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MULTILINGUALISM AND SCIENCE

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SCIENCE AND LANGUAGE: AN ANCIENT ALLIANCE

*My experiences were not performed in the linguistic, but
in the biomedical field and, to be precise, in basic
immunology.*

***Reflecting on words is not, however, an alien activity for
the scientific work.***

The commitment to languages is now particularly important since the géo-linguistic map is changing under the pressure of population growth, technological innovations and global communications.

THE FUTURE OF WORLD'S LANGUAGES ACCORDING TO “SCIENCE”

(*Science: AAAS American Association for Advancement of Science*)

“*Science*”, the well known and highly impacted scientific magazine, published in 2004 a whole section dealing with the future of the languages , from which this sentence is drawn :

We are living through
an extraordinary moment of linguistic history.
The world's language system, having evolved over centuries,
has reached a point of crisis and is now rapidly restructuring.

***We will experience some decades of rapid,
and perhaps disorienting change,
after which a new linguistic world order will emerge.***

(David Graddol, *Science*, 303, 1329, 27 Feb 2004)

THE COMMITMENT OF SCIENCE WITH NATURAL LANGUAGES

The attention paid by «*Science*» to the problem of languages is not surprising.

Although the analysis of languages is commonly believed to be an elective field of interest of literates and philosophers,

the tighter challenge with the natural languages has been engaged for centuries by scientists

CREATING THE LANGUAGE OF SCIENCE REQUIRES A GOOD DOSE OF EFFORT

Science is a sophisticated creation of human mind : in order to express scientific ideas, languages must elaborate a specialized vocabulary, adapting the words to the epistemic requirements of scientific knowledge.

***The language of science does not come spontaneously
but must be created with a good deal of effort***

Studying science, is like studying a new language where *new words or customary words*, as energy, work, power becomes *terms*, endowed with a precise conceptual meaning, different from the customary sense .

FEW HISTORICAL LANGUAGES HAVE CREATED A *LANGUAGE FOR SCIENCE*

People can have scientific thoughts, do scientific experiments, have scientific conversations, in whichever language they wish to use—in theory.

*But in practice, science has not been so
conducted.*

*Very few languages have developed a scientific
language.*

THE SHORT LIST OF HISTORICAL SCIENTIFIC LANGUAGES

“Taking languages that register a statistically significant proportion of the world production of something we might now call *science*, we find (in alphabetical order): *Arabic, Chinese (classical), Danish, Dutch, English, French, German, Greek (ancient), Italian, Japanese, Latin, Persian, Russian, Sanskrit, Swedish, Syriac, and Turkish (Ottoman)*”.*

“There is no other sphere of human cultural activity—trade, poetry, politics, what have you—that takes place in such a limited set of tongues. Behind the truism, therefore, is a fact of tremendous importance”. *

*(** Gordin- scientifique Babel: Le langage de la science, de la Chute du latin à l'émergence de l'anglais, Profil / Univ Chicago Press:. 2015).*

EXACT WORDS TO CREATE AN ORDER WITHIN THE DISORDER OF THINGS

Science need clear and precise words, able to superimpose a rational order to the disorder of things.

The objects of science are not ***brute facts***, rather they are **facts ordered** according to a design able to extract meaning from the flood of events spontaneously offered to our experience.

***“The man of science must work with method.
Science is built up of facts, as a house is built of
stones; but an accumulation of facts is no more a
science than a heap of stones is a house”***

(H. Poincaré, La Science et l'Hypothèse, Flammarion, 1917).

A COMPLEX *INSTRUMENT* MADE OF WORDS, IMAGES AND FORMULAS

Four centuries of work have provided modern science with a definite language *composed of words, images, diagrams, tables, graphics and mathematical, physical and chemical symbols.*

Each component conveys the meaning in a different way, and everyone help building the message.

The styles of argumentation are strongly encoded: the vocabulary is complex, the syntax is precise, the details are punctual and sentences must exclude ambiguous interpretations.

SCIENCE IS A WELL CONSTRUCTED SPEECH

They were the great «*nomenclateurs*» of the XVIII century, as Linné and Lavoisier, that wanted to bring order to the knowledges created during centuries of observations devoid of every « certain demonstration » (*Galilée*),

They tried to free the science from the inaccurate words of the «common sense», replacing them with a rational and rigorous language.



