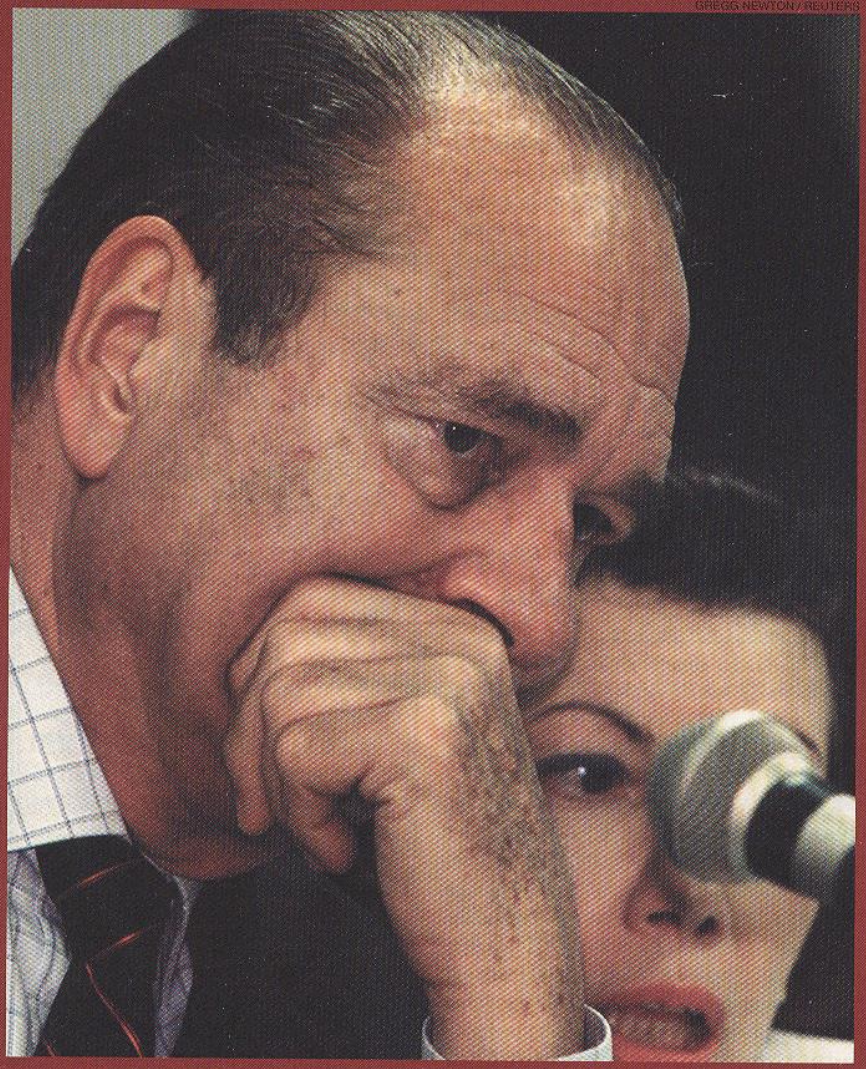
BABBLING OUR WAY TO A NEW BABEL: ERASING THE LANGUAGE BARRIERS

By Sam Lehman-Wilzig

Automated translation systems will revolutionize communication—and may help preserve languages at the same time.

GREGG NEWTON / REUTERS



Pardon My French: Jacques Chirac, president of France, listens to an interpreter at a press briefing in Rio de Janeiro. Automated translation would be instantaneous: Speakers and listeners would feel no time lags and would not be interrupted by human interpreters every few sentences.

From the time of the Tower of Babel, mankind has been stuck between linguistic consolidation and segmentation. On the one hand, the world's numerous languages are a positive source of cultural diversity; on the other, they're an obstacle to our understanding each other.

We are now at the beginning of a revolution that will change the world: Automated translation technology will bring us significantly closer to a universal communication system, while at the same time preserving the richness and beauty of linguistic and cultural diversity.

The vehicle for this transformation is the Synchronous Automated Translation System (SATS), which is now under development at a number of computer companies.

