LANGUAGE AND THE INGENUITY GAP IN SCIENCE[1]

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Over the centuries, first Latin and then French, German and Russian have receded in perceived importance as languages of science. Other powerful languages, with extensive internal scientific discourse, such as Japanese and Chinese, have always been largely excluded. The dominance of English has elevated the reputation of English-language universities and advantaged native speakers of English by creating a self-reinforcing loop of language flow. Abstracting services insist on English-language abstracts; citation indexes often include only English-language citations; thus English appears to dominate scientific discourse, and English-speaking universities invariably head the lists of leading scientific institutions. The inexact assumption appears to be that, with enough pressure, others will be forced to learn English in order to compete. Thus scientific advancement circumscribed by the English language is erroneously equated with scientific advancement in general. If this discriminatory situation is to change, the advantaged must acknowledge their advantage and explore ways of redressing the imbalance.

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The Languages of Science

Ever since the retreat of Latin in the seventeenth and eighteenth centuries as the international language of scholarly communication (a medium that had the advantage of belonging to no particular nation, though owned by an international elite of academics and intellectuals), efforts have been made to come up with a similarly neutral and non-partisan substitute – beginning with the dreams of so-called philosophical languages by Descartes, Wilkins, Leibnitz, and Newton in the 17th and 18th centuries – language systems conceived as exact means of scientific discourse (Eco, 1995; Stillman, 1995; Rossi, 2000). These efforts have carried through into our own day in numerous projects for international languages based on elements from existing languages (Blanke, 1985; Blanke, 2006; Duličenko, 1990; Large 1985). None has made the progress that its creators anticipated, though Esperanto has a broad following and is spoken and used internationally (Janton, 1993; McCoy, 2009).

In fact, the choice of languages of scientific communication in subsequent centuries has largely been a battle fought by politically powerful nations able to invest in strong scholarly infrastructures and in research and development, and hence able to persuade others to use their national languages. Phillipson (1992, 2008) has described such processes as linguistic imperialism – a more or less conscious effort to advance one's linguistic interests internationally, though accompanied by an ideology of inevitability, as though imperial expansion were a part of the natural order. German held its own in science and medicine until after World War I, in equality with, or even ahead of, French and English, but has now

retreated;[2] only in recent years has French largely conceded the field to English (for example, abandoning its policy of encouraging French academics to publish in French);[3] Russian was for a number of years of some significance but has also lost strength, in part because of a weakening of its scientific establishment (Kryuchkova 2001, p. 414).[4] Other powerful languages, with extensive internal scientific discourse, such as Japanese and Chinese, have always been largely excluded from international currency. On the other hand, the dominance of English, brought on by the economic power first of Britain (in the 18th and 19th centuries), then of the USA (in the 20th and 21st), has elevated the reputation of English-language universities and advantaged native speakers of English by creating a self-reinforcing loop of language flow.

Such self-reinforcement is evident in the language choice of scientific publications. Recent years have seen an acceleration in the use of English in scientific publication (Tsunoda, 1983; Baldauf & Jernudd, 1983, cited by Carli, 2007; Large, 1983). By the mid-1990s, according to one source (Mair 2006:10), English was used in 90.7 percent of natural science publications and in 82.5 percent of humanities publications,[5] causing scholars to

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[2] Mair, 2006:9, citing Tsunoda, 1983, shows how French, English and German were essentially equal as languages of publication in the natural sciences until around 1927, when English pulls definitively ahead; see also Ammon, 1989.

[3] Associated with the ideology of French superiority as a scientific language is the assertion, extending at least back to the eighteenth century, that French is more 'logical' or 'clear' than other languages (see Swiggers 1990). On the domain shift from French to English, see Durand, 2001.

[4] For a slightly more sanguine view on the future of Russian, which none the less assigns Russian to the second tier of languages, see Mikhalchenko and Trushkova 2003, especially p. 286.

