CNRS researchers' popularization activities: a progress report

Pablo Jensen, Yves Croissant

SISSA – International School for Advanced Studies Journal of Science Communication
ISSN 1824 – 2049 http://jcom.sissa.it/

Article

CNRS[1] researchers' popularization activities: a progress report

Pablo Jensen, Yves Croissant

We have analyzed the popularization activities undertaken by ten thousand CNRS researchers by means of their annual reports[2] for the years 2004, 2005 and 2006.
This is the first time that such an extensive statistical study on science popularization practices is carried out. Our main findings are :

- *the majority of researchers is not involved in popularization (51% has not done any popularization over the three-year period, two thirds have been involved in no more than one popularization action).*
- *popularization practices are extremely diverse, both at the individual level (we have identified three subpopulations that feature distinctive attitudes towards popularization), and at the level of scientific disciplines (researchers in Humanities are twice as active as the average), as well as in laboratories or geographical regions.*
- *the number of actions reported in 2005 greatly increased compared to 2004 (+ 26%), while they slightly diminished in 2006.*

Introduction: popularization, an element in science-society relations

Restoring the symmetry between science and society

Academic studies on the relations between science and society, be they qualitative or statistical, have so far been rather asymmetrical. They have mostly focused on the perception of science by the public, setting aside researchers' perception of the public. In particular, the main statistical indicators (Eurobarometers [1] or the surveys by the National Science Foundation [2]) have revealed that the public trusts "science" when it is presented as an abstract category, but that its attitude is more complex when it comes to specific fields or applications [3],[4].

This asymmetry in the approach to science-society relations is in line with the so-called deficit model [5]-[8]. Between 1960 and 1985 the teaching of elementary scientific facts and methods of the public was a priority, as the public was viewed as illiterate in this respect. Subsequently (up to about 1995), a slightly less science-centric vision prevailed (the so-called Public Understanding of Science), which acknowledges that the public may have opinions that deserve to be analyzed. Yet deep down, handing down information to the public remained a priority, as this was expected to secure its endorsement of the vision held by scientific authorities. During the 1990s a new and more balanced view of relations between science and society began to compete with, or complement, the deficit model [4],[9]-[11], which was grounded on a more "generous" vision of the public [12] as well as on the numerous criticisms of the previous approaches: the knowledge of the "facts" of science taken out of their context is understood to be more alienating than it is informative (a criticism previously expressed with the term "*showcase effect*" [13]), the relation between the knowledge of science and its appreciation is empirically unsolved… In short, the deficit model insists on the certainty of science and its irremovable nature, as

[1] Centre National de la Recherche Scientifique (National Center for Scientific Research) is a government-funded research organization, under the administrative authority of France's Ministry of Research.
[2] CRAC – comptes rendus annuels des chercheurs

well as on the pedagogical side of science-society relations, while the "contextual" model focuses on the uncertainties that exist within science and on the ties with social institutions.

Several researchers therefore admit that the main stakes in the relations between science and society are held within the scientific community itself, previously viewed as monolithic and beyond reproach. For Bryan Wynne, researchers too have prejudices, particularly regarding the public's ignorance [10]. Sheila Jasanoff, president of the association for Social Studies of Science, claims that researchers are the ones that ought to change, not the public. She writes [14] that the challenge facing science is to connect once again its knowledge to that of the majority of the people, who live parallel lives on the same planet and experience, in their own way, the same realities. She believes that "the public understands science already, in a way of its own, that is invisible to most researchers. The public thus perceives the historical, institutional, political, utopian, imaginary and practical aspects of science". Naturally these do not always match those that scientific institutions would like to communicate, as they mostly seek an uncritical acceptance of the authority of science.

The outreach policies of scientific institutions

For several years now researchers and academic institutions seem to have admitted to the importance of establishing strong ties between science and public opinion, at least as far as *public outreach* is concerned. Some practical examples follow.