Unlike conventional translation, where the speaker must pause every few sentences while a human interpreter interrupts, the automated system will provide instantaneous translation. It will be *synchronous* in that the speaker and listener will not feel any perceptible time lag.

The system will be *automated:* It will use an advanced computerized program (artificial intelligence) that requires no human intervention. As such, it can be integrated into our social environment in practically any form of machine or technology.

The system's *translation* will be a correct rendition from one language into another in syntax, idiom, phonetics, and, with regard to text, in spelling as well.

System means that the user will be communicating not with an individual program or medium, but rather with something that is highly networked; that is, the user will be connected seamlessly to other translation modules. The consequence of this is immense, for once SATS is up and running it will no longer need any further human input to do its job—even in an environment where language keeps evolving.

In the networked world of the future, all media will be wirelessly linked, so that SATS will be available for normal everyday speech and not merely textual translation. When a user downloads a text translation system, it will arrive with the most recent improvements, including the latest new words. Moreover, if one SATS has a problem in translating something, it will immediately send out a query to all other SATS around the globe (precisely as we do today with search engine questions on the Internet), to see whether any other SATS has a satisfactory translation. The underlying technology for this is already at hand in principle: "Atomica" (www.atomica.com) provides instant dictionary definitions and other updated, real-time information for any term in your word processing or Internet document, as long as you are online.

Given that there are from 5,000 to 6,000 languages in the world, no single system SATS could translate them all to each other. But based on the Internet principle, the worldwide SATS could offer specialized language modules, just as music has been downloadable through sites like Napster.

Rapid Progress in Translation Technologies

Experts have made significant advances in automated translation technology in recent years.

Artificial speech generation is widely used today in telephone directory assistance, direct marketing, and customer service communication. Word error rates for automated speech recognition are dropping by a factor of two every couple of years, and this technology now appears in commercial products such as top-of-the-line cars and personal communicators.

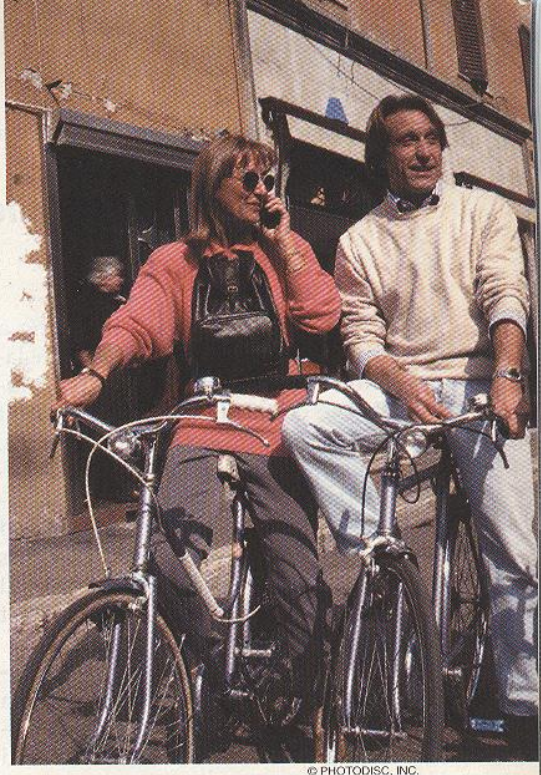
Textual translation is also in widespread use, especially on the Internet. For example, "Babel Fish" (http://babelfish.altavista.com/translate.dyn) automatically translates whole Internet pages between 19 pairs of English, French, German, Italian, Spanish, and Portuguese. And speech translation has made significant strides recently: The global C-STAR II (Consortium for Speech Translation Advanced Research at www.c-star.org) has perfected a topic-specific translation program that enables real-time teleconferencing among Japanese, South Korean, Italian, French, German, and U.S. scientists.

Future SATS advances should be even more impressive as a result of artificial intelligence research focusing on neural networks, parallel processing, and fuzzy logic. These approaches enable "intelligent programs" to teach themselves through trial and error, exactly as a toddler does—but at high speed, 24 hours a day, without interruption.