According to Lavoisier “ l’on ne peut perfectionner le langage sans perfectionner la science, ni la science sans le langage »

THE OLD NAMES DISAPPEARED

Linné published, in 1758, his first analytic classification of living organisms in a book entitled *Systema Naturae*, that he revised more and more for about ten years.

Lavoisier was the main author of the *Méthode de la nomenclature chimique* (1787), which introduced the first systematic chemical classification, based on the reduction of natural substances to their elementary constituents.

***The old names full of « fantaisie » disappeared:
the « vitriol de Vénus » becomes « sulfate de cuivre ».***

(MT Zanola, Arts et métiers au XVIIIe siècle. Études de terminologie diachronique. Paris, L'Harmattan).

THE ANCIENT ROOTS OF THE NEW TERMINOLOGY

The new dictionary encouraged the use of words derived by greek and latin roots, to underline their abstract rationality and to mark their difference from common sense.

Linné imposed latin names to plants and animals, leaving up the old «vernacular» names and Lavoisier, accordingly, changed the names of chemical substances.

Following the « nomenclateurs », many generations of scholars collaborated to construct a rational terminological répertoire, as a kind of " lingua franca" of everyone and no one, approaching the always coveted universality

THE GIFT OF CLASSICS: A REPERTOIR OPEN TO THE MUTUAL UNDERSTANDING

The academic *élites* of the modern Europe were leaving the medieval latin as shared language of communication, while keeping a substantial knowledge of its backgrounds.

The classical roots allowed to forge words that sounded familiar to educated people and were easily assimilated by the major scientific european languages.

The new repertoire was then perceived as intimately transnational and open to the mutual understanding

THE AGE OF THE MULTILINGUALISM *ELITAIRE*

The scientists learned to juggle multiple languages, even *passively*, being able only to listen and read, or also *actively* becoming able to write and speak with their peers.

The scientific language, built on a shared core, seemed able to express itself everywhere with the same precise adequacy.

For at least two centuries, inter-comprehension and multilingualism (English-French-German) seemed an appropriate response to language barriers.

THE INDUSTRIAL CIVILISATION AND THE RETURN OF BABEL

The illusion of universality rapidly faded during the twentieth century, when industrial civilization expanded the number of researchers, extended the tasks of science and moved his boundaries well beyond Europe.

The "big science" was born, with its broader outlooks, considerable financings, complex equipments and large laboratories.

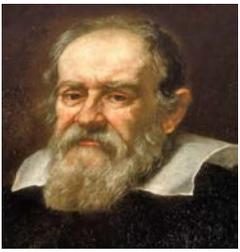
*The impact of socioeconomic fallout changed the rules of transfer and dissemination of scientific knowledge :
changing the world, the science has also changed the terms of its own development.*

THE REVIVAL OF LIVING LANGUAGES ON THE AGE OF TECHNOSCIENCE

The language of science used today is the consequence of these changes.

Scientific knowledge no longer requires ancient languages to mark the special nature of its conceptual and objectual references.

The use of terms with Greek or Latin roots is still common, but current scientific language is more and more influenced by words stemming from contemporary idioms.



À REBOURS: RECALLING GALILEO

The language of “big science” is, paradoxically, once again rich of *suggestions* as the one of physics and astronomy was in the XVIIth century .

Galileo was not afraid to call *lens* (from lentils) its wonderful glasses or to recover the vulgar terminology of the craftsmen.

Then and now, specialized terms are born where innovations develop.

Lexical novelties produced in the major academic and industrial centers of America, Europe and Asia, are adopted everywhere.

BEHIND THE NEW TERMS: CURIOSITY, PASSIONS AND INTERESTS

The way in which neologisms are created changes from one discipline to another, but the mixture of tradition, imagination and caprice is a common trait in all fields.

In a world which describes itself as "knowledge society", many features of scientific lexicon reveal the **complex pattern of curiosity, passions and interests that stirs to the bottom of the research work.**

« *BIG SCIENCE* », PRESS AND PUBLICITY

The use of communication styles borrowed by press and advertising has greatly increased in the scientific domains most involved in the technological fallout with large socio-economic impact

The greater the knowledge, the larger its dissemination and more scientific Babel becomes visible.

