symbolic Species: The Co-evolution of Language and the Brain*. (NY and London: Norton, 1997) 43-46.

individual sounds and spellings. Orthography is concerned with that middle level: the elements and particles of which words consist.

An orthographic **element** is the smallest part of a written word that contributes to the total semiotic or syntactic content of the word and is spelled consistently from word to word. Elements are the written counterpart of the morphemes of the spoken language. We can use the traditional division of elements into bases and affixes. Thus the word *protector* can be analyzed, or explicated, into three elements – a prefix plus a bound base plus a suffix: ⟨pro+tect+or⟩. *Unpainted* also can be explicated into three elements – a prefix plus a free base plus a suffix: ⟨un+paint+ed⟩.

Unlike elements, **particles** do not contribute semiotic or syntactic content to a word, though they usually do contribute orthographic information. For instance, one very common type of particle is the second consonant letter that is inserted in the process of twinning – as, for instance, when the suffix *-ing* is added to a stem like *twin*: ⟨twin+n+ing⟩ rather than *⟨*twining*⟩. The particle <n> does not add content, but it does satisfy the orthographic expectation of two or more consonant letters after a preceding stressed short vowel.¹³

Elements and particles are important to the orthographer because they make it possible to analyze written words into their smallest signifying parts, which makes it possible to describe the patterns and relationships – synchronic and diachronic, homologic and analogic, syntagmatic and paradigmatic – that link the words in our lexicon and thus provide unities within the system.

We are also interested in the elements because of questions of economy: Simply put, there are fewer elements than there are words in the lexicon. The variety and richness of words complicates hugely any attempt at orthographic analysis and description. Thus, in the name of economy and efficiency, we shift down to the level of the elements, which make possible that variety and fecundity at the level of the word. For instance, the bound base *log1* occurs in 1,243 different words, such as *analogy*, *anthology*,

¹³ Cf. D. W. Cummings, *American English Spelling* (Baltimore: Johns Hopkins UP, 1988) chap. 2 “The Explication of Written Words” 32-66 (where the semantic/semiotic distinction was not maintained).

apology, and *astrology*; and the free base *graph* occurs in 761 different words, such as *graphic*, *autograph*, *bibliography*, *graphite*, and *paragraph*.¹⁴

Interrelationships within the System

Orthographic Rules. Although it is common to treat spelling rules rather condescendingly and to view English spelling as unruly at best, orthographic rules do exist. There have to be regularities and ruliness in any subsystem within a language, for without rules a language cannot work, nor can its writing system. As the word *rule* is being used here, a rule is simply an attempt to describe the systematic, agreed upon, and more or less institutionalized regularities and interrelationships among the syntagmatic components at various levels in the system – that is, among the sounds, spellings, words, elements, and particles.

In the English orthographic code³ and codes² there are certain **tactical rules** that describe the expected and conventional concatenations of sounds and spellings and of elements and particles in the language. They reflect the way things have come to be done over the centuries. An example of a tactical rule is the statement that the sound [ŋ], eng, is spelled <ng> everywhere except before the velar stops [k] or [g], where it is regularly spelled <n>: thus *sang* and *ting* with [ŋ] spelled <ng> but *sanguine* and *tinkle* with [ŋ] spelled <n> before [g] and [k]. This contemporary tactical rule is the result of a feature of the Old English phonemic system: The phoneme we recognize as /ŋ/ was in Old English not a phoneme but an allophone of the phoneme /n/, a variant that occurred only before the velar stops [k] and [g].¹⁵

¹⁴ These figures are based on the Lexis database, which consists of four data tables that record the analysis – or explication – of 129,029 English words. The tables are as follows: (i) Words, containing the 129,029 words and their explications into elements, particles, procedures, and processes, (ii) Prefixes, containing the 245 prefixes found in the explication of those 129,029 words, (iii) Suffixes, containing the 1,196 suffixes found, and (iv) Bases, containing the 16,981 free and bound bases. The Lexis database is available gratis at dwcummings.com. All examples of explication are from Lexis.

¹⁵ A. Campbell. *Old English Grammar* (Oxford: Clarendon Press, 1983) §50(2), 50(4), and 62.