Eventually, such system-wide learning will render SATS virtually omniscient in its translation capabilities. Solutions to the many linguistic and technical problems will evolve not only through more-sophisticated programs, but also through the more general improvements in the media environment and cyberspace: greater bandwidth, faster speeds, and better connections.

How Soon Will It Happen?

The continuing evolution of computer power suggests that high-level automated translation systems will be operational in the near future.



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Tourists in the future could travel with a new advantage: They could speak their own language everywhere. Fully developed translation technology would seamlessly facilitate communication with local residents—including phone calls and face-to-face conversations.

This assessment is based in part on Moore's Law regarding the doubling of computer power every 18 months. IBM has already announced that it will have an operational teraflop supercomputer by 2005 (one *trillion* operations a second)—approaching the capabilities of the human mind in complex information processing, the basis for true artificial intelligence. If one takes as a general rule that today's PC is equal in power to the supercomputer of a decade and a half ago, then we should see the first primitive SATS by about 2015.

One further important reason for optimism is financial: Corporations are investing in machine translation as powerhouses such as Philips, Siemens, IBM, Intel, and Microsoft realize that SATS will have a profitable future. At present, the voice-

"Intelligent programs will teach themselves through trial and error, exactly as a toddler does—but without interruption."

Overcoming Problems in Translation

The obstacles to developing a truly workable automated translation system are numerous. Machine communication must first recognize simple text and speech, then comprehend both, then independently generate communication, and finally translate text and speech. Here are some key skills that synchronous automated translation systems (SATS) must possess:

• **Identify irrelevant word sequences.** Any language with a 60,000-word vocabulary can theoretically have 3.6 billion two-word sequences. One of the first goals in programming SATS is to teach the system how to conserve memory space by discarding rare or unlikely word sequences, such as two verbs, one immediately after the other. Vastly increased memory in future computer systems will alleviate part of the problem; artificial-intelligence algorithms will enable more-effective discarding of unfeasible sequences.

• **Distinguish the meanings of homographs and homophones.** Every language has a huge number of homographs—words with the same spelling but different meanings or pronunciations (such as *lead* which, as a metal, is pronounced "led")—and homophones—words with the same sound but different spellings *(to, two,* and *too).* Programs now in development will enable automated translation systems to understand grammar, syntax, and context.

• **Interpret idiomatic expressions.** Many times the meaning of a word or a series of words is nonliteral: "He took a *bath* in the stock market" is not to be understood as bathing on Wall Street. Fortunately, idiomatic expressions are finite, and their meanings can be programmed in much the same way as single words.

• **Find equivalent words.** Relatively few words have a one-to-one equivalency in two different languages. Knowing which specific word to use requires not merely a mastery of the target language but a great deal of understanding of how the real world works. Non-equivalency between languages will only be overcome when true artificial intelligence is developed in the field of semantics.

• **Recognize neologisms.** People are constantly making up new words or adapting foreign words to their own language. An automated translation system must draw the same conclusions that humans do: that an inadvertent error did not occur—either in the sender's message (misspelling, mispronunciation) or in its own "reading/hearing."

• **Find the pauses.** Natural human speech has very few pauses between words. Today's SATS have difficulty even identifying which words the communicator is expressing, let alone successfully translating them. More-sophisticated systems are overcoming this problem with greater processing speed.

• **Make sense of nonsense.** *Eh, umm,* and *ah* are all part of our natural speech, providing us with additional time to gather our thoughts before our next verbal barrage. To the automated translation system, though, a sound is a sound; these sounds must be taken as seriously as regular words. Such utterances can be included as part of the SATS vocabulary.

• **Zero in on dialects.** Most languages have regional speech accents (the way the words are pronounced) and dialects (differences in vocabulary). To be proficient merely in English, for example, SATS would have to know many British and American pronunciations, plus the accents of English speakers in Australia, Wales, South Africa, Ireland, Canada, Pakistan, the West Indies, and other countries. To address this problem, SATS can prompt speakers to identify their geographical dialect.