THE METAPHOR AND CLICHÉ OF DNA

The language of DNA has been defined as a *cornucopia of metaphor and cliché* in a commentary that appeared *Nature*:

NATURE
April 30
2015

The language of DNA is a veritable cornucopia of metaphor and cliché. Since James Watson and Francis Crick solved the double helix, biologists have imagined DNA as an information-storage device: magnetic tape, a computer program or, most commonly, a book that contains the instructions for making a cell's proteins. In multicellular organisms, this precious tome is secured in the vault of the nucleus, the

THE PLURALITY OF LANGUAGES AS EPISTEMIC DANGER

Facing the enormous patrimony of knowledge generated by an extended international collaboration, researchers began to feel the plurality of languages as a danger to the epistemic standards of the "open science".

Those who publish in a minor language, that the majority do not master, can break the unity of the global science system, because they subtract their assertions to the mutual inquiry of the experts (peer review).

A COMMON LANGUAGE FOR GLOBAL EXCHANGES

The instances of the scientists started being shared with the world of commerce, industry and communication

New users did not cultivate universalistic ambitions: **they were driven by practical requirements and wanted a *lingua franca* for the global trade.**

Instruments for the rapid dissemination of new knowledge became even more important than those required for their production.

HISTORY CHOSE THE ENGLISH

The politic and military history of Western countries decided for everyone and English became the *lingua franca* of science.

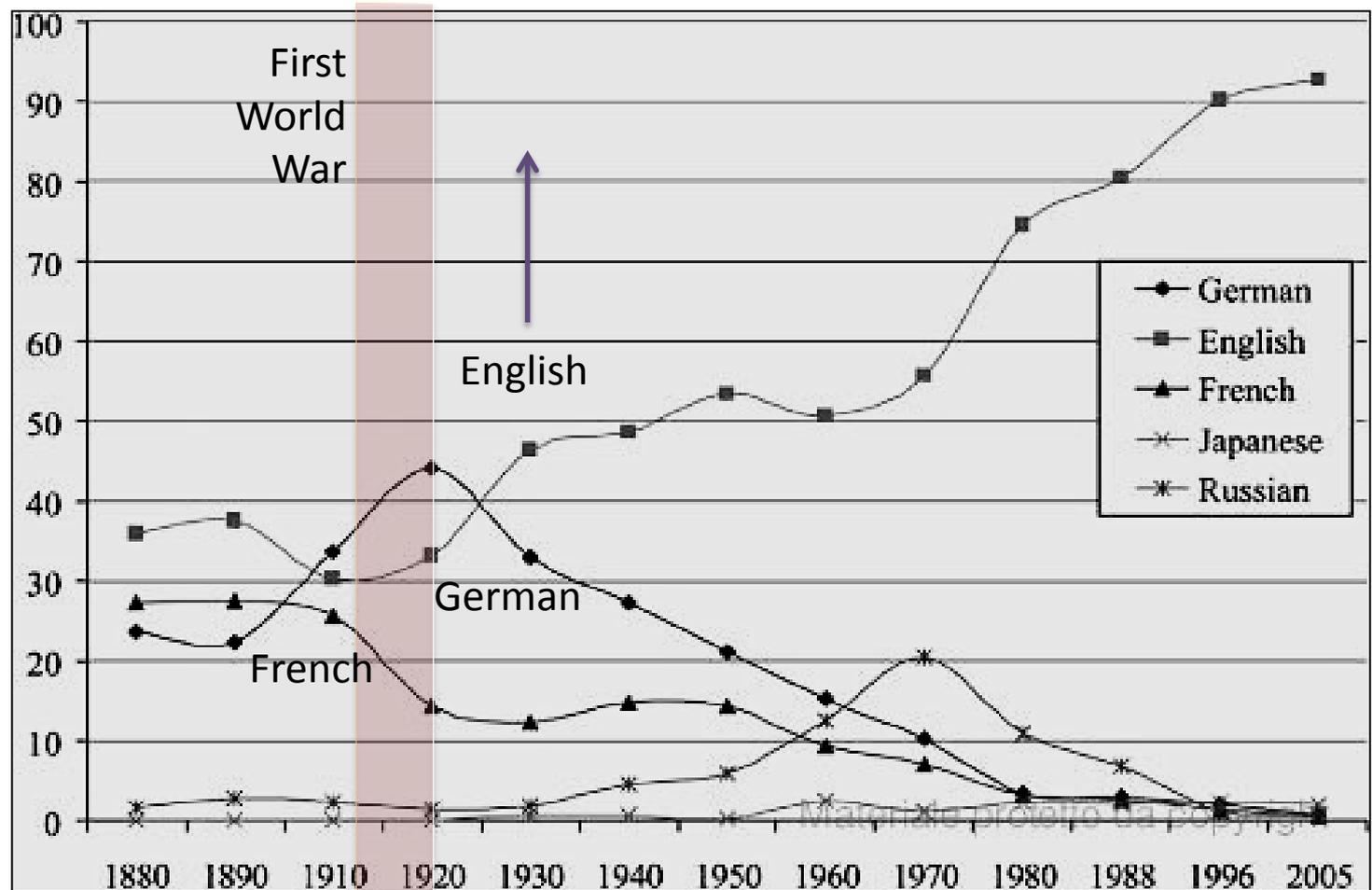
In a few decades, told the Economist (December 1996),
« *English impregnably established as the world language standard : an intrinsic part of the global communications revolution* " *

