Understanding scientific concepts does not come easily to Americans, who nevertheless enjoy tremendous benefits because of scientific progress. The average citizen has a need to know more about scientific concepts to participate in the ongoing dialogue about everything from the cloning of Dolly (the sheep), to the possible entitlement of prescription drug coverage for senior citizens, to the way the Internet is changing the American way of life. Language sets up our framework for understanding, and awareness of the politics embodied in the three origins of the English language is the key to explaining scientific concepts more clearly. Because of an ancient cultural struggle, English is unusual among Indo-European languages in its way of "knowing," a core concept of science. To enter our minds, scientists must remember our hearts.

Commentary: Communicating Science

The Difficulty Introduced by the Historical Politics of the English Language

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For some reason, Americans generally have difficulty understanding scientific concepts. Although a small percentage of Americans embrace the study of science and spend their lives working in the space program or improving the flavor of low-fat foods, for many people, science courses are dreaded high school and college classes. Americans clearly have a fascination with science—witness the popularity of science fiction books and the interest in

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space probes. Still, most Americans are content to have scientific breakthroughs be "spectator events." We venture to guess that the typical American could not provide even a rudimentary explanation of how cloning occurs, how the Internet works, or what quantum mechanics is.

Yet, a democratic society depends on a public that is at least informed enough to participate in a dialogue about the ethical dimensions of cloning, which scientific concepts should be taught in schools, or whether to allow irradiated foods to be marketed. Various observers have suggested factors that might contribute to this state of affairs, including the difficulty in adequately staffing high school science classes and a culture that is quick to label those with scientific knowledge as "nerds" or "geeks."

This essay points in a different direction for an explanation of what contributes to the difficulty in understanding scientific concepts—the English language itself and the way it is often employed to communicate scientific concepts. "Language is the nucleus for society, allowing its members to connect and coordinate their perceptions and understanding of the world" (von Foerster 1979). Language also sets up a framework for understanding, guiding our observations, our ideas, and our experiences. In this context, "a mere linguistic irritant can pollute thinking and become a pathogen in the social fabric, if it affects critical concepts or processes" (von Foerster 1980).

Certainly, a number of other factors contribute to the resistance to, or acceptance of, concepts. These factors include the general culture, philosophical assumptions, and values. Even taking these factors into consideration, however, it seems that science, as a concept in American life, suffers from the additional burden of the English language used for articulating it. Whorf (1956) argued that the categories of the mind are not universal among all thinking human beings. Rather, Whorf contended that the categories of the mind are relative to the native language of each person.

Three Ancestries, One Language

In this essay, we suggest that some part of the difficulty that Americans have in understanding scientific concepts grows out of the condition of English as a compound language spoken with three linguistic ancestries: Anglo-Saxon, Danish, and Norman. We propose that scientific communication is not clear to many people because it is expressed almost exclusively in Norman English, the language of the oppressor nation, that is historically heard with mistrust. After discussing this concept in more detail, we look at

TABLE 1
"Translation" of a Scientific Abstract

Original French/Latinate Phraseology Abstract	*Anglo-Saxon/Danish Translation Overlook*
Journalists, cognition, and the presentation of an epidemiologic study: Cognitive processes can inform an understanding of newswork. In this case study, the authors examine a growing literature relating cognitive theories to newsmaking and then apply some of the principles in that literature to media coverage of EPA-mandated reformulated gasoline in Milwaukee, Wisconsin. In an analysis of how local Milwaukee television news presented an epidemiologic study answering health complaints associated with the gasoline additive, the authors find a number of cognitive processes at work, especially those involving bias and error. Finally, the authors consider implications of such processes for newsmaking	*News workers, how folks think, and TV shows* about a study of illness: The way we think can shape our understanding of news work. In this case study, the writers look at the growing body of thought linking the mind's workings to news making and overlay their understanding on the way news workers handled stories about the new gasoline that the EPA said must be used in Milwaukee, Wisconsin. In a look at how TV news in Milwaukee broadcast a study about illness answering grumbling about health linked to the new gasoline, the writers find many kinds of thinking going on, markedly those with slanting and mistakes. Last, the writers mull over the meaning of such forthcomings for news making. (Note that there are no modern Anglo-Saxon/Danish words for *case study*, *stories*, and *gasoline* [i.e., chaotic air]. Shortening *television* to *TV* is a typical folkway of Anglicizing a Latinate term. The letters of the alphabet, except perhaps J, are Anglo-Saxon/Danish in origin.)

the implications of the three origins of English by analyzing the peculiarities in its "know/knowledge/science" linguistic structure.