• **Have a sensitive ear.** Some languages give the intonation of words an important place in speech communication; indeed, some Japanese words have up to eight meanings, depending on pitch and volume! Automated translation systems will have to have a "hearing" sensitivity at least the equal of humans. To handle such nuances as sarcasm, SATS must have a contextual understanding beyond the words themselves. This is arguably the most difficult problem for SATS and will demand the highest level of contextual understanding.

• **Translate body language.** Substantive information as well as social-emotional messages are delivered through nonverbal communication. In order for SATS to perform its job maximally it will have to include a visual component: the ability to "see" the speaker and perhaps provide corresponding pictures of the receiving culture. Given the relatively finite number of key nonverbal signals, ultimately SATS will be equipped with a reasonable ability to "translate" nonverbal language as well.

—Sam Lehman-Wilzig

recognition and artificial-speech industry alone has a $1.3 billion annual volume of sales.

This economic potential is largely due to the fact that cyberspace is moving into the wireless age; SATS will be extremely mobile, enabling users to function anywhere. Moreover, the growing miniaturization of computers further increases the possible uses, and economic potential, of SATS. Finally, the instantaneous interconnectivity of networks will enable local SATS to perform at levels that might be impossible were they not networked.

Using SATS in the Future

In the future, all computers and all forms of media will be equipped with automated translation systems. The entire global phone system—which is already doubling as a major carrier of mass infomedia and person-to-person data—will also have SATS. Anyone watching video, listening to radio, or downloading information from the Internet will receive the material in his own language regardless of the language of origin. The embedded SATS will seamlessly do the translating.

Should you find yourself in a foreign land, at a time when virtually every object in our world will be voice-activated, you need merely ask "open door" in your native tongue and the built-in SATS will understand the message. Ditto for driving a car and turning on the hot water ("21° Celsius, medium pressure, please").

For interpersonal communication, the phone system will translate conversations in the respective languages of the caller and recipient, either by knowing what language each phone number uses or by being cued by each speaker's first words. For face-to-face conversation between people speaking different languages, a miniature cellular phone (perhaps in the form of an earring) can link to the SATS. To enable people to read text in a social environment—street signs, billboards, and window displays—the SATS will be built into a person's eyeglasses or contact lens. A sign in France stating "Paris huit kilometres" would appear on the American's eyepiece as "5 miles to Paris."

Automated translation systems will probably never reach absolutely perfect interpretation—but then neither will human translators. The real question is whether SATS will be able to translate the deepest meanings of one culture into another at the same high level of the best human translators today.

SATS will have some advantages over human translators. The best translators today are capable of excellent translation in three to five languages; however, SATS's virtually unlimited memory and networking will enable it to translate many more languages at any one time. This advantage will extend translation to those languages and cultures either too small or peripheral to have a significant number of expert human translators today.

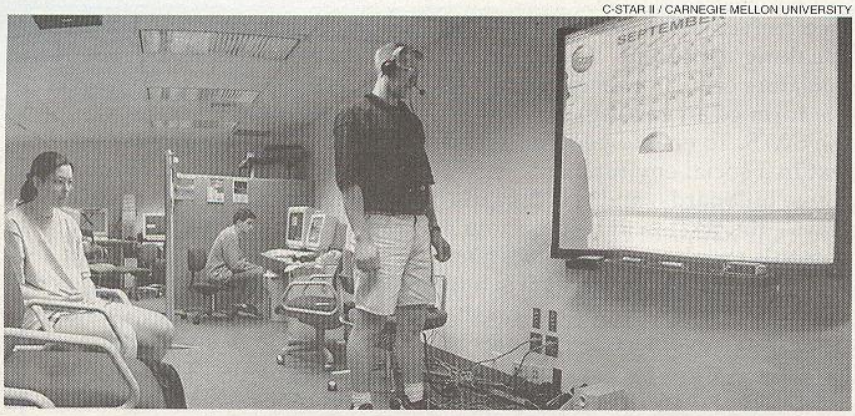
SATS should be able to add a visual element to its interpretation that human translators today cannot provide (other than some rudimentary body language). The problem of transcultural translation in the future will be addressed in a multimedia environment where linguistic translation of particularly difficult terms, strange objects, and unusual concepts will be augmented by different sorts of futuristic visual media more amenable to cross-cultural comprehension. An Eskimo who is reading about Japan will be able *see* the grain of rice that doesn't exist in his society.