[5] Such figures are self-reinforcing in a different way: first we have to define what constitutes a "scientific" publication, and this process of definition may well have its English-language bias. Gaetani (2004, p. 5)

show a preference for writing in English and, accordingly, for more publications to move to English. Increasingly, or so I am told by my European colleagues, university criteria for promotion and permanent appointment in Europe give more credit to publications in English than to publications in other languages, sometimes acknowledging *only* publications in English. Over time, one consequence of such policies, particularly when coupled with the use of English as the language of instruction in higher education, may well be to erode the capability of scientists to use their own language in scholarly discourse: they and their interlocutors may lack the terminology to do so. Phillipson (2003, p. 81) documents the dangers of such domain loss in the Scandinavian countries: language atrophy can lead to communication failure 'because any information for the general public in a democratic society has to be made available in a local language.'[6] It also, of course, creates a gap

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quotes Truchot (1996): 'Rappelons que s'il y a quelque 100 000 journaux scientifiques publiés dans le monde, dont 50 % sont en anglais, le noyau dur de l'édition scientifique mondiale est constitué d'environ 4 000 journaux, contrôlés à plus des deux tiers par des éditeurs américains, britanniques et néerlandais qui publient presque intégralement en anglais [...] De plus, ce sont les articles de ce noyau dur qui servent de références. Ce sont eux qui sont indexés de manière prioritaire dans les fichiers informatisés, c'est-à-dire dans les banques de données qui ont été constituées pour réunir et diffuser l'information scientifique.'

[6] Carli (2006, p. 1) is emphatic on the dangers: 'La comunicazione scientifica internazionale rappresenta oggi un evidente caso di conflitto linguistico per i radicali e pervasivi fenomeni di riduzione ed estinzione linguistico-culturale in favore di un monolinguismo anglofono. Questo è ben visibile in numerosi settori della ricerca scientifica primaria, quella altamente specialistica e settoriale, tanto che all'inizio di questo nuovo millennio tutte le lingue diverse dall'inglese, comprese le cosiddette lingue di cultura, ricoprono lo *status* di lingua minoritaria nel dominio della trasmissione del sapere scientifico-specialistico.'

between vernacular elementary and secondary education on the one hand and advanced education on the other.

The Dominance of English

The current dominance of English holds huge advantages for the English-speaking world. The language-teaching industry is dominated by the UK and the US, generating billions of dollars annually for both countries – dollars transferred from non-English-speaking countries.[7] International student flows follow similar channels – from non-English-speaking to English-speaking countries – making English-speaking universities widely known across the world and perhaps investing them with an elevated and undeserved reputation. And if English-speaking countries enjoy the benefits of teaching English to the world, they are also able to spend far less themselves on foreign-language instruction in the schools than their non-English-speaking peers, thereby giving them more time and more money for other pursuits. In fact, national foreign-language readiness in the United States remains dangerously low (Scott, 2005), and foreign-language learning cannot compare with the levels in non-English-speaking countries.[8]

If they wish to enter this English-dominated international scientific community, the scientists of non-English-speaking countries must publish in a language not their own, and

[7] Phillipson (2003, p. 77) cites British Council figures indicating that over 550,000 foreigners attend language schools in Britain each year. The Council claims that the 'English language industry' (teaching, publishing, etc.) is the second most important income-generator for Britain after North Sea oil. See also Graddol 1997, 2006.

[8] After enjoying modest increases over the past several years, foreign-language enrollments are again dropping in the United States. See, for example, Rhodes and Pufahl (2010), who document significant declines at the elementary school level in the United States. News reports point to similar declines in the United Kingdom (Garner, 2009).

incur costs in time and money in having their texts edited into acceptable English (Ammon, 2003). If they publish in their own languages, not only will their work be inaccessible to their peers in many other countries, but also it will not be indexed in the major citation indexes because these compilations are themselves dominated by English and often index only English texts or texts abstracted in English. Thus the Social Science Citation Index, the Arts and Humanities Citation Index, and the Science Citation Index, published in the United States by the Institute for Scientific Information, specify that 'English language article titles, abstracts and keywords are essential' if a periodical is to be included (Sandalin & Sarafoglou, 2004:11). Translation services lag behind in their output, and relatively little material published in languages other than English is translated into English (Barany, 2005; Meneghini & Packer, 2007).

The inexact assumption appears to be that, with enough pressure, others will simply be forced to learn English in order to compete. In fact, language frequently limits their participation even if they partially master English, since it is hard for them to engage fully in the informal communication that is such an important part of scientific exchanges. Their lack of engagement encourages the erroneous belief that scientific advancement circumscribed by the English language can be equated with scientific advancement in general. Valuable work in other languages is often simply lost (Gibbs 1995) – among other reasons because native English speakers lack the skills in the other languages that they would need to access this discourse. Among native English-speakers, the age of the polyglot scientist would appear to be over.