Before proceeding, however, it is useful to give examples of how a Norman English statement can be translated into parallel Anglo-Saxon/Danish English with striking results. The left-hand column of Table 1 shows the title and abstract of an excellent article that appeared recently in *Science Communication* (Trumbo, Dunwoody, and Griffin 1998). Scientific abstracts are typically loaded with Norman/Latinate words, and this one is no exception. The right-hand column gives a "translation" of the abstract into mostly Anglo-Saxon/Danish root words. The topic is of great importance, since the press is a fundamental democratic institution: as such it is important that the general public understand the points the article makes. It seems clear that the public could understand and internalize the Anglo-Saxon/Danish version of the abstract more easily than the Norman French derived version, even though they both really say the same thing in "English."

The difference in the emotional connotation of Anglo-Saxon/Danish words and Norman words can be used with great rhetorical effect:

> When in 1940, Winston Churchill wished to appeal to the hearts and minds of the English-speaking people it is probably no accident that he did so with the plain bareness for which Old English is noted: "We shall fight on the beaches, we shall fight on the landing grounds, we shall fight in the fields and in the streets, we shall fight in the hills; we shall never surrender." In this celebrated passage, only surrender is foreign—Norman-French. (McCrum, Cran, and MacNeil 1986, 62)

A Powerful Language

The English language is currently the principal language of international commerce. Spoken by more people than any other language except Chinese, it is arguably easy to learn despite its illogical spelling. English is respected for the power and precision of its oratory and literature. It is a very democratic language, one that can be used by "all the people." Its impressive ease of use and power stem from three features:

- English nouns have no gender endings.
- English grammar is simpler and more flexible than the grammar of other languages. For example, nouns can easily become verbs, an impossibility in many other languages. In this way, we can *bus* children and *school* them, and we can *dog* someone's footsteps. Word order is flexible. There are only three declensions, and only the possessive usually requires a change in ending.
- English has a rich vocabulary containing two or three times as many words as any other language. The *Oxford English Dictionary* contains more than 500,000 words, and another half a million technical terms are uncataloged. By comparison, German has about 185,000 words and French fewer than 100,000 (McCrum, Cran, and MacNeil 1986, 19, 47). This remarkable vocabulary size provides English speakers with an array of tools for considerable subtlety.

"Word pairing," an unusual characteristic of English, is one source of this subtlety. Paired words express slight variations of a different concept for which other languages have only one word and concept. For example, *manage* and *lead* both translate into *leiten* in German. English also gains power from its "density" in the sense that it contains many words for things and concepts that require two or more words to express in other languages. For example, *embers* are *glimmende Kohlen* in German or *gloeinde sintel* in Dutch.

English has become the primary international language because of the legacy of the far-flung British Empire; because of the importance of the

English-speaking countries in world affairs; and because a great deal of science, technology, and popular culture are available in English (McCrum, Cran, and MacNeil 1986, 19).

History of the English Language

Surprisingly, Americans learn less about their language than do people of other countries. Americans, unlike Europeans, do not study etymology or the history of words. The standard education in Germany and Austria, for example, still includes Greek and Latin at the grammar school level. In addition, Americans typically are not familiar with the history of England and the formation of the English language, although this information is commonly taught to English schoolchildren. Consequently, for our American readers, we provide a brief summary of key events in the history of the English language.