In short, the problem of precise, culturally contingent translation will

SERGEI KARPUKHIN / REUTERS

Russia's President Vladimir Putin (left) talks with Spain's Prime Minister Jose Maria Aznar through an interpreter. Human speech translators rarely interrupt world leaders to clarify ambiguous language, sometimes creating diplomatic misunderstandings. This problem could be avoided by computer translation systems that alert government representatives to nuances and precise meanings of words.

C-STAR II / CARNEGIE MELLON UNIVERSITY



Taking the first step: Technicians conduct a speech translation test, part of the C-STAR II research program at the Interactive Systems Lab of Carnegie Mellon University. To be workable, automated translation systems must be able to comprehend speech and text and independently generate communication.

not disappear or be fully resolved by SATS. However, the improvement and growing use of SATS—even if never close to perfect—will still constitute a marked improvement over the mass interlinguistic silence or incomprehension that exists today among the majority of the world's people.

SATS: Political Effects And Consequences

Language is a serious political irritant in many countries, and in some places it constitutes the major bone of contention. In South Africa, for example, speaking in English vs. Afrikaans vs. Bantu may create intense political friction. A full-fledged SATS environment could help alleviate the problem of "language war." SATS enables all sides to continue using their own language, even in discourse with the other linguistic groups, without endangering national cohesion and without the minority having to worry about the gradual disappearance of its language.

International crises today develop quickly because instantaneous mass communications put enormous pressure on government leaders to respond to problems immediately. With hot-line SATS, world leaders can communicate with each other directly, without the logistical, real-time, and security encumbrances of translators. Many small-scale political problems can thus be quickly smoothed over before escalating into full-fledged international crises.

In diplomacy, the nuanced meaning of words can have major political significance, and misunderstanding due to mistranslation can be catastrophic. The bombing of Hiroshima and Nagasaki in 1945 may well have been the most extreme example of this. Toward the end of World War II, Japan's prime minister responded to the American ultimatum for unconditional surrender by announcing that his government would *mokusatsu* the demand. The word has two meanings: "to consider" and "to take no notice." Japan's own English-language translators chose the latter usage; the world heard that the Japanese had rejected the American ultimatum, rather than that it was being considered. The bombing of Hiroshima and Nagasaki followed.

Today, it is almost unheard of for an interpreter to stop a government leader in mid-sentence to ask for the precise meaning of what was said. SATS will have no psychological compunctions about doing so—nor will it be disinclined to warn the receiver about translation ambiguity so that he could ask the leader for clarification.

Automated translation systems may increase international migration in the future. While other obstacles to migration abound, such as the cost of airfare and the danger of illegal border crossing, the most significant factor in an immigrant's calculations is language, for without knowledge of the local language, the initial few years in a new country will certainly be extremely difficult. However, with universal SATS as a resource, the problems involved in finding and keeping employment in a foreign country are far smaller because all local media and discourse can be efficiently translated.

Unfortunately, economic absorption will not necessarily be accompanied by social assimilation. Today, those who do not speak the native language are considered outsiders. While their short-term economic situation may improve, their inferior status within general society stays the same—reducing their chances of upward economic mobility. In the future, SATS could help to provide economic relief for millions of migrants, while perpetuating their socio-political powerlessness.

Over the short to medium term, masses of immigrants retaining their native language will probably lead to greater local xenophobia, as can be seen already today in the rise of political groupings such as the French National Front, the German neo-Nazis, and the Austrian far right. In the near future, many of the more advanced economies of Europe and Japan will need to attract huge numbers of foreign workers in order to supplement a rapidly declining youth population. Thus, instead of eventual linguistic and cultural integration, the SATS future may entail greater linguistic fragmentation among immigrant nations, leading to heightened political turmoil.