In a letter to the CNRS staff in 2005, Bernard Larrouturou, then general director, stated the importance of taking into consideration "scientific culture popularization actions" for the evaluation of researchers: "one must insist that they give equal importance to scientific work and to activities related to the popularization and dissemination of scientific culture: participations in "open door" events, or the publication in magazines or other popularization works, in events organized for non-specialized audiences, newspaper articles or TV appearances, etc.". In the document that was supposed to steer his long-term policy, the "Multi-year action plan" [17], the CNRS thus declares that: "If current [evaluation] practice is suitable for the purpose of evaluating academic research, the same cannot be said for interdisciplinary activities and for other avenues of scientific work: transfer and enhancement of scientific knowledge, teaching, dissemination and popularization. Consequently, the work by CNRS researchers who choose to engage in these activities, which are very necessary for the CNRS, is not adequately acknowledged and researchers are therefore reluctant to proceed in this direction." This attitude seems to be shared by the majority of researchers: in her study on the attitudes of researchers with reference to popularization [19], Suzanne de Cheveigné concluded: "All interviewed researchers unanimously declared: popularization is now a key and unavoidable component of research work." Motivations provided by researchers are numerous: the yearning to inform the public, to make one's field of research better known and encourage students to take up science, or even the need to account to civil society for the use of funds provided to laboratories.

In the United Kingdom, Martin Rees, president of the Royal Society, also points out that "Researchers need to engage more fully with the public. The Royal Society recognizes this, and is keen to ensure that such engagement is helpful and effective […] The Royal Society has resolved to take several initiatives in response to the Consultative Group's recommendations. We hope the findings will be helpful to other funding organizations, universities and research institutions in their efforts to promote and enhance the engagement of researchers with the public." One of their findings is that "Most researchers have highlighted that social and ethical implications exist in their research, agree that the public needs to know about them, and believe that researchers themselves have a duty, as well as a primary responsibility, for communicating their research and its implications to the non-specialist public." [16]

On the other hand, aside from the *outreach activities* carried out on more or less voluntary terms by institutions, the actual reality on the field appears to be marked by contrasts. Hence, in his report submitted for his application as CNRS "Directeur de Recherche" (Senior Scientist), a mere 9 lines are provided to summarize some fifteen years of economic and cultural enhancement of research. Likewise, the Royal Society survey concludes that for scientists research work is the only respectable activity: "research is the only game in town", and popularization has to be done after one is through with "real" work.

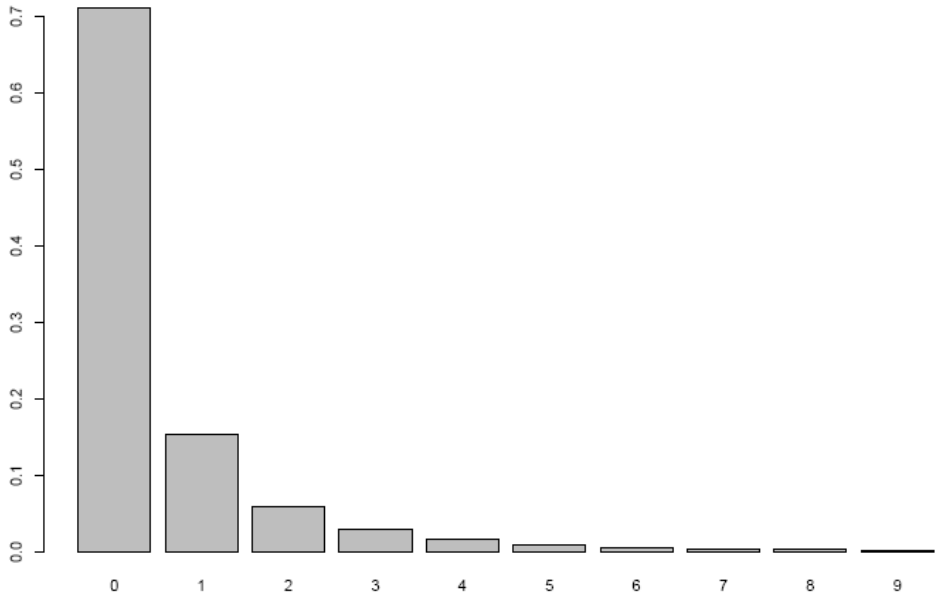

Figure 1. Distribution of researchers according to the average number of actions over a given year. About 70% of researchers do no popularization actions at all in one year.