English is a combination of the languages of three countries. The citizens of Britain were originally Anglo-Saxons, Viking Danes, and Norman French. These three groups of people occupy the same physical countryside under the same vaulted airy space known as heaven (Anglo-Saxon), sky (Danish), and firmament (Norman French). Although people from these three "countries" share the same English language, it is still possible to carry on elementary conversations in "English" using only Anglo-Saxon, only Danish, or only Norman French derived words (Geipel 1971, 70).

The Anglo-Saxons controlled England until the early 800s, when a sporadic Danish invasion of the northeast coast began. Unlike earlier Viking hit-and-run raids, the Danes sought to hold the land they invaded. Alfred the Great, the only English king ever called "Great," eventually assembled a full army and beat the Danes at the Battle of Edington, creating a balance of power between northern and southern England. The Treaty of Wedmore in 886 established Danelaw in northeast England. Danelaw owed nominal allegiance to Alfred but was allowed to follow the Danish legal code.

Danelaw and Wessex

Alfred consciously set out to use language rather than force of arms to unite the country and create a sense of unified national identity. He wanted to educate the general populace in the Anglo-Saxon language, a shocking departure from the usual practice of educating only the nobility in Latin, and a source of patriotic pride to his countrymen. He initiated the *Anglo-Saxon Chronicles*, a kind of national journal, and encouraged peaceful commerce

between the Anglo-Saxon and Danish communities (McCrum, Cran, and MacNeil 1986, 52). In its time, the England of Alfred the Great was perhaps the most civilized place in Europe.

The Anglo-Saxon and Danish languages were similar enough that the speakers could mostly understand each other, somewhat analogous to the situation found existing today between the Swedish and the Danes. But, persistent misunderstandings created a pressure toward simplification. The two languages merged over the course of a relatively few years through a process that stripped away many of the word endings, inflections, and other grammatical complexities (McCrum, Cran, and MacNeil 1986, 71). The merging of languages combined vocabularies, thus creating a denser language. When different words had similar meanings, word pairs sometimes appeared. Some of the surviving Anglo-Saxon/Danish word pairings include anger/ire, craft/skill, sick/ill, wander/wend, and rear/raise. The merging was very democratic. That is, Danish words do not imply superiority over Anglo-Saxon words or vice versa. The Danish language entered the Anglo-Saxon language very deeply. For example, we say "thou art" and "you are" rather than "thou bist" and "you sind" because of our Danish ancestors. There are about 400 words in common use that are clearly Danish, and about 2,000 if one includes words that linger in rural English dialects (Geipel 1971, 69-70).

The Norman Invasion

The Norman invasion of England and the subsequent merging of languages and cultures stands in dramatic contrast to the relatively peaceful, democratic merging of Anglo-Saxon and Danish into Old English.

About the year 1000, converging royal lineages brought England peacefully into the Danish Empire for a time. But thereafter, disputes over lineage led to conflicting claims for the English throne held by Harold the Red. A Danish army invaded the north of England to claim the throne. At the same time, William, leader of the Viking tribe that had conquered Normandy and subsequently adopted the French language, invaded the south. Harold defeated the Danish army in a vicious battle, and turned south with a weakened force to face and lose to the Normans at the Battle of Hastings. Harold, and much of the English nobility, died in one of the two battles, leaving no English leader able to resist William.

The people of Danelaw, rightly fearing that they would lose their traditional status as freemen under the Norman feudal barons, organized local resistance groups and appealed to the Danish King, Svein Ulfsson, for help. However, William's cavalry stopped Ulfsson's brother near York in 1069. William took revenge with the typical Norman method of burning and

leveling vast areas of northern England. He then built Norman strong points throughout the country. The imprint of the Norman reign of terror has never left English culture, nor has the bitter and enduring Anglo-Saxon/Danish resistance to it. As discussed below, this unresolved political struggle is locked into the English language and into the minds of all who use it. We suggest that this Anglo-Saxon/Danish resistance to the language of the Norman overlords induces resistance to scientific communication because scientists typically use the language of the French overlords to express scientific concepts.