Another tactical rule is that when choosing between <k> and <ck> spelling [k] in word-final position, [k] is spelled <k> if it is immediately preceded by a long vowel sound, a vowel digraph, or a consonant letter, but it is spelled <ck> if it is preceded by a short vowel unigraph. Thus *woke*, *weak*, *work*, *walk*, *wink* with <k> but *wick*, *wreck*, and *whack* with <ck>. And thus, too, we recognize adoptions like *kayak*, *bolshevik*, and *wok* as relatively unassimilated alien forms, peripheral to the English spelling system.

Procedural rules describe the things that happen when elements and particles combine to form written words. They basically show “how to do it.” Examples of procedural rules are those for deleting silent final <e> and for twinning the final consonant of certain words when adding suffixes to them, as in *deletion* deleté+ion and *twinning* twin+n+ing.

There is also a rich and complex set of sound-to-spelling **correspondence rules**, which are the result of the application of tactical and procedural rules over the centuries.¹⁶

These tactical, procedural, and correspondence rules describe many of the patterned syntagmatic relationships that exist among the sounds, letters, elements, and particles within the system. There are also patterned paradigmatic relationships that usually have not been thought of as rules: for instance, the paradigm made up of all the words in the lexicon that contain the bound base +*cess* (165 in the Lexis database) or the paradigm of those adjectives that take the noun-forming suffix *-ity* like *humidity* (1,405 in Lexis) as compared with those that take *-ness* like *dampness* (3,176). Descriptions of such paradigmatic relationships, if not rules in the strictest sense of the word, are surely part of the ruliness of English orthography.¹⁷

¹⁶ *American English Spelling* attempts a detailed sampling of these correspondences, pages 201-460. The CommonWords database at dwcummings.com contains tables that list the 356 sound-to-spelling correspondences and spelling-to-sound correspondences in the Lexis analysis. Also see Edward Carney, *A Survey of English Spelling* (London and New York: Routledge, 1994).

¹⁷ Cf. ‘Motivation and Arbitrariness’ in “Why Study Indo-European Roots?” elsewhere on this website.

In addition to the agents, the components of the orthographic code, then, are the words of the lexicon, which are further analyzed into their elements and particles, which can themselves be further analyzed into sounds and spellings. There are also tactical and procedural rules and the conventionalized sound-to-spelling correspondences and various paradigms, which describe some of the more important patterned interrelationships and regularities that exist within the orthographic system.

The Dynamics of the System. The engagements of code with performance, and of content with meaning, I believe, involve instances of that “edge of chaos” discussed by complexity theorists like Stuart Kauffman, who proposes that “life evolves toward a regime that is poised between order and chaos” and that “life exists at the edge of chaos” :

Borrowing a metaphor from physics, life may exist near a kind of phase transition. Water exists in three phases: solid ice, liquid water, and gaseous steam. It now begins to appear that similar ideas might apply to complex adapting systems. For example, we will see that the genomic networks that control development from zygote to adult can exist in three major regimes: a frozen ordered regime, a gaseous chaotic regime, and a kind of liquid regime located in the region between order and chaos. . . . Networks in the regime near the edge of chaos – this compromise between order and surprise – appear best able to coordinate complex activities and best able to evolve as well.¹⁸

In his discussion of complexity theory, the physicist M. Mitchell Waldrop says that at the edge of chaos you find complexity:

a class of behaviors in which the components of the system never quite lock into place, yet never quite dissolve into turbulence, either. These are the systems that are both stable enough to store information, and yet evanescent enough to transmit it.¹⁹

At the edge of chaos, code and performance, and content and meaning, engage one another during acts of writing and reading. Order here is

¹⁸ *At Home in the Universe* 26.

¹⁹ *Complexity: The Emerging Science at the Edge of Order and Chaos* (New York: Touchstone, 1992) 293.

represented by the established and agreed-upon givens of the system, the information stored in code³ and in the less idiosyncratic parts of codes². Chaos, and thus the opportunity for surprise, is represented by performance. The potential for chaos is there in the more idiosyncratic parts of the writers' and readers' codes², their propensity to error, their level of attention, their creative will – all of the inner things that affect the lexical choices writers and readers make

In 1582 the Elizabethan headmaster Richard Mulcaster said that “The right writing of our English . . . is a certain reasonable course to direct the pen by such rules as are most conformable to the propriety of sound, the consideration of reason, and the smoothing of custom”.²⁰ Today we would say that whenever we read or write, our performance is worked upon by four conservative demands: (1) the *demands of expression* (basically, the expectation that similar sounds will be spelled similarly and consistently from word to word, Mulcaster’s “propriety of sound”), (2) the *demands of content* and (3) the *demands of history* (the expectations that consistent semiotic content will be spelled consistently and that the expression and contents of words and elements should reflect their etymological sources and subsequent lineages, Mulcaster’s “smoothing of custom”), and (4) the *demands of systematicity* (such things as predictability, pattern, ruliness, endurance, Mulcaster’s “consideration of reason”). Our relationship to these demands is another example of the familiar circularity: The demands immediately affect and define our performance, but since most of the demands are in large part the residue of past performances, performance also affects and defines the demands.