When international rankings of major research universities are made, universities in English-speaking countries score best, and countries whose languages have little or no international circulation, and whose scientists are accordingly obliged *from the beginning* to

master a foreign language (normally English), tend to come in behind the leading English-speaking countries and ahead of countries whose languages have significant international currency or a critical mass of in-country speakers, such as German, Italian, French, and Spanish (there are, of course, some notable exceptions). A major reason for this discrepancy is the self-reinforcing loop of language flow: English circulates widely, is indexed and hence is cited; English is cited and hence is indexed and hence circulates widely. The Shanghai Jaio Tong rating of universities (one of the two best-known of such ratings) relies for 20% of its scores on the three citation indexes published by the ISI. A further 20% relies on publication in two English-language journals – *Science* and *Nature*.[9]

The other leading university rating of wide currency is the THES/QS Top Universities Rating, based in the UK. It relies heavily on peer rankings (40% of the scores) and on rankings by employers (10%).[10] As far as one can tell, communications with these peers and employers are conducted in English and the majority of them seem to come from English-speaking backgrounds. Given also the strong position of English-speaking universities as international training institutions, it is hardly surprising that these institutions rise to the top.[11]

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[9] See criteria at http://www.arwu.org/ARWUMethodology2009.jsp (Accessed March 2010)

[10] See criteria at http://www.topuniversities.com/university-rankings/world-university-rankings/methodology/simple-overview (Accessed March 2010)

[11] The Top Universities Rating has been widely criticized as resembling a beauty contest. Recently, the survey has shifted to Scopus from ESI (Essential Science Indicators) for its citations, doing so, in part, because the coverage of Scopus is wider and covers more foreign-language publications. The shift has done little to move non-English-speaking universities up the scale. See http://www.topuniversities.com/worlduniversityrankings/.

Linguistic Inequality and Its Implications

If there were a direct correlation between the international circulation of scientific work and its quality, only inequality of treatment would be at issue. But there is considerable anecdotal evidence that work meriting international circulation is in fact being produced. This is particularly so in countries with languages sufficiently widely spoken domestically to sustain such scientific work – especially when their languages are sufficiently different from English to render English hard for speakers of those languages to master[12] (notably China and Japan: see Durand, 2001, pp. 74-75, and, for a somewhat different view, La Madeleine, 2007; see also Gibbs, 1995). So the monolingualism widely encountered among scientists, especially those from the USA, does carry inherent disadvantages (they may remain ignorant of significant developments in many fields), even if the disadvantages are outweighed by the advantages.

David Graddol has warned (2006) that the biggest threat facing British scientists is a growing unwillingness to master other languages. English is rapidly becoming a language of second-language speakers: it may even have dropped to fourth position in the world in the number of native speakers, while the number of non-native speakers is continuing to grow rapidly (Graddol 1997, 2006). Not only does this mean that on a worldwide scale control of the English language is slipping out of the hands (or mouths) of its native speakers, but also that native English speakers are trapped in their own language even as individual multilingualism (the term used to describe speakers capable of handling several languages) is

[12] I am not, of course, suggesting that some languages are harder than others in any absolute sense, only that it is easier for, say, a Swede to master English than it is for someone from China, whose language bears no direct linguistic relation to English and who must accordingly invest many hours in learning English (see, for example, Moreno Cabrera 2000, pp. 118-119).

on the increase elsewhere in the world. As this happens, more and more non-English-speaking universities are offering English-language programs, thereby challenging the near-monopoly previously enjoyed by the English-speaking countries. The European Union's Erasmus program for the international exchange of students, and now the Bologna Process, designed to improve mobility among institutions and now covering some 46 countries,[13] has encouraged this development.

In scientific publication, one way of reducing the inequality between native English speakers and the rest is to insist on the use of a form of simple English in scientific communication (Ammon 2003). While theoretically possible, such simplification seems in practice to be hard to achieve: witness the project Basic English, launched by Charles K. Ogden in 1930 and much discussed in the years before and after World War II as a way of promoting the international currency of English by making the language easy to use. Ogden proposed a pared-down form of English with a limited but flexible vocabulary. However, native English speakers had great difficulty limiting themselves to a restricted register, and in any case Basic English, by drastically reducing vocabulary, produced a kind of semantic overload on the lexicon, leading to extreme lexical and grammatical ambiguity.

A second way is to insist on the use of a neutral language, much as Descartes and Newton proposed three centuries ago. Esperanto is a highly expressive and yet readily learned language, and it has many speakers (Janton, 1993);[14] but going back to the linguistic

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[13] See the Official Bologna Process Website, http://www.ond.vlaanderen.be/hogeronderwijs/Bologna/ (accessed March 2010).