The Anglo-Saxon/Danish and Norman Languages Merge

Strong as the Normans were, they were not able to impose their French dialect on the Anglo-Saxon/Danish population. Their numbers were much fewer than the native English population, and the nobility was often more interested in their lands in France than in England. More important was the fact that the English language was by that time too supple and too much the symbol of the downed but not defeated Anglo-Saxon/Danish nationhood. The Anglo-Saxons grimly continued writing their *Chronicles* for another ninety years, finally abandoning it in 1154. They were never able to throw off their French-speaking overlords, who eventually lost their lands in France in the Hundred Years' War and came to identify with England as their native land.

"The Normans controlled the military, government, religion, laws, hunting, social relationships and etiquette, morals, fashion, and cuisine" (Jespersen 1955, 87). In modern English, the vocabulary used in these activities is so laden with French-derived words that one can compose complete sentences that avoid Anglo-Saxon/Danish altogether. For example: "Company officials ignored established estimating practices." Some judicial phrases, such as "attorney general" and "fee simple," still retain their French noun-adjective word order. In contrast, most farming terms are Anglo-Saxon/Danish.

The merging of these two languages occurred rather slowly. In fact, Robert of Gloucester noted in 1300 that England still had two separate languages. A considerable body of Norman literature, written in French, survives from the period after the invasion to about 1300. However, very little Anglo-Saxon literature survives from that period. The Norman temperament revealed in this literature was essentially practical:

> Neither romantic sentiment, nor mysticism, nor lyric cry have much part in the literature of Normandy or Norman England. But curiosity, it would seem,

> needed constantly to be gratified, and themes of a religious or moral nature are very numerous and imply a wide appeal. (Baugh 1948, 136)

Anglo-Saxon/Danish remained the language of the underclass. But, beginning about 1200, the underclass began borrowing words from the French language. The greatest number of borrowings from French occurred from 1200 to 1400. Chaucer wrote in English that is understandable to modern ears toward the end of this period. Substantial borrowings were still occurring as late as 1650, when the first American colonies were founded (Baugh 1948, 94).

We can glean from the characters in Chaucer's *Canterbury Tales* that "putting on airs" represented a common way for the underclass to add the words of its alien overseers to its own speech. One might seek to impress one's friends by embellishing an Anglo-Saxon/Danish word with its French synonym. This practice created the many pairings that characterize modern English vocabulary. "Thus, the meat of ox, cow, calf, sheep, swine, boar, and deer [Anglo-Saxon/Danish words] became beef, veal, mutton, pork, bacon, brawn, and venison [Norman words] because French cuisine was considered superior" (Jespersen 1955, 84).

Sometimes words with surface similarity simply merged, such as the Anglo-Saxon/Danish word *rest*, meaning repose, and the Norman word *rest*, meaning remainder. In areas of life that the Normans dominated, their words either largely displaced Anglo-Saxon words or replaced them altogether. For example, Anglo-Saxon *deor*, meaning animal (similar to German *das Tier* and Dutch *dier*, both meaning animal), was replaced by *deer*. Many Norman words from the court and government, such as *justice, judge, jury, court, suit, sue, plaintiff, defendant, plea, plead, summon, cause, marry, prove, false, male, female, parliament*, and *system*, completely eliminated their Anglo-Saxon/Danish counterparts (Jespersen 1955, 87).

In general, when two synonyms have both survived, one Anglo-Saxon/Danish and one Norman, the former is primitive, fundamental, linked to feelings, and popular whereas the latter is often formal, polite, refined, and has a weaker hold on the emotions. For example, in extremity we say "God help me," not "God aid me" (Jespersen 1955, 99). Unlike the Anglo-Saxon/Danish paired words, there is often a snobbery implied: *home* versus *residence*, *house* versus *manor* or *mansion*, *hut* versus *cottage*.