But another political future is possible in which the very notion of "linguistic superiority" might ultimately be undercut. If the globalization of current communications continues apace, then many people will be communicating daily through the Internet with people from different cultures who speak other languages. In these SATS-mediated conversations, *everyone* will share the same linguistic status. The foreigner in our midst speaking to us locally through SATS mediation might closely resemble ourselves communicating on the world stage.

Trend Impact Analysis: The Arrival of Automated Translation Technology

Automated translation technologies have made significant advances in recent years. Intensifying research in translation technologies coupled with increasing computer power could lead to prototypes of intelligent translation systems by 2015. Meanwhile, speech-recognition products have become available in personal communication devices and some automobiles.

To clarify the implications of this trend, THE FUTURIST has identified a number of possible impacts as automated translation systems improve.

Economics

A synchronous automated translation system (SATS) opens up new labor markets, notably in developing nations.

SATS facilitates international marketing of all products. Instructions for complex products can be provided in local languages.

National film and television programming becomes a vast market thanks to automatic voice dubbing and synthesis.

SATS makes it possible for migrating workers to communicate effectively when they first arrive in a new country. It also increases productivity among new workers.

Human translators, publishers, and language instructors could lose their jobs. (However, humans will often be employed in the near term to polish the work of machine translators. If overall translation costs go down, there could be a new demand for human translators.)

Government

International meetings and communications are facilitated.

Diplomatic misunderstandings are reduced because automatic interpretation identifies precise meanings of words and phrases.

SATS reduces the likelihood that language remains a political irritant within countries. Minority linguistic groups will feel less pressure to give up their native languages.

As SATS brings down the language barriers that deter the migration of workers, larger numbers of migrants employed in affluent countries may increase political turmoil.

Demography

Automated translation makes language less of a barrier between people.

In SATS-mediated conversations, all speakers regardless of culture will share the same linguistic status.

Tourism expands as never before. People equipped with portable translation devices instantly overcome language obstacles.

As people stop learning foreign languages, the world's languages cease cross-pollination.

Environment

People are better able to live where they want to live without losing touch with their culture or having to learn another language.

Urban environments—including advertisements, street signs, and tourist information—become universally friendly to all visitors.

Values and norms could reach a new consensus based on improved communications. For instance, environmental protection could more easily take hold globally in the twenty-first century.

Society

More literature, other cultural products, and information from around the world will become readily available.

Interpersonal communications through telephone translation systems and wearable translation devices enable millions of individuals who speak different languages to establish direct contact and relationships with each other.

Students no longer learn a second language. Instead, they major in "intercultural studies."

Technology

People around the world can be trained more easily in modern technologies. A major barrier to the growth of technology will be removed.

There will be a growing demand for translation equipment and new interest in technologies capable of being used by people in the hinterlands as well as cities.

Technical research institutes may be established in out-of-the-way places. New ideas could enter technology from remote areas.

—Edward Cornish with the staff of the World Future Society

Translation's Economic Consequences

The most obvious economic consequence of automated translation will be the eventual end of the translation profession. In addition, most translation-related ancillary businesses, such as dictionary compilers and publishers, would be adversely affected.

We may also see a marked decrease in foreign language courses and materials for the general public and the economic decimation of those sectors dealing with foreign language instruction. Instead of fulfilling a second language requirement, students might concentrate on "intercultural studies" to make up for the lack of firsthand linguistic knowledge of other peoples.

Savings in reduced costs of translation will be immense. For example, European Union institutions today spend close to half of their operating costs on translation, and this accounts only for translation work actually carried out, not translations that should have been done but weren't for budgetary reasons. The European Union employs about 2,000 translators to handle 11 languages. Already today, approximately 10% of its translations are done by machine, and the figure is growing rapidly.

SATS will almost certainly lead to a huge expansion of international tourism. A possible scenario: At the local airport, each incoming tourist will be provided with a SATS set—a small translation voice speaker-box with mini-microphone and a set of translation earphones. The tourist will go through his entire trip in that country talking in his own language; his voice will be instantaneously translated into the local dialect. The earphones, of course, will enable him to hear the natives in his own language while they speak in their local tongue. This is not science fiction: A portable speech translator has been under development by the Carnegie Mellon and Karlsruhe universities' Interactive Systems Labs since 1995.