A progress report on CNRS researchers' popularization activities

In such a context, it is essential to analyze researchers' popularization activities, in the sense of direct exchanges between researchers and the general public on scientific issues. Studies on popularization practices of researchers are rare. Among these is a statistical and qualitative analysis on the "Role of researchers in scientific popularization" made in 1992 and never published [18], a qualitative study on CNRS researchers in 2000 [19], and a first description of the status of statistical studies of CNRS researchers' popularization activities in 2004 [20]. Last year, a statistical study on "the factors affecting scientific communication by researchers and engineers" was conducted by the Royal Society on a sample of more than 1000 researchers and engineers in the U.K. [16].

In this article we present the first exhaustive study (involving all CNRS researchers), on popularization practices over a three-year period (2004-2006). By following the same researchers over three years we are able to better understand their attitude towards popularization and possible trends.

Everyone working in a specific scientific field has their own perception of researchers' popularization practices. Hence, one often hears that "it's always the same people that get down to it" or that "young researchers are more open to popularization". The data we have collected enable us to examine more systematically the reported practices and to outline the popularization activities of CNRS researchers. We have examined the characteristics of researchers that may influence their behavior, such as the scientific field in which they are involved, their age or gender. We first present some tables with raw data, while the ones obtained by means of a statistical analysis enable us to measure the isolated effect of each variable, all other things being equal. Indeed, as several characteristics are correlated to one another, the raw data combine the effects of the individual factors, suggesting false determinants for popularization activities.

Distribution of popularization activities

CNRS researchers declare some 7000 popularization activities a year, that is about twenty a day which, however, amounts to less than one per researcher (approximately 0.6). However, calculating this average is rather meaningless, since the distribution of such activities is extremely uneven. Hence, 5% of the

most active researchers account for half the popularization activities. At an individual level, one can identify three subpopulations [20]:

- a "silent majority", one researcher in two has never been involved in popularization work; 2 in 3 have at most once in three years.
- a minority open to popularization: one in three researchers is involved in popularization activities 1-4 times a year.
- active science communicators: 3% of researchers often do popularization work (more than 4 times a year) and account for 30% of CNRS activities.

The existence of three subpopulations defined by their regular attitude towards popularization can be confirmed by following the individual activity of each researcher over three years. To this purpose let us call c_3 the portion of researchers that has always dealt with popularization (with a number of actions in 2004, 2005 and 2006 greater than zero), c_2 the portion of researchers who do popularization work in at least two out of three years (with a number of actions greater than zero in 2004-2005, or 2004-2006, or 2005-2006), and c_1 the portion of researchers who did some popularization work in any one given year and c_0 the portion of researchers who never did popularization work in three years (number of actions in 2004, 2005 and 2006 equal to zero). The values extracted from real data are: $c_3 = 0.125$; $c_2 = 0.16$, 0.15 and 0.20; $c_1 = 0.26$, 0.30 and 0.30; $c_0 = 0.507$. The three values given for c_1 and c_2 correspond to the possibilities for choosing the years to be considered. The fact that they are relatively constant suggests that a simple model, in which researchers have constant attitudes can account for these data.