Nontechnical words are generally Anglo-Saxon, and technical words are usually Norman and carry the connotation of dry Norman intellectuality and superiority. For example, in referring to the term that changes in an equation, we select the Norman word *variable* instead of *wanderer* (Anglo/Saxon) or *wending* (Danish). The English Renaissance further emphasized the linkage

between technical words and the part of English derived from Latin roots. The scientific revolution of the 1600s and 1700s added many Latin-derived words to the English language to describe new technical concepts because writers felt these words were more precise than English words (McCrum, Cran, and MacNeil 1986, 129). Isaac Newton, for example, wrote primarily in Latin. However, Jonathan Swift decried what he saw as the corruption of English with foreign jargon (McCrum, Cran, and MacNeil 1986, 131). In contrast to the incorporation of Latin terms into English, languages such as Dutch and German often create compound terms from their native language to describe technical concepts (the earlier note about the direct acceptance of the English term not withstanding). It is interesting that in the latter half of the twentieth century, we English speakers have reverted to our Teutonic cousins' practices in inventing terms for new technologies such as computers, for example, *floppy disk*, *laptop*, and *hard drive*. Latinate phrases such as "disk operating system" usually get compressed to "un-Norman" sounding terms: "DOS." Similarly, physicists have drifted away from Norman-sounding names, instead using such word combinations as *top quarks*, *bottom quarks*, *strangeness*, and so on.

Analysis of Knowing, Knowledge, and Science

To show how the tension buried in English subtly affects the processes of our thinking, we shall now explore the peculiar English paired words *knowledge* and *science*. The English language has an anomalous structure for handling the concepts of knowing, knowledge, science, and scientific terminology. The differences with other European languages include the following:

- Given the English language's sizable, subtle, and dense vocabulary, it is striking to find that nearly all Indo-European languages have up to three verbs for the single English verb *know* (Buck 1949). Having only one commonly used word reduces the subtlety with which we can express this important concept.
- English builds two nouns off the verb *know*: *knowing* and *knowledge*. English commonly creates a noun by adding *ing* to a verb: *building*, *purring*, *hammering*, and so on. Knowing suggests an activity, whereas knowledge tends to imply something fixed or static. The word *knowing* seems awkward. No other English word ends in *ledge*, so this special ending gives *knowledge* a slightly important and elevated feeling. Why are there two words when most European languages have only one? And why is there something odd about each word?
- In Dutch and German, Teutonic sister languages to English, there is only one word for both *knowledge* and *science* and all older children and adults can

TABLE 2
Comparison of the Verb *to Know* among Languages Related to English

Modern English (Oxford English Dictionary 1989)	*Anglo-Saxon/ Danish (Oxford English Dictionary 1989)*	*French (Ledesert 1972)*	*Dutch (Renier 1969)*	*German (Betteridge 1958)*	*Latin (Simpson 1959)*
know (ken, now obsolete)	cunnan/kenna	connaitre	kennen	kennen	cognoscere
know	cnawan/gecnawan				gnoscere
know (wit, obsolete; weet, now archaic)	witan/vita	savoir	weten	wissen	scire

possess it. The English phrase "scientific knowledge" is a tautology in Dutch and German.

- Even though many nouns easily become verbs in English, *science* is definitely not one of them. For example, one would never say "I science (or 'sci') my garden pretty well." In contrast, such a statement would be perfectly acceptable in Dutch or German. Why is the English language, whose grammar is often more flexible than Dutch or German, restricted in this way?

These differences in available words affect our thinking. English has fewer verbs for "to know" but more nouns—*knowing*, *knowledge*, *science*. In less technological times, the worst effect of these differences was probably to contribute to the isolation of learned persons from the mainstream culture. However, in the latter half of the twentieth century, when most adults need to keep learning new technical concepts just to maintain their employment, anything that causes people to "glaze over" when they encounter scientific concepts encumbers progress in an increasingly competitive world.

We will begin the analysis of *knowledge* and *science* by comparing them with languages related to modern English. We will then look at them from the viewpoint of English-language politics to gain a deeper understanding of their framework.

Table 2 compares the verbs for *know* (Buck 1949, 1193-1252). Table 3 compares the nouns for *knowledge*.