The international scientific community is now resolutely and absolutely monoglot

* The Economist, 1996- Language and electronics: the coming global language. 21 December, p 37-39

THE ASCENT OF ENGLISH IN SCIENCE

The fall of French and German started around the first World War, when Europe built his debacle. The US went on stage with the power of new technology and scientific papers was flooded by Anglo American language.



Languages in which science has been published from 1880 to 2005, plotted as a % of the global scientific literature (U. Ammon, *Applied Linguistics Review* 3, no. 2 (2012): 333–355).

THE GLOBAL WORLD *COLLAPSED* INTO MONOLINGUALISM

The *collapse* into the monolingualism is an historically novel phenomenon because the latin, quoted as a model, has always been a universal, but never a global language

Latin was not global in the world, when science spoke Greek, Arabic and Chinese and was not global in Europe, where it coexisted with vulgar idioms and finally surrendered to national languages.

In the time of the "knowledge economy", English is not only the technical heart of the scientific language, but is also the language used to talk and discuss science.

A MONOPOLY WITHOUT BARRIERS

The use of English has gradually replaced local languages, imposing the anglication of scientific journals, of national conventions and finally of the **language of higher education**.

English identifies so much with science that students project backward his supremacy, anglicizing the most celebrated names of the German and French scientists of XIXth and XXth century.

Many times, with my students, I had to rectify the "Koch's bacillus" which became Kuuk.

In the global world the barriers of time seem to have fallen with those of space, and people seems to have lose the "historical perspective of the reality"

FEELING AT HOME?

Scientists feel at home with the English because the daily readings are in English, the methods and reagents have English names, and the work is shared with distant laboratories, where everyone speaks English.

SCIENCE 14 August 2015 • Vol 349 Issue 6249 705
RESEARCH ARTICLE **HIV-1 VACCINES**

Diversion of HIV-1 vaccine–induced immunity by gp41-microbiota cross-reactive antibodies

Wilton B. Williams,^{1*} Hua-Xin Liao,¹ M. Anthony Moody,¹ Thomas B. Kepler,² S. Munir Alam,¹ Feng Gao,¹ Kevin Wiehe,¹ Ashley M. Trama,¹ Kathryn Jones,¹ Ruijun Zhang,¹ Hongshuo Song,¹ Dawn J. Marshall,¹ John F. Whitesides,¹ Kaitlin Sawatzki,² Axin Hua,² Pinghuang Liu,¹ Matthew Z. Tay,¹ Kelly E. Seaton,¹ Xiaoying Shen,¹ Andrew Foulger,¹ Krissey E. Lloyd,¹ Robert Parks,¹ Justin Pollara,¹ Guido Ferrari,¹ Jae-Sung Yu,¹ Nathan Vandergrift,¹ David C. Montefiori,¹ Magdalena E. Sobieszczyk,³ Scott Hammer,³ Shelly Karuna,⁴ Peter Gilbert,⁵ Doug Grove,⁵ Nicole Grunenberg,⁴ M. Juliana McElrath,⁴ John R. Mascola,⁶ Richard A. Koup,⁶ Lawrence Corey,⁴ Gary J. Nabel,^{6†} Cecilia Morgan,⁵ Gavin Churchyard,⁷ Janine Maenza,⁴ Michael Keefer,⁸ Barney S. Graham,⁶ Lindsey R. Baden,⁹ Georgia D. Tomaras,¹ Barton F. Haynes^{1*}

The English of this paper authored by about fifty people from East and West, seems really the language of all and nobody.