A first assumption is that all researchers share the same fundamental attitude towards popularization, and that the difference in their levels of activity is due to the different solicitations from one year to the next, or to the fluctuations in their professional and personal lives. Translating this into figures means that the popularization probability over a year is the same for all. This model, however, does not reproduce real data, as the probability ought to be equal to c_1, that is 0.30 but in that case the portion of researchers who did no popularization work at all in three years should be equal to $(1-0.3)^3$, that is 0.34, which falls considerably short of the real value, that is $c_0 = 0.507$. One could therefore assume that there is a group of inactive researchers (c_i), which does no popularization work at all complemented by a portion of researchers $1-c_i$ having a fixed probability of doing popularization each year. But an assumption similar to the previous one, this time applied to those who bare active over the three years also leads us to dismiss this model, as it envisages too small a portion of active researchers. One therefore reaches a model of three populations which is the only one that can conveniently accommodate the data. By making adjustments one finds the data with the following characteristics:

- a portion of 0.43 who never do popularization;
- a portion of 0.50 who sometimes do popularization work with one probability of 0.46 each year;
- a portion of 0.07 who does popularization each year.

One can compare these populations with the ones presented above, based on the number of actions per year, to get an idea of the different possible interpretations. Clearly these are always simplifications and more than three populations exists. The number three represents a minimum to account for the data available to us.

Types of popularization activities

To draw up their annual report, researchers must specify the type of popularization activities that they claim to have performed. The following tables display a distribution of types of activities according to the different scientific departments of the CNRS. These categories changed between 2004 and 2005. Subsequent to the analysis of the 2004 reports the categories have been fine-tuned, in order to better indicate the type of activity and avoid the large number of occurrences of activities defined as "0ther" in 2004.

It is interesting to analyze the misrepresentation of certain disciplines for each type of activity. For instance the over-representation of HSS researchers in Radio/Television and, to a lesser extent, in activities involving associations, the press and conferences. Not surprisingly, these researchers are by far under-represented in "open door" events. On the other hand, their weak presence in schools is food for thought for the community. The NPP, CS and ES departments are over-represented in "open door" activities, which are relatively scarce in LS. These departments are rather absent from actions involving the press, radio or publishing.

	NPP	CS	ESA	LS	HSS	ES	PMS	ICS
Other	0.48	0.33	0.32	0.33	0.25	0.37	0.32	0.36
Publishing	0.03	0.11	0.08	0.06	0.11	0.09	0.09	0.12
Exhibitions	0.11	0.12	0.07	0.07	0.07	0.04	0.08	0.07
Movies/Multimedia	0.04	0.03	0.06	0.04	0.06	0.03	0.03	0.03
Press	0.14	0.23	0.18	0.26	0.21	0.29	0.30	0.26
Open doors	0.16	0.13	0.11	0.07	0.02	0.15	0.12	0.09
Radio/TV	0.04	0.06	0.17	0.16	0.27	0.03	0.07	0.07

Table 1. Distribution of popularization actions by type and scientific department in 2004 (the total is equal to 1 for each scientific department). The meaning of the acronyms is the following: Chemical Sciences (CS), Nuclear and Particle Physics (NPP), Earth, Sciences, Astrophysics (ESA), Life Sciences (LS), Humanities and Social Sciences (HSS), Engineering Sciences (ES), Physical and Mathematical Sciences (PMS), Information and Communication Sciences (ICS).

	NPP	CS	ESA	LS	HSS	ES	PMS	ICS
Other	0.13	0.12	0.08	0.09	0.05	0.11	0.10	0.11
Conference/Public debate	0.22	0.16	0.28	0.19	0.28	0.22	0.22	0.19
Exhibitions	0.09	0.12	0.06	0.06	0.05	0.09	0.11	0.14
Actions aimed at associations	0.02	0.03	0.04	0.04	0.06	0.02	0.03	0.04
Actions in schools	0.13	0.14	0.11	0.11	0.03	0.10	0.16	0.11
Books/CD-Rom/Software	0.02	0.03	0.04	0.03	0.04	0.04	0.05	0.05
Open doors	0.16	0.15	0.08	0.07	0.02	0.12	0.12	0.10
Newspapers and magazines	0.09	0.13	0.13	0.20	0.19	0.17	0.13	0.16
Radio/TV/Movies	0.07	0.06	0.13	0.15	0.24	0.08	0.05	0.05
Popularization website	0.07	0.05	0.04	0.04	0.04	0.05	0.04	0.05

Table 2. Distribution of popularization actions by type and scientific department in 2005 (the total is equal to 1 for each scientific department). The meaning of the acronyms is explained in table 1.