Replication and Instantiation. In order to evolve, a system must be able to replicate itself, or have itself replicated. In the orthographic system words are stored in the code as abstract types; they are put to use in performance as concrete tokens – in a perfect parallel to the distinction between content and meaning. Orthographic reproduction, or replication, is simply that process of instantiating word-types as word-tokens and content as meaning in performance – as spellers spell and readers read.

The instantiation of a written word-type as a written word-token and of content as meaning is an engagement across ontological levels: The type

²⁰ *The First Part of the Elementary* (Menston, England: The Scolar Press, 1970) 105.

exists as an abstraction, a universal more or less completely abstracted from time and place, in Popper's World 3; the token exists as a concretion, a particular grounded in an event, bound to the time and place of its use, or performance, in Popper's World 2. Instantiation occurs in acts of meaning-making – that is, in the original creation of texts as spellers use the written language to formulate and record their meanings, and again as readers interpret the text and experience meaning from it.

Metaphor and Metonymy. One great principle of lexical evolution is that lexical change in both content and expression is motivated by metaphoric and metonymic meanings. In metaphor a word is used to refer to something that is categorically different from that to which the word normally refers but that is perceived as being in some way similar to the word's normal referent. Metonymic relationships are not based on similarity but rather on, broadly, contiguity – that is, on associative relationships such as part-and-whole, cause-and-effect, more-or-less, first-and-next, thing-and-quality, spatial or temporal adjacency.

Metaphor and metonymy have been treated as the two basic ways in which the mind and language work by such people as the linguists Roman Jakobson and Morris Halle,²¹ the linguistic philosophers George Lakoff and Mark Johnson,²² the literary critics Rene Wellek and Austin Warren,²³ the psychoanalyst Jacques Lacan,²⁴ and the mythologist James Frazer.²⁵ So it is not surprising that metaphor and metonymy are basic to orthographic change, which results from the human mind actively engaging written language. Plotkin's secondary and tertiary heuristics evolved because of the demands of locomotion and the need to deal with time and space – and causal – relationships projecting into the future. These time, space, and causal relationships are metonymic. The skills of orientation

²¹ *Fundamentals of Language* ('S-Gravenhage: Mouton, 1956) 76-82.

²² *Metaphors We Live By* (Chicago and London: University of Chicago Press, 1980) esp. chaps. 1 and 8.

²³ *Theory of Literature* (New York: Harcourt, Brace, and World, 1970) 194-99,

²⁴ See John P. Muller & William J. Richardson, *Lacan and Language* (Madison, CT: International Universities Press, 1982) 12-13 and passim

²⁵ *The New Golden Bough*, ed. Theodor H. Gaster (New York: S. G. Phillips, 1959) 7-37.

entailed in locomotion also involve the ability to maintain strands of unity and sameness, which are metaphoric. Thus, the capacity for metonymy and metaphor is fundamental to Plotkin’s second and third heuristics – that is, to human intelligence, both individual and communal.

The principles of metonymic and metaphoric extension apply to variation, competition, and selection among expressions, including spellings. The metaphoric principle works in the development of variant expressions primarily through the processes of analogy and assimilation.²⁶ It also includes the often-maligned folk etymology, by which users try to make an unusual or singleton form fit into some perceived pattern. Some examples of metaphoric extension:

Original Word	Evolved To	By Analogy With
<i>chaise longue</i> “long chair”	<i>chaise lounge</i>	<i>lounge</i>
<i>ele, eill</i> “wing of a church”	<i>aisle</i>	<i>isle</i> and French <i>aile</i> “wing”
<i>formest</i> (<i>form</i> “first” + <i>-est</i> \))	<i>foremost</i>	<i>fore</i> and <i>most</i>
<i>igland</i>	<i>island</i>	<i>isle</i>
<i>pentice</i>	<i>penthouse</i>	<i>house</i>
<i>rime</i>	<i>rhyme</i>	<i>rhythm</i>
<i>rōs marinus</i> “dew of the sea”	<i>rosemary</i>	<i>rose</i> and <i>Mary</i>
<i>shame-fast</i>	<i>shamefaced</i>	<i>face</i>
<i>up so doun</i> “up as if down”	<i>upside down</i>	<i>side</i>

The following is a striking example of the assimilation of endings to highlight the parallel functions of the words: Old English *mōdor*, *brōthor*, *fæder*, and Old Norse *systir* evolve to *mother*, *brother*, *father*, *sister* – all with the common [ər] ending spelled <er>. Another such set includes *could*, *would*, and *should* from Old English *cūthe*, *sceolde*, *wolde*.

An important subgroup of metaphoric alteration consists of the re-Latinization of English words that had usually been adapted from French with their Gallic variations of originally Latin words, as in *estallment* (from Norman French), which evolved to *installment* “debt payment” by analogy

²⁶ For more, see “Analogy” and “Assimilation” in *The Oxford Companion to the English Language*, ed. Tom McArthur (Oxford & NY: Oxford UP, 1992).

with Latin *installāre*. In a very few instances there is an unhistorical Latinization of an native Old English word, as in *horred* (past participle of *horren* “bristle”), which evolved to *horrid*, by analogy with Latin *horridus*. Other examples, including some from Greek:

Original English Word	Evolved to	By Analogy With
<i>assaut</i>	<i>assault</i>	Latin <i>*assaltus</i>
<i>cisoures, sisoures</i>	<i>scissors</i>	Latin <i>scissor</i> “tailor”
<i>dette</i>	<i>debt</i>	Latin <i>dēbita</i>
<i>douten</i>	<i>doubt</i>	Latin <i>dubitāre</i>
<i>enterditen</i>	<i>interdict</i>	Latin <i>interdictum</i>
<i>sophumer</i> (<i>sophum</i> “sophism” + <i>-er</i>)	<i>sophomore</i>	Greek <i>sophos</i> “wise” + <i>mōros</i> “foolish, dull”
<i>tarmachan</i> (Scots Gaelic)	<i>ptarmigan</i>	Greek <i>pter+</i> “wing”
<i>vitaille</i>	<i>victual</i> , respelled to <i>vittle</i>	Latin <i>victuālis</i>

Metonymic Variation. Orthographically, the most common metonymy is synecdoche, the use of a part to represent the whole. Synecdoche is most obvious in clippings, a form of contraction in which new word forms are clipped from older, longer forms. As Max Muller pointed out in the earlier quotation from Darwin, in the competition for use and instantiation, short and easily pronounced or spelled words tend to be selected in favor of longer, more difficult ones. For instance, with the spread of the internal combustion engine and the concomitant wider use of the word *gasoline*, that eight-letter trisyllable becomes too long, demanding too much time and energy. So the trisyllable is clipped to the monosyllabic, and much less energy-consuming (though polysemous), *gas*.

A more complicated example of clipping starts with the word *cabriolet*, which referred originally to a type of horse-drawn carriage and later to a model of motorcar. In the 19th century a device was developed for measuring the tariff, or tax, charged by a motorcar for hire, the taximeter. In a display of versatile clipping, motorcars fitted with such devices, called in full *taximeter cabriolets*, came to be called *taximeter cabs* or *taximeters* or, in time, *taxicabs*, *taxis* or, shortest of all, *cabs*.

Beyond simple clipping, synecdoche is involved in many different kinds of contraction and simplification, as in *daughter elements*. A daughter

element is a new element that is a homograph of an older element that occurs as part of a word whose entire content is contracted into the new daughter element. For instance, in *sorbitol* sorb3+itol, the base *sorb3* comes from *sorb*, the name of the service tree, while in *polysorbate* poly1+sorb4+ate and *sorbose* sorb4+ose the base *sorb4* is a daughter element, a synecdoche of *sorbitol*. *Adrenal* ad+ren+al, is contracted in the daughter element *adren1*, as in *adrenocortical*, *adrenocorticotropic*, *adrenolytic*, and other technical formations. Also, *adrenal* has the derivation *adrenaline*, which itself is contracted in the daughter element *adren2*, as in *adrenegen*, *adrenochrome*, and *noradrenergic*. Daughter elements are clear-cut instances of synecdoche, the part-for-whole metonymy.