THE ILLUSION OF HAVING UNDERSTOOD

The feeling of familiarity appears suddenly deceptive when scientists try to find the right words to transfer their own ideas from one language to another.

The cognitive approximation and the discrepancy between being sure of having fully understood and the level of actual ownership of the text, clearly appears

It is not the presentation of experimental data which hampers the comprehension, but, rather, the inability to master the mental models and to grasp the citations implied in the text.

Here, one stands alone in front of the words, shielded only by its competence and its own cultural sensitivity.

(ML Villa, L'inglese non basta, Mondadori, 2013).

THE SCIENTIFIC LANGUAGE IS CHALLENGED BY THE FUZZINESS OF COMMON WORDS

Science requires to transform words into unambiguous terms and symbols, but in creating terms and in defining and updating their meanings, it depends from the imprecise richness of common words.

"No mathematician would think by formulas"

Incisively asserted Einstein, indicating that the rigorous and formalized language does not free the science from natural languages to explain technical terms and to define their conceptual and objectual references

THE MESSAGE OF EQUATIONS

Even the *strongly* formalized equations of the physics need *language to figure out what is going on* :

$$E = mc^2$$

Is a well-known equation, but what does it say?
To understand it we need to know the
names of the variables.

**Without verbal context an equation is
neither true nor false.**

**It is a very powerful tool but it is also *parasitic* to the
human languages that surround it, and tell us what the
variables represent.**

AREAS WHERE OUR MENTAL LEXICON HAS BEEN WIRED

The language is not only the vehicle to exchange informations; it is *also, and above all*, the way to produce ideas and make them clear to ourselves.

When we try to express our thoughts with the highest possible accuracy, we must resort to the deepest cognitive areas where our mental lexicon has firstly been wired.

Here the mother tongue has a greater ability to give substance to thoughts and turn them into clear words.

Here a word may vehicle other words, with a richness that secondary languages barely recreate.

In the ground, where the new ideas are born, even science rediscovers the plurality of languages and their historical connections with the cultural heritage that feeds them.

THE CRUTCHES OF POINCARÉ

The great mathematician Henri Poincaré, in a series of six conferences held in Göttingen, used the German in the first five, but the French in the sixth, stating:

Mesdames, messieurs :

*Today I have to speak French, and I must apologize for it. It is true that in my earlier lectures I expressed myself in German, in very bad German: to speak foreign languages, you see, is to want to walk while one is lame; it is necessary to have crutches; my crutches were until now mathematical formulas, and you could not imagine what a support they are for an orator who does not feel himself very firm. In this evening's lecture, I do not want to use formulas, I am without crutches, **and that is why I must speak French.***

*(*Mécanique nouvelle, Henri Poincaré Göttingen, 28 avril 1909; translated by Gordin)*

THE TEMOIGNAGE OF LAFFORGUE

The awareness that *intellectual work has requirements that the communication does not include* echoed through the statement of Laurent Lafforgue (French mathematician, Fields Medal 2005), released in French and published in English by the journal Nature:

“Although most scientists are in principle inclined to embrace the idea of one language for communicating, the dominance of English can disadvantage non-English speakers.

*The most creative thinking tends to be done in the language in which a person feels most at home”
...“it is to the degree that the French mathematical school remains attached to French that it conserves its originality and its force”*

(154 | NATURE | VOL 519 | 12 MARCH 2015 COMMENT)

SHALL WE EXIT THE MONOGLOT TRAP BY THE WEB?

Could it be possible,

in a world where English is the global language used to give universal fame to new ideas, to celebrate further the multilingualism as an instrument for preserving cultural diversity ?