The forms of *know* represented in Table 2 are as follows:

TABLE 3
Comparison of Nouns for *Knowledge* among Languages Related to English

Modern English Noun (Oxford English Dictionary 1989)	*Anglo-Saxon/ Danish (Hall 1975)*	*French (Ledesert 1972)*	*Dutch (Renier 1969)*	*German (Betteridge 1958)*	*Latin (Simpson 1959)*
knowledge (ken, now obsolete)	cunnung	connaissance	kennis, voorkennis	Die Kenntnis	cognito
knowledge	cnowunge	savoir			notitia
knowledge, science (witting, dialect)	witscipe	science	Wetenshap	Das Wissen, die Wissenshaft	scientia

- *Ken*, meaning to observe or experience passively. In German, *kennen* almost means to perceive subconsciously. To avoid confusion in the following discussion, the Latin word *cognoscere* will be used for the ken meaning of *know*.
- *Know* refers to differences in aspect, and means come to know or recognize. English is the only Teutonic language to retain this ancient Indo-European verb (Buck 1949, 1208). The Latin word *gnoscere* will be used in our discussion for this meaning of *know*.
- Wit implies mental proactivity, informing one's self about facts. We will use *scire* for this meaning of *know*.

In modern English, *know* has taken over all of these meanings in addition to part of the meaning of *can*, as in "know how." Thus, English has no convenient tool to parse the spectrum of ways that *knowing* happens. The other languages shown in Table 2 divide that spectrum into the meanings of *cognoscere* and *sciere*.

In Table 3, we see that the English noun *knowledge* relates to *know* in its meanings of *cognoscere* and *gnoscere*. However, the noun *science* corresponds to the meaning of *sciere*. Dutch, German, and Latin build their nouns for *knowledge* directly from the corresponding verbs, but French, like English, introduces *science* as the noun for proactively acquired knowledge rather than building off *savoir*. *Science* has no such relationship to any French verb. Rather, it derives from *sciens* from the present participle of *scire*. *Savoir*,

prominent as a verb, is a rather less common noun that seems to relate to the *gnoscere* meaning of *knowledge* for which there is no corresponding verb.

Other Romance languages, such as Italian and Spanish, both share this displacement of their verb meaning *sciere*. In Italian, the verbs *conoscere* and *sapere* have the meanings of *cognoscere* and *sciere*, and the corresponding nouns are *conoscenza* and *scienza*. *Sapere* is also a noun with the apparent meaning of *gnoscere*. To add to the confusion, *sapere* in Latin has the meaning of the English verb *wise*, as in "wise up" (Rebora 1967).

The Spanish verbs *conocer* and *saber* carry the meanings of *cognoscere* and *sciere*. The noun corresponding to *conocer* is *conocimiento*, and there is no noun at all corresponding to the verb root *saber*. In its place is *ciencia*, meaning science, implying technical, proactively acquired knowledge, just as it does in French and English (Gooch and Garcia de Paredes 1978).

The tension between Norman French and Anglo-Saxon/Danish is apparent in Tables 2 and 3. The Old English structure for *knowing*, dense from the merging of Anglo-Saxon and Danish, retained all three of the traditional Indo-European root verbs and neatly created nouns from each of those verbs. This structure was democratic in that none of the words implied superiority over the other words. This structure collided with the less orderly French structure that retained only two of the verb meanings but three of the noun meanings. One of the nouns, *science*, implied the hierarchical superiority still found in its meaning in the Romance languages. That is, a person has *science* only with special training. The outcome of the collision is the confusing modern English structure with one verb, *know*, and two nouns, *knowledge* and *science*. These two nouns do not work well together.

We will next look at the political tension between these two words. The word *knowledge* did not exist before the Norman invasion. It first appeared in the region of old Danelaw, in areas well away from the regions where the first universities were being founded. Because we can rule out universities as a source of the word, it seems likely that *knowledge* was coined in the only other area of social life where it would be crucially important— that is, Norman-controlled courtrooms. A Norman barrister confronted with a *wit*ness, a surly citizen of old Danelaw who refused to speak French, would have faced a difficult problem in formulating his questions. Did the witness have *witscipe*, *cnowunge*, or *kenning* of a matter before the court?

