The global system of science and the changing structures of international collaboration

Conference: Why Research in Internationalization Matters.

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I The genesis of global science

„Science is by definition international“

(Spanish biologist at EMBL, Heidelberg, 2004)

Science is international on the historical basis of the construction of institutions (lasting for centuries) that support and guarantee the globality of science.

Goal of the talk: Giving a brief overview of the genesis of the institutions bringing about the globality of science – and describing recent transformations of science in terms of cooperation and collaboration.

Institutions of global science

The European university (since 1200) as a local hub in a global system of scholarship.

Europe-wide migration as the process connecting the local hubs, effecting transfers of knowledge and persons.

Libertas academica as the juridical background to autonomy.

Res publica literaria/république des lettres as the claim for the self-government of an autonomous and European community of scholars (17./18th centuries)(claim for autonomy formulated in a political language)

Institutions of globality in the second scientific revolution (1760-1840)

The emergence of the scientific discipline as the basic social, cognitive and communicative unit in the internal differentiation of science. The scientist as specialist in a global discipline. Disciplines as epistemic communities.

The publication as the highly standardized element of scientific communication formulating a global claim for truth.

Research as a global imperative for the incessant transformation of scientific knowledge (after 1780).

Inclusion revolutions in global function systems

The re-emergence of global science based on an „inclusion revolution“ (including everyone who is able to do specialized research and able to publish it in the forms that are defining of science).

„Inclusion revolution“ as a process characteristic of all function systems (transforming elite systems into systems open for everyone) and going on in our days.

II Cooperation, collaboration, coauthorship

Individuality in science

Modern science is first of all an individual search process for novelties that in its results is addressed to colleagues who function as observer, critic and competitor. Individual contributions are formulated on the basis of what has been done by colleagues before. Social relations are based on connectivity (affirmed by citations) and small variations.

Cooperation

Single authorship is until 1900 the dominant form of the inclusion of individuality in science.

In the ‚New England Journal of Medicine' single authorship amounts to 98% of contributions in 1900. Until 2000 it falls to 5%.

Coauthorship succeeds to single authorship as the dominant form of contributing to science. It is a reaction to increasing complexity in science: complexity of problems, multiplicity of necessary data, availability of instruments, differentiations and individual specialization relating to theories and methods and other competences relevant for doing science.

Cooperation and coauthorship contributes to inclusion into science: It enables publication for those who have only „half a paper in themselves at the present moment in time" (De Solla Price). Cooperation maintains and enlarges inclusion in a system of science becoming ever more complex.

Groups

Individuality in science is over the 20th century progressively supported by group membership. One has a group, is a leader of a group, defines one‘s work as being part of a group. But publication is invariably based on the attribution of individual authorship. At the same time there is an incessant and accelerating growth of the number of authors per paper.

Cooperation, coauthorship and the progressing of globalization

Over the course of the 20th and early 21st century there is an incessant growth of:

multiple authorship (three authors per paper being the most frequent case today)

number of institutions represented by individual authors

number of institutions represented by the same author

number of countries represented by institutional addresses of individual authors

number of disciplines represented by individual authors (a switch from interdisciplinarity to multidisciplinarity)

The increasing complexity and globality of authorship is driven by the complexity of tasks and the search for status/citations.

The growth of number of authors, number of institutions, number of countries, number of disciplines is caused by looking for persons who are able to master one of the many relevant tasks and who via their institutions, countries, disciplines bring scientific status to the papers one wants to publish.

At the same time the published paper is cited more often if more authors, more institutions, more countries and more disciplines are added.

The logic of advancing institutional complexity is furthered by making use of cumulative advantage and hoping for further cumulative advantage.

Top institutions/highly ranked institutions are hubs in the small world network of authors, institutions, countries and disciplines

MIT as a university defined by its incoming president as a collaborative endeavor.

Internationality is an opportunity structure for complexity – the search for complexity of science is the cause of the internationality of science.

III The rise of hyperauthorship

The rise of hyperauthorship

Higgs boson postulated in a trio of papers in 1964. Two of them solely authored by UK theoretical physicist Peter Higgs, the third paper has three authors: Higgs, Brout, Englert.

Experimental confirmation published in 2012 in a paper with 2.932 authors.

A more precise measurement of the mass of the Higgs boson published in 2015 in a paper with 5.154 authors.

In 2021 a research paper examining the effect of Sars-CoV2 vaccination on Covid-19 infections and mortality with 15.025 authors

Three types of papers in presentday science

Single or plural authorship of **up to ten authors** = 95% of science

Multiple authorship of more than ten authors connected to higher impact = 5% of science

Hyper-authorship beyond 100 authors and/or 30 countries <1%, but fast rising in many disciplines

Significant impact on the citation impact of some countries,

Especially for small countries (Sri Lanka, Impact x5)

But even for big countries like the USA

Small effect in the case of China (national authorship 75%)

What is behind hyperauthorship

Search for statistical power: e.g. effects of genetic variants on the function and structure of the brain.

Structural change of the scientific paper: it resembles a **metaanalysis**

The rise of consortia that collect data of working groups around the world: **Enigma** in genomics, neurology and psychiatry; **Many babies consortium** in developmental psychology; **Psychological science accelerator** in psychology.

Inclusion and diversity as a structural motive – inclusion of younger scientists, female scientists, more and up to now marginal countries.

Complex coordination of writing processes of papers – Google docs as technology.

An explicit taxonomy of scientific roles qualifying for authorship – Contributor roles taxonomy.

Significant influence on the citation impact of small countries (x2 in big countries, x4-x11 in small countries)

A second system of science?

The shadow world of **predatory journals** and **fake authorship –** another path of inclusion into science?