Could it be possible

to communicate in vehicular English, **and at the same time keep thinking with the language in which everyone feels most at home?**

The answer to these questions is very difficult but the analysis of linguistic associations contained in the web can provide some unexpected suggestions

A PAPER FROM *PNAS*: LINKS THAT SPEAK

“Links that speak: The global language network and its association with global fame”

This is the title of a successful article published on the Proceedings of the National Academy of Sciences (PNAS) on December of the last year* .

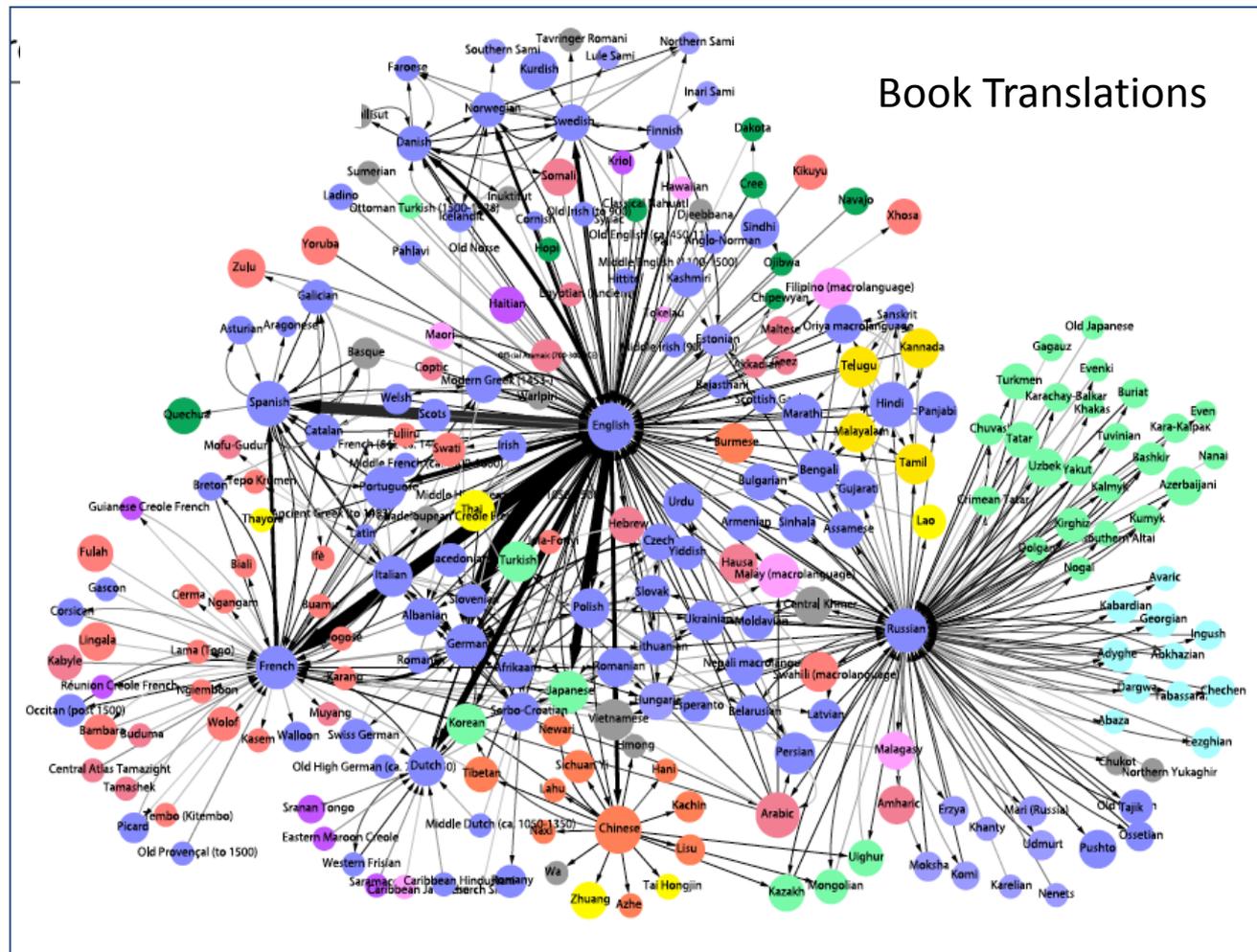
Authors of this paper are several famous researchers that have collected a large number of data from three multilingual *Global Language Networks* (GLN) including **1-book translations , 2- citations of Wikipedia, and 3-Twitter Messages**

(*S.Ronen, B. Gonçalves, KZ Hua, A.Vespignani, Steven Pinker, et César A. Hidalgo, 1PNAS | Published on line, December 15, 2014 | E5617).