Other synecdoches are due to simplifications in pronunciation that then very often motivate changes in the spelling. Many of the simplifications illustrated below involve both metonymy and metaphor working together:

Grandpa > *grampa* > *gramp(s)*. This simplification involves a patterned assimilation: In the consonant cluster [ndp] the [d] is lost and the alveolar [n] assimilates to the now adjacent bilabial [p], thus becoming bilabial [m]. The loss of the [d] is common in such a position: Compare *grandfather* [ˈgræn,fä-thər] in which the [d] is lost (though not the <d>), and the assimilation to [m] does not occur because the [n] and [f] are already close in their place of articulation. Compare also *handkerchief* [ˈhæŋ-kər-chɪf] in which the [d] is again lost and the alveolar [n] assimilates to the velar [k], thus becoming velar [ŋ]. Perhaps related is the loss of [d] and <d> as in *ordinary* > *ornery*.

Creature > *critter*. The tense [i] laxes to [ɪ] (tensing being a more energetic pronunciation) while the affricate [ch], or [tʃ], simplifies to the stop [t], with a respelling to mark the short <i>.

University > *varsity*. In the 17th century *university* was clipped to *varsity*. The variation of the <er> spelling to <ar> reflects the British [är] pronunciation of <er>.

Synecdoche is particularly common in scientific and technical words, which routinely involve clipping and a recombination of lexical information much like the recombination of genetic information in biology. Often in technical words several clippings recombine into a new element. For instance *amphetamine* is from *a(lpha)+m(ethyl)+ph(enyl)+et(hyl)+amine*, which produces a new element, perhaps most plausibly explicated as

amphetam+, with the compressed new sense “amphetamine” and with the potential for new formations such as <amphetamate> or <amphetamous>, though apparently no one has as yet felt the need for such words. The process recycles at the expression plane and compresses at the content plane. And yet it is a compression of content in which much of the constituent sense is lost: It is unlikely that the first <m> in *amphetamine* carries the sense “methyl” for any users. The technical lexicon is very rich in such formations in the form of acronyms; the following are just a few examples:

i(so)bu(tyl)phen(yl) pro(pionic acid) > *ibuprofen*
ra(dio) d(etecting) a(nd) r(anging) > *radar*
d(eoxyribo)n(ucleic) a(cid) > *DNA* (which then can enter into derivations such as *Dnase*, *DnA + ase*), “an enzyme that catalyzes the hydrolysis of DNA” also spelled *DNAse* and *DNAase*)
n(on)s(teroid) a(nti-)i(nflammatory) d(rug) > *nsaid*, pronounced [ɛn-sɛd]

Variations in expression can be motivated by metonymic relationships other than synecdoche. Since metonymy deals with linear, or syntagmatic, relationships, syntagmatic rearrangements are metonymic. The most common type of this rearrangement is metathesis, a reversal such as that between [fɛn] and [pro] in the formation of *ibuprofen*. Metathesis ranges from quite self-conscious and deliberate reversals to those that are quite unconscious and driven by articulatory processes. A conscious metathesis is *mho*, the reversal of *ohm*, which is itself from the surname of George Ohm, a German physicist. The reversal of *ohm* to *mho* is quite appropriate since a mho is equal to the reciprocal of the ohm.

In many cases the metathesis has led to a new spelling. All of the following examples involve the reversal of [r] with either a preceding or following vowel, the single most common kind of metathesis in English:

brid(d) > *bryd*, *byrd* > *bird*
cræt > *cart*
crul > *croul* > *curl*
drit > *dirt*
thridda > *third*
wyrhta > *wryhta* > *wright* “worker”:

crud > *curd* (*crud* reemerged in the 20th century referring to an undesirable thing)
pretty > *purty* (recent, showing the process still at work)

Although [r] is the consonant sound that is most often metathesized, other sounds also can be, especially the other liquid, [l], and the fricative [s]. The following are some examples:

Old English *dox* “dusky” > Middle English *duske* > *dusk*
Old English *tūsc* [tusk] > Old English *tux* [tuks] > *tusk* [tusk]
Old English *wæps* > *wasp*
Old English *hæpse* > *hasp*
French *chassé* > *sashay*, with phonetic respelling