SATS will open up vast markets for national film and television productions, including the native English-speaking market, the largest outside of China and India. In development today is software that matches an actor's mouth movements to dialogue in a different language. As the technology of synthetic voice is already well advanced, most future films will be cheaply and easily translated into local languages, with the synthesized voices of local stars automatically dubbed in perfectly. Even local theater productions in any language will be far more accessible to the SATS-equipped world at large.

Once SATS removes the linguistic barrier, international migration of workers should increase well beyond the large numbers of today—especially among low-skilled, poorly educated workers whose English (or any other second language) skills are virtually nonexistent.

New power of babble: Automated translation systems could enable most of the world's people to communicate directly with one another—each speaking and hearing in his or her own language—by about 2020.

The economic benefits of this migration are clear. The Third World unemployed will have greater opportunities to find gainful and relatively high-paying employment. The developed world, on the other hand, will attract laborers for the difficult or boring jobs that their own local population is unwilling to carry out.

There is an alternate economic scenario: skilled Third World communications workers employed by First World corporations and working in their own native land (for example, Indian programmers today writing code in Bombay for Silicon Valley companies). Here, cyberspace SATS would be the critical element in such an economic marriage of convenience, removing the final barrier to corporate communication (time and distance have already been negated by cyberspace). Such a general development would have the added advantage of avoiding the political problems that physical migration creates for the host country.

Cultural Clash and Cohesion

The most immediate cultural effect of SATS will be on language itself. Once people stop learning, reading, and hearing foreign languages, the world's languages will cease their cross-pollination. Since languages have always been enriched by foreign influences, SATS threatens to render them far less dynamic in their development.

On the positive side, SATS should lead to the retention and preservation of languages, especially those now threatened by extinction due to a low population base or the dominance of major languages. About 20% to 40% of the world's languages are already moribund (no youth speak them); only 200 languages have more than a million native speakers. SATS might be a last-minute savior for many truly ancient tongues.

The world today is awash in English, and its hegemony seems to be expanding and strengthening. Even in the European Union it has already become the *de facto* Continental-regional language. However, SATS could end the dominance of English. The invention of print ended the dominance of Latin in the Western world by enabling the quick spread of local vernacular. Much the same thing probably will happen to English as a result of SATS, for the logic of universal translation leads in the direction of native language retention. People in a universal SATS environment would be unlikely to make the effort to learn a foreign language, especially one as difficult as English. The question is essentially one of timing: Will English lin-

guistic hegemony become irreversible before SATS becomes entrenched? With English spoken as a mother tongue by only about 10% of the world's population today, it is difficult to see it overwhelming the world by 2020, when SATS will begin to turn the tide against English.

Automated translation has the profound potential to either unite world ideology and values or create further diversity. Along with preserving languages, SATS could maintain and enrich the diversity of culture (texts, fashion, religious rites, song) while at the same time bringing the world closer together in a more fundamental normative fashion. As communication increases around the globe, we might gradually come to understand and internalize each other's values and norms.

The SATS-enhanced ability of everyone to grasp what others say and believe in might push the world's various civilizations toward greater consensus on the key ideas and values of the twenty-first century. But SATS-induced linguistic diversity can also help retain local culture: Language is the glue that holds local culture together—and when the language is retained, so are other accouterments of the culture.

The Last Word

Automated translation systems may be either a centrifugal factor that fragments the world or a centripetal force that binds cultures closer together. Both trends could well occur simultaneously.

SATS will reinforce the other major postindustrial, Information Age forces—such as mass media, transnational organizations, interdependent world problems, and international migration—that are inexorably leading us to greater world integration. On the other hand, SATS will have a profound diversifying tendency, enabling each culture to preserve its identity.

It is doubtful that we will arrive at this equilibrium without turmoil in the world's political, economic, and cultural systems. Although mostly beneficial in the long run, the SATS revolution will be a profound one. We would do well to view it as such and not as merely another technological marvel. □

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