[14] Just how many users or speakers Esperanto has is not so much a matter of dispute as a matter of lack of hard data (estimates range from a low of 50,000 to a high of two million). Assessing numbers of speakers of a language, especially when it is a second or third language, is notoriously problematic (Tonkin 2003, p.

beginning by substituting Esperanto for English seems politically and socially unlikely, even if it can be shown to be cost-effective (see Grin, 2005). Perhaps a compromise has to be achieved – though the makers of public opinion may feel that, even if they perceive unfairness in the present language regime, they are content to live with it.[15]

A third way is to set up a system of compensation (Van Parijs, 2003), whereby the native speakers of English actually subsidize the non-native speakers by assisting them in learning English (rather than profiting from them) and by covering the cost of rendering their texts into acceptable written English.

Remediating Inequality

As matters stand at present, the fundamental unfairness of the system (unfairness in the sense that native English speakers have no need to learn a second language in order to engage in international scientific communication while everyone else does) seems surprisingly acceptable to the international community – perhaps because the non-native English-speaking actors in that community have themselves made a considerable investment in the learning and use of English and have no wish to surrender that advantage.

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323), and such assessment is doubly difficult when the population is scattered over many countries and when almost all learning of the language takes place outside the channels of formal school-based instruction. How much Esperanto must someone know to become a user of the language? How much attrition must occur before someone no longer knows a language? Is there a difference between speaking and reading knowledge? On the problem of assembling language statistics internationally, see McConnell 2003; on the problem of definition of a user, see Mackey 2003.

[15] On alternative approaches to overcoming language difference, see Fettes (2003). On the feasibility and desirability of Esperanto, see Piron (1994), Durand (2002:111-117). On the concept of linguistic justice (and hence the notion of fairness, as I use it here), see Van Parijs, 2003.

Perhaps the best we can do is to change the rhetoric, by making it persistently clear to native English-speakers that they do indeed possess an advantage over speakers of other languages that they should set about voluntarily equalizing. There are some indications that this is beginning to happen (see, for example, Meneghini & Packer, 2007). Nothing less than a rethinking of the language policy of the international scientific community seems called for – a shift from rank profit-making to egalitarian information-sharing.

In the meantime, I would suggest, editors of journals, organizers of conferences, and other facilitators of scientific discourse might reconsider their own micro-version of language policy, providing technical assistance to non-native English speakers using English, urging tolerance on their audiences, encouraging language learning among the monolingual, and making a systematic effort to include non-English-language material in their bibliographies and citations.

Above all, we must avoid imagining that current language use is somehow 'natural' or somehow the product of ineluctable forces of 'globalization.' It is not: it results from conscious choices made by the linguistically advantaged and by the lack of any coherent countervailing policy (Hamel, 2006). Developing such a policy by exploring cost-effective means of inclusion and minimizing exclusion seems essential (Tonkin 2003): there is no such thing as a policy-free environment, only policies that are more fair or less fair, more explicit or less explicit. The ongoing expansion of English may seem like a natural and unstoppable evolution, much as a decline in multilingualism may seem inevitable, linked as it is with the homogenizing forces of globalization. But, as Hamel reminds us (2006), such a process is not agent-less.

In its August 12, 2007, obituary of Moe Fishman, a grand old man of the American left, the New York Times, quoting the Economist, explained how Fishman 'stumbled over the

word "globalization"' while speaking at a protest against globalization. Fishman, commenting on his linguistic fumble, remarked, 'It was so much easier to say when we called it imperialism.' The point, of course, is that imperialism is the product of a clearly defined actor, the imperialist; globalization, we are asked to believe, comes (as Keats said of poetry) as naturally as leaves to a tree. But, to reiterate a point already made, neither globalization nor the rise of English can be described as an unalloyed good, nor are they biological phenomena but quite specifically made by human beings. Scientists, of all people, should regard assumptions about the present linguistic situation skeptically and ask some hard questions about who benefits and at whose cost – and at how the resulting inequalities can be remedied.

Bibliography

Ammon, Ulrich (1989). Die Schwierigkeiten der deutschen Sprachgemeinschaft aufgrund der Dominanz der englischen Sprache. *Zeitschrift für Sprachwissenschaft* 8, 257-272.