LANGUAGES AS HUB

The GLNs -according to the authors- reveal that the languages of the world have a *hierarchical structure dominated by a central hub, which is English, and a halo of intermediate hubs, which includes other global languages (French, Spanish, Russian, German)*

The novelty is the definition of languages in terms of HUB, according to a cyber-airport metaphor well documented by the images (here the translation of books)



A GOOD METAPHOR FOR A MULTILINGUAL WORLD

Like all good metaphors, HUB contains much more than what it would mean

In computer science and telecommunications, a hub (literally fulcrum) represents a knot of a network of data: *materials are brought in the central location and sorted for delivery to a variety of destinations.*

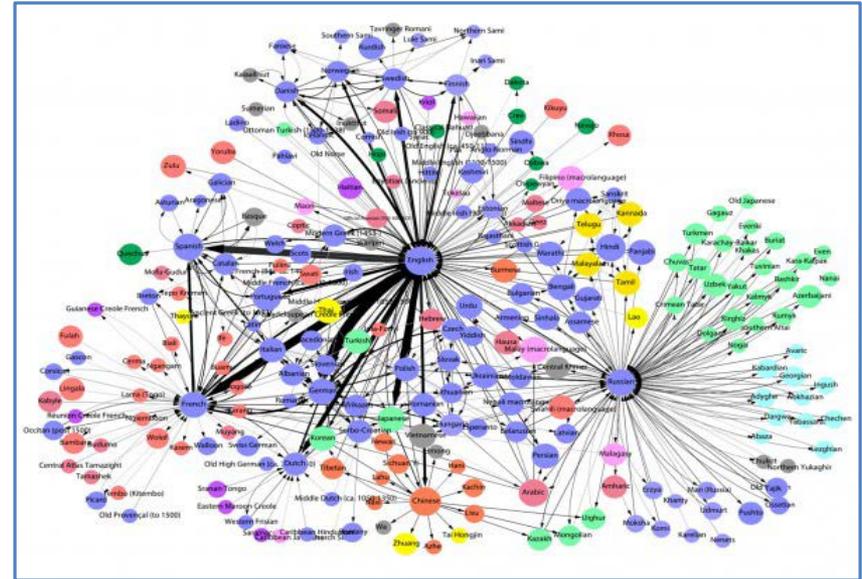
Accordingly, English-language-HUB shall work no more as a point of arrival, but as a «sorting device» for multiple terminal landings

The English-language-hub *is very rich of connections, showing the most transmissions to and from other languages: we shall use it as transfer point, but we must not fail to leave and reach our intended destination.*

STAY CONNECTED AND LET YOUR IDEAS MOVE AROUND THE WORLD

All languages, both major and minor, benefit from being linked through large and small hubs:

If you are isolated, your communications can barely reach speakers of other languages.



“If I want my national language to be more prominent, then I should invest in translating more documents, encouraging more people to tweet in their national language,”

“On the other side, if I want my ideas to spread, I should pick a second language that’s very well connected.”

(S. Ronen, <http://news.sciencemag.org/social-sciences/2014/12>)

The true language of the global world is the translation

CONCLUSION

To conclude, I want to remember that in the 90s of the twentieth century, a naive interpretation of globalization drew the image of a world without history, ubiquitous, mobile and monoglot.

Early in this century, we realized that the history has not ended, geography is not dead and the future will be multilingual.

The duty for us is to learn the languages of the neighbors without abandoning ours, using them within the wealth of the local context.

Being fluent in English and have nothing more to say, would be a very tragical outcome.

*Please, let me end with a short sentence in
my neglected mother tongue:*

***Nella scienza, come in ogni arte, ciò che
serve per elaborare il nuovo è certamente
più profondo e diverso da ciò che serve in
seguito per pubblicizzarlo.***

F I N E