Emergent Properties and Self-reorganization

In evolving biological systems new and unpredictable global properties can emerge, just as life emerged from a dead chemistry, and consciousness emerged from an a-conscious biology. Truly global emergences are rare, but one in English orthography would appear to be the rise of various diacritic regularities to distinguish phonetic differences. There is, for instance, the emergence of the use of syllable structure as a strategy for diacritically marking vowel quantities. The result is the set of tactical conventions that English spellers and readers invoke to distinguish between, say, *twinning* and *twining* – *twinning* with a VCC string (and thus a closed syllable) and a short head vowel sound; *twining* with a VCV string (and thus an open syllable) and a long head vowel. In Old English long vowels could occur in either open or closed syllables, as could short vowels. The diacritic strategy emerged during the evolution of Old English into Middle English, marked by the systematic lengthening of vowels in open syllables and the shortening of those in closed syllables. It also led to the convention of using silent final <e> as a long vowel marker. This final <e> was all that was left of a number of Old English endings and was originally pronounced [ə]. After it fell silent in late Middle English, it was still there in the spelling to complete the VCV string. This diacritic use of tactical patterns is an emergent feature of modern English orthography.

Robust systems also have the ability to reorganize themselves to adapt to relentless change in their environments. One self-reorganization in our orthographic system was the Gallicization of English starting with the Norman Conquest and extending until the end of the Middle English period. Beyond the fairly obvious, and superficial, effect entailed in the adoption of

hundreds and hundreds of French words during this period, there were also less obvious, deeper effects as the Norman scribes replaced certain native English conventions with their Gallic habits. These replacements include (1) the metathesis of the <hw> Old English consonant cluster to <wh> (so that Old English *hwæ*l became *wh*ale); (2) the replacement of the native <cw> and <cu> spellings of [kw] with <qu> (so that Old English *cwē*n, *cuē*n became *que*en); and (3) the generalized tendency to follow Gallic forms rather than the Latin forms from which they had descended, a tendency that led to future complications as some Gallic forms were re-Latinized and others were not. Further reorganization also occurred in the adaption of French loan disyllables, which complicated the VCV expectation of a long head vowel – such as in *lemon* and *river*, as is described in the essay “Standardization in Early English Orthography” elsewhere on this site .

A second self-reorganization led to the rise of Standard Written English in the 14th and 15th centuries, which stimulated the evolution of English to a post-alphabetic orthography and whose effects were greatly enhanced in the 16th and 17th centuries by the advance of printing in England. The spread of printing and the multiplication of identical texts greatly enhanced the rise of standardized spellings and the reduction of variants. A spelling that occurs in a large number of printed texts comes increasingly to be the expected and preferred spelling, especially if it falls into the patterns set down by the various attractors at work in English spelling, as also described in “Standardization in Early English Orthography”. A standardized printed text makes silent reading easier, which in turn makes speed reading more feasible, which in turn encourages even more standardization, in a cycle of increasing returns. Another effect of printing was more widespread literacy, which created a need for spelling and orthoepy books for new readers. Fred Brengelman has shown how the work done by the writers of these books – people like Richard Mulcaster, John Cheke, Thomas Smith, John Hart, William Bullokar, Alexander Gil, and Richard Hodges – furthered the rationalization of English spelling during the 16th and 17th centuries²⁷

The transformation from an alphabetic to post-alphabetic orthography had probably begun at the very dawn of English writing, due to the ongoing contention between the new Germanic literacy and the old and established

²⁷ “Orthoepists, Printers, and the Rationalization of English Spelling,” *JEGP* 1980 79:332-54.

literacy of Latin. It is important to remember that during the early centuries the people who were literate in English were at least equally literate in Latin with its large corpus of written texts. And by and large Latin was spelled as it had been written, not as it was spoken in its various dialects and versions. The self-reorganization involved in the Gallicization of English and in the spread of printed Standard Written English helped what was originally a phonetic-alphabetic orthography evolve into our present post-alphabetic system.