	CS	NPP	ESA	LS	HSS	ES	PMS	ICS
Other	0.14	0.11	0.06	0.10	0.05	0.10	0.10	0.10
Conference/Public debate	0.18	0.24	0.28	0.19	0.30	0.20	0.24	0.23
Exhibitions	0.09	0.08	0.06	0.05	0.06	0.11	0.11	0.09
Actions aimed at associations	0.02	0.03	0.05	0.05	0.05	0.04	0.04	0.02
Actions in schools	0.14	0.14	0.09	0.14	0.02	0.13	0.11	0.10
Books/CD-Rom/Software	0.03	0.02	0.04	0.03	0.04	0.03	0.04	0.05
Open doors	0.16	0.09	0.08	0.09	0.01	0.13	0.12	0.13
Newspapers and magazines	0.13	0.14	0.15	0.18	0.19	0.13	0.13	0.14
Radio/TV/Movies	0.06	0.06	0.14	0.14	0.22	0.08	0.07	0.06
Popularization website	0.06	0.08	0.05	0.03	0.05	0.05	0.05	0.08

Table 3. Distribution of popularization actions by type and scientific department in 2006 (the total is equal to 1 for each scientific department). The meaning of the acronyms is explained in table 1.

Active science communicators

They are about 300 researchers who devote a sizeable part of their efforts to the popularization of science, selected according to their regular activity (at least four actions a year). HSS (a department which only has one researcher in 7 staff members) accounts for approximately half of these researchers, 30% of whom in the Regional Directorate Paris A (which accounts for less than 9% of staff). They devote considerably more time to teaching than the average (24 hours instead of 15 a year). They are more often Senior Scientists (45% compared to an average of 39%) and can be found especially among the researchers of the Sections “Human and environmental evolution and interactions”, “Sociology: rules

	n04	n05	n06	number	gross	isolated
CS	0.34	0.33	0.35	1561	0.00	0.00
NPP	0.54	0.69	0.56	312	0.77	0.79
CA	0.82	1.24	1.23	709	2.23	2.11
LS	0.33	0.46	0.46	2359	0.23	0.29
HSS	1.25	1.56	1.51	1533	3.25	2.81
ES	0.55	0.58	0.48	496	0.58	0.40
PMS	0.37	0.52	0.48	1152	0.33	0.34
ICS	0.56	0.55	0.42	587	0.50	0.47

Table 4. Popularization according to the scientific departments. *n04*, *n05*, and *n06* represent the average number of actions per researcher during the years 2004, 2005 and 2006, *number* is the number of researchers for the department included in our study (on a total of 8745), *gross* and *isolated* are the supplementary percentage of actions per researcher (over the three years) with respect to the chemistry department, in gross terms and all other things being equal respectively. The meaning of the acronyms is explained in table 1.

and regulations", "Politics, power and organization" and particularly "Solar systems and the universe", where their presence is four times greater than the average. A small fraction of these active science communicators can be considered to be "semi-professionals" of scientific communication, as the time they devote to popularization is comparable to the time spent in proper research work. For example, some 30 researchers that have undertaken over 30 activities in three years. These "semi-professionals", just like active science communicators belong to HSS and to the section "Solar systems and the universe", half of them being CR1 (1st class Junior Scientist) and the other half DR2 (2nd class Senior Scientists). This implies career problems, as the central part of their evaluation is based on strict research criteria, with outreach activities, etc. playing a secondary role in sharing any leftover time.