Ammon, Ulrich (2000). Towards more fairness in international English: Linguistic rights of non-native speakers? In Robert Phillipson (Ed.), *Rights to language. Equity, power and education* (pp. 111- 116). Mahwah, NJ & London: Erlbaum.

Ammon, Ulrich (2003). Global English and the non-native speaker: Overcoming disadvantage. In Humphrey Tonkin & Timothy Reagan (Eds.), *Language in the 21st century* (pp. 23-34). Amsterdam: Benjamins.

Baldauf, Richard B. & Björn Jernudd (1983). Language of publications as a variable in scientific communication. *Australian Review of Applied Linguistics* 19, 193-214.

Barany, Michael J. (2005). Science's language problem. *Business Week,* March 16. www.businessweek.com. Accessed March 2010.

Blanke, Detlev (1985). *Internationale Plansprachen. Eine Einführung.* Berlin: Akademie-Verlag.

Blanke, Detlev (2006). *Interlinguistische Beiträge. Zum Wesen und zur Funktion internationaler Plansprachen.* Frankfurt am Main: Peter Lang.

Carli, Augusto (2006). Le lingue della comunicazione scientifica internazionale. *Simpozio della conferenza internazionale dell'ILEI, Parma.* http://www.ilei.info/agado/Carli_it.pdf. Accessed October 2009.

Carli, Augusto & Calaresu, Emilia (2007). Language and science. In Marlis Hellinger & Anne Pauwels (Eds.), *Handbook of language and communication: Diversity and change* (pp. 523-552). Berlin & New York: Mouton de Gruyter.

Duličenko, Aleksandr (1990). *Meždunarodnye vspomogatel'nye jazyki.* Tallinn: Valgus.

Durand, Charles (2001). *La mise en place des monopoles de savoir.* Paris: L'Harmattan.

Durand, Charles-Xavier (2002). *La nouvelle guerre contre l'intelligence II. La manipulation mentale par la destruction des langues.* Paris: Guibert.

Eco, Umberto (1995). *The search for the perfect language.* Tr. James Fentress. Oxford & Cambridge MA: Blackwell.

Fettes, Mark (2003). The geostrategies of interlingualism. In Jacques Maurais & Michael A. Morris (Ed.), *Languages in a globalising world* (pp. 37-46). Cambridge: Cambridge University Press.

Gaetani, Silvia (2004). Le lingue della comunicazione scientifica. Unpublished ms., University of Modena. www.slc.unimore.it/on-line/Home/documento10472.html Accessed March 2010.

Garner, Richard (2009). Foreign language teaching is in decline. *The Independent,* October 30.

Gibbs, W. W. (1995). Lost science in the third world. *Scientific American*, 273: 92–99

Graddol, David (1997). *The future of English? A guide to forecasting the popularity of the English language in the 21st century*. London: British Council.

Graddol, David (2006). *English next: Why global English may mean the end of 'English as a foreign language.'* London: British Council.

Grin, François (2004). L'Anglais comme lingua franca: Questions de coût et d'équité, commentaire sur Philippe Van Parijs. *Économie publique,* 15/2.

Grin, François (2005). *L'enseignement des langues étrangères comme politique publique*. Rapport ... du Haut conseil de l'évaluation de l'école, 19. Paris: Haut conseil de l'évaluation de l'école. http://cisad.adc.education.fr/hcee/documents/rapport_Grin.pdf. Acced March 2010.

Grin, François (2008). Principles of policy evaluation and their application to multilingualism in the European Union. In Xabier Arzoz (Ed.), *Respecting linguistic diversity in the European Union* (pp. 73-83). Amsterdam: Benjamins.

Grin, François & Vaillancourt, François (1997). The economics of multilingualism. *Annual Review of Applied Linguistics,* 17, 43-65.

Hamel, Rainer Enrique (2006). The development of language empires. In Ulrich Ammon, N. Dittmar, K. J. Mattheier, Peter Trudgill (Ed.), *Sociolinguistics – Soziolinguistik. An international handbook of the science of language and society. Ein internationales Handbuch zur Wissenschaft von Sprache und Gesellschaft,* 2nd ed. Vol. 3. Berlin & New York: Walter de Gruyter.

Janton, Pierre (1993). *Esperanto: Language, literature, and community*. Albany, New York: State University of New York Press.

Kryuchkova, Tatjana (2001). English as a language of science in Russia. In Ulrich Ammon (Ed.), *The dominance of English as a Language of Science: Effects on other languages and language communities* (pp. 405-423). Berlin & New York: Mouton de Gruyter.