In German, it is possible for a witness to play games with a hostile lawyer by toying with the distinction between *wissen* and *kennen*. One is not culpable if one does a questionable action with only *kennen* of its consequences (Frank Mars, personal communication, 10 March 1994). We can imagine Norman courts losing patience as their lowly Saxon peasant witnesses quibbled about *ken* versus *know* versus *wit*. We can imagine them casting around

for a word that would allow no wiggle room on the witness stand. It would also follow that the Normans would be careful to protect their fine word *science* from whatever mundane notions were in the heads of their Saxon serfs. The word *cnowunge*, the ancestor of *knowing*, would have been a likely place to start. In fact, the *ledge* in *knowledge* is related to *lock* as used in *wedlock*. Thus, *knowledge* has the connotation of "locked in knowing," a perfect word to nail down a slippery witness. This tension between the legalistic but democratic and just-folks connotations of *knowledge* and the elitist connotations of *science* remains with us to this day.

Thus, modern English with its undifferentiated verb *to know* causes us to focus on *who* has knowledge (or *witting*, to be more exact) rather than *how* they got it. The clear implication is that if one has science, one is simply a cut above someone who has only knowledge. It is little wonder that a scientist speaking in a general public forum is not likely to get a warm reception. From the "three countries of English" framework, the scientist is saying "I am of a higher order than you are and I know clever things you do not know."

Validation of the Results of Linguistic Analysis

To check the validity of this linguistic analysis, we can look at the Russian language (*HarperCollins Russian dictionary* 1994). Russian is the only other Indo-European language to have only one verb for *know*. *Znaht* means know and *znanie* means knowledge. The *nie* in *znanie* is a common ending in Russian for a noun built from a verb, unlike the *ledge* in *knowledge*. *Nauka*, which means science, is linked closely to the root verb *uchit*, which means teach (even though its spelling is superficially different). *Nauka* is broader in meaning than *science* is in English. Like English, Russian has a number of paired words such as *korova/goviadina* corresponding to *cow/beef* in English. However, the pairings seem to be more like that between Anglo-Saxon and Danish than between Old English and Norman French. It is intriguing that Viking tribes related to the Danes who invaded England also controlled parts of Russia. But, because Russian dictionaries typically do not contain etymologies, as is the practice with English dictionaries, it was not possible to probe further for this essay. In any case, *nauka* and *znanie* are not paired words in Russian the way that *science* and *knowledge* are in English. Thus, nothing in the Russian language contradicts the conclusion that the English treatment of *knowing* is quite odd and well outside the norm for the rest of the Indo-European languages (A. Antipina and O. Yakovleva, personal communication, 17 May 2000).

Conclusion

Just as we cannot "know what we do not know," so also we cannot "science what we do not science." Just as our brains invent visual information to keep us from being aware of the blind spot at the fovea in our eyes, any language creates the illusion that it has the ability to supply all communication needs. However, the English language now categorizes knowledge according to who knows it: the intelligentsia versus common people (*science* vs. *knowledge*). Furthermore, at least some of the vocabulary of science carries the connotation that it comes from a superior power or even an oppressor. In contrast, the other Indo-European languages categorize knowledge according to how it was acquired (roughly the difference between *ken* and *wit*). In those languages, both the intelligentsia and the masses *ken* and *wit* things. This English language oddity creates a gulf that interferes with the process of informing the citizenry about new scientific concepts.

We are suggesting that the best way to deal with this problem is for scientists to communicate in the language of the common citizen—that is, Anglo-Saxon/Danish. Empirical research in this area might find ways to communicate abstract concepts more effectively through the use of Anglo-Saxon/Danish words. It seems likely, for example, that expressing abstract concepts and values in the Anglo-Saxon/Danish language, rather than in the Norman French/Latin language, would result in faster comprehension and more complete internalization of concepts in ways that can be measured objectively.

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