Post-Alphabetic Orthography

One advantage of an orthography that has evolved beyond the alphabetic principle of assigning one spelling to one sound is that a post-alphabetic system can convey more information than can a simple alphabetic, or phonetic, system, making it more autonomous, freer of the spoken language, something more than a simple secondary recording system. After the Norman Conquest and with the establishment of Written Standard English, English orthography had evolved well past its alphabetic-phonetic origins to a system that could be labeled phonetic-etymological-systemic. Some people abbreviate this notion with the single term *morphophonemic*.²⁸ Recall that Richard Mulcaster, the Elizabethan teacher, described English spelling as now ruled by sound, custom, and reason, jointly. One result of that change is to increase greatly the amount of information stored in and conveyed through the system. This density can be illustrated by comparing a single-dimensional phonetic spelling with a multi-dimensional English spelling. Consider the word *successfully*: Using a strictly phonetic alphabet, it would be [səksəsʃəli]. The only information stored and conveyed by such a spelling is the pronunciation of the word.

On the other hand, and consistent with the ability of evolving systems to store and employ denser forms of energy, English spellings, especially when they are unfolded in explications, are seen to store and convey much more information, reflecting the demands of expression, semiotics, history and systemics mentioned earlier: *Successfully* explicates to ⟨sub+c+cess+ful+ly⟩¹. The phonetic information is still there in the spelling, though represented less directly: A reader familiar with the tactics of English can pronounce such a spelling with considerable surety: The two reduced vowels are spelled <u>, but a reader familiar with English's tendency to stress the base element will put the stress on *cess*, thus reducing the sounds spelled by the two <u>'s towards the neutral

²⁸ See, for instance, Michael Stubbs, *Language and Literacy: The Sociolinguistics of Reading and Writing* (London: Routledge and Kegan Paul, 1980) 43.

schwa. A reader familiar with the tactics of the hard and soft <c> would also recognize that the first <c> must be pronounced [k] and the second [s]. The other spelling-to-sound correspondences are quite straightforward.

But more importantly, the first <u> spelling does not just represent the vowel sound; it also helps identify the opening element as an assimilated form of the prefix <sub->. Also, the second <u> spelling helps identify the first of the two suffixes in the word, <-ful>, while the final <y> spelling helps identify the second suffix, <-ly>¹. The consistent spelling of these elements, and of the base, <+cess>, carries information about the history and morphology of the word that is blurred in a strictly phonetic spelling: The explication shows *successfully* to be a word adopted from Latin, thus providing etymological information. It also shows that morphologically the word is an adverb formed by adding the suffix <-ly>¹ to an adjective, which was itself formed by adding the suffix <-ful> to the noun *success* – which is itself a complex word formed by combining an assimilated prefix with a bound base. All of this etymological and morphological information is in addition to the phonetic information compressed in the spelling.

The English spelling also conveys rich information about the larger orthographic system: By conveying the shape of the elements composing the word, the spelling also stores several paradigmatic relationships into which the word can enter:

- (i) other words with the prefix <sub->, including
- (ii) other words with <sub-> assimilated to <suc->, and thus
- (iii) other words with assimilated prefixes;
- (iv) other words with the noun-to-adjective derivational suffix of degree or amount <-ful>;
- (v) other words with the adjective-to-adverb derivational suffix <-ly>¹;
- (vi) other words with the bound base <+cess>.

And since the base <+cess> bears a special relationship to its co-element <+ceed> (as in the noun-verb pair *success*, *succeed*), the spelling stores yet more paradigmatic relationships with other words with co-elements. All of these different paradigmatic relationships increase the relative motivation and ruliness of the orthographic system and thus reduce the sense of arbitrariness and contingency in it.

A post-alphabetic orthography like ours pays a price in a higher level of abstraction and at times just plain vagueness in its phonetic representations. But that admission aside, the fact remains that the spelling <successfully>

includes more information than does the purely phonetic [səksɛsfəli], information that works to reduce the sense of arbitrariness in the system.

The value one places on that information is not the issue here, though it seems likely that our present spelling is much more efficient for the speed reader than a phonetic spelling would be, especially in an international language such as English, in which dialect differences would lead to quite different phonetic instantiations. It was such dialect differences that helped produce the evolution away from a strictly alphabetic system in the Middle Ages and early Renaissance, and probably almost certainly would do so again if there ever were a successful reform attempt to make English spelling more strictly phonetic. The information at issue here also represents a great resource for the teaching of the language arts: there is a great deal that can usefully be taught about our orthography. There is a useful subject matter there. Teaching spelling does not have to be simply “give-them-a-list-on-Monday-and-a-test-on-Friday”. It does not have to be simply one damned word after another.