La Madeleine, Bonnie Lee (2007). Lost in translation. *Nature,* 445, 454-455.

Large, Andrew (1983). *The foreign-language barrier: Problems in scientific communication.* London: André Deutsch.

Large, Andrew (1985). *The artificial language movement.* Oxford: Blackwell.

Mackey, William F. (2003). Forecasting the fate of languages. In Jacques Maurais & Michael A. Morris (Eds.) *Languages in a globalising world* (pp. 64-81). Cambridge & New York: Cambridge University Press.

Mair, Christian (2006). *Twentieth-century English: History, variation, and standardization*. Cambridge: Cambridge University Press.

McConnell, Grant D. (2003). Towards a scientific geostrategy for English. In Jacques Maurais & Michael A. Morris (Eds.) *Languages in a globalising world* (pp. 298-312). Cambridge & New York: Cambridge University Press.

McCoy, Roy (Ed.) (2009). *Jarlibro 2009*. Rotterdam: Universala Esperanto-Asocio.

Meneghini, Rogerio & Packer, Abel L. (2007). Is there science beyond English? Initiatives to increase the quality and visibility of non-English publications might help to break down language barriers in scientific communication. *EMBO Reports,* 8/2, 112–116. http://www.nature.com/embor/journal/v8/n2/full/7400906.html. Accessed March 2010.

Mikhalchenko, Vida Io., and Trushkova, Julia. 2003. Russian in the modern world. In Jacques Maurais & Michael A. Morris (Eds.) *Languages in a globalising world* (pp. 260-290). Cambridge & New York: Cambridge University Press.

Moreno Cabrera, Juan Carlos (2000). *La dignidad e igualdad de las lenguas.* Madrid: Alianza Editorial.

Phillipson, Robert (1993). *Linguistic imperialism.* Oxford: Oxford University Press.

Phillipson, Robert (2003). *English-only Europe? Challenging language policy.* London & New York: Routledge.

Phillipson, Robert (2008). The linguistic imperialism of neoliberal empire. *Critical Inquiry in Language Studies,* 5 (1), 1-43.

Rhodes, Nancy C., & Pufahl, Ingrid (2010). *Foreign language teaching in U. S. Schools: Results of a national survey.* Washington, DC: Center for Applied Linguistics.

Rossi, Paolo (2000). *Logic and the art of memory: The quest for a universal language.* Chicago: University of Chicago Press.

Sandelin, Bo & Nikias Sarafoglou (2004). Language and scientific publication statistics. *Language Problems & Language Planning,* 28, 1-10.

Scott, Robert A. (2005). Many calls, little action: Global illiteracy in the United States. *Language Problems and Language Planning,* 29, 67-82.

Stillman, Robert E. (1995). *The new philosophy and universal languages in seventeenth-century England: Bacon, Hobbes, and Wilkins.* Lewisburg: Bucknell University Press; London: Associated University Presses.

Swiggers, Pierre (1990). Ideology and the 'clarity' of French. In John E. Joseph & Talbot J. Taylor (Eds.) *Ideologies of Language* (pp. 112-130). London & New York: Routledge.

Tonkin, Humphrey (2003). The search for a global linguistic strategy. In Jacques Maurais & Michael A. Morris (Eds.) *Languages in a globalising world* (pp. 319-333). Cambridge & New York: Cambridge University Press.

Truchot, Claude (1996). La langue française en sciences. Un cas de figure : la situation linguistique des sciences en France. *Le français et les langues scientifiques de demain, Actes du colloque tenu à l'Université de Québec à Montréal.* Québec : Conseil de la langue française du Québec.

Tsunoda, Minoru (1983). Les langues internationales dans les publications scientifiques et techniques. *Sophia Linguistica,* 13, 70-79.

Van Parijs, Philippe (2003). Linguistic justice. In Will Kymlicka & Alan Patten (Eds.) *Language rights and political theory* (pp. 153-186). Oxford & New York: Oxford University Press.

Van Parijs, Philippe (2004). L'Anglais lingua franca de l'Union européenne: impératif de solidarité, source d'injustice, facteur de déclin? *Économie Publique,* 15 (2), 13-32.

Van Parijs, Philippe (2008). Linguistic diversity as curse and as by-product. In Xabier Arzoz (Ed.), *Respecting linguistic diversity in the European Union* (pp. 17-46). Amsterdam: Benjamins.