Tables describing researchers' characteristics

We would like to present an exhaustive description of the characteristics considered in our analysis which are likely to influence the behavior of researchers with respect to popularization:

- scientific department or section
- age
- position (CR2, CR1, DR2, DR1)
- region
- gender
- time devoted to teaching

Scientific disciplines

The CNRS is divided into scientific departments (eight in 2004) that specify the general field of research. A more fine-grained division is constituted by the 40 sections, which indicate the scientific disciplines.

Our findings indicate that popularization practices are greatly influenced by the scientific discipline in which the researcher is involved. Hence, half the researchers declare to be involved in the Department of Humanities, while science communicators only amount to about one fifth of the departments PM (physics and mathematics), LS (life sciences) and CS (chemical sciences). The influence exerted by the scientific discipline is also revealed by the average number of actions: 1.4 for HSS, as against 0.3 for chemistry, physics or biology (see table 4).

In the Humanities Department, this large number of actions can be partly accounted for by the fact that its research work is connected with domains that are much closer to the everyday concerns of the public. The second position held by sciences of the universe is also easily explained by the great demand of the public for this suggestive field of studies. And yet, an assumption based on the "demand" for popularization would suggest considerable activity in the Life Sciences Department (considering, for instance, the public's interest in issues like GMOs, life, health, etc.), while this department ranks second to last!

	actions	numbers
Mathematics	0.37	2.59
Physics, theory and method	0.40	2.28
Interactions, particles and strings	0.61	3.52
Atoms and molecules, lasers and optics	0.48	2.79
Condensed matter: organization and dynamics	0.61	2.70
Condensed matter: structure	0.42	2.51
Information science and technology	0.50	3.48
Micro and nano-technologies, electronics and photonics	0.50	2.92
Materials and structures engineering	0.61	1.73
Fluids and reactants: transport and transfer	0.57	3.43
Super and macromolecular systems, properties and functions	0.39	2.65
Molecular architecture synthesis	0.27	2.46
Physical chemistry: molecules and environment	0.38	3.27
Coordination chemistry: interfaces and procedures	0.37	3.38
Materials chemistry: nanomaterials and procedures	0.35	3.32
Biochemistry	0.28	3.30
Solar systems and the universe	1.68	2.29
Earth and earth plants	0.87	2.54
Earth systems: superficial layers	0.87	2.14
Continental surface and interfaces	0.76	1.76
Molecular basis and structure of life systems	0.24	3.17
Genomic organization, expression and evolution	0.25	3.86
Cellular biology: organization and function	0.24	2.79
Cellular interaction	0.26	2.84
Molecular and *integrative* physiology	0.32	2.86
Development, evolution, reproduction and aging	0.33	2.43
Behavior, cognition and brain	1.02	2.49
Integrative *vegetal* biology	0.26	2.49
Biodiversity, evolution and biological adaptation	1.02	2.12
Therapy, pharmacology and bioengineering	0.36	2.25
Human and environmental evolution and interactions	1.67	2.16
Ancient and medieval history	1.44	2.35
Modern and contemporary history	1.70	1.49
Languages, language and speech	0.96	1.96
Philosophy, history of philosophy and text science	1.37	1.78
Sociology rules and regulations	1.47	2.23
Economics and management	0.71	1.41
Society and cultures: comparative approaches	1.45	1.61
Environment, territory and society	1.85	1.12
Politics, power and organization	1.89	1.54

Table 5. Average number of popularization actions according to the CNRS functions. The second column indicates the percentage researchers from the section compared to the total of the CNRS. The horizontal lines single out a part of the *sample* in Scientific Departments: in the order MPS, ICS, ES, CS, CA, LS and HSS (NPP corresponds to the section "Interactions, particles and nuclei").

A more fine-grained analysis in terms of scientific sub-fields enables us to comprehend this last point (table 5). Indeed, the biology sections dealing with issues that have sparked the interest of public debate (the brain, GMOs, etc.), account for an average number of actions (close to 1) that is considerably higher than the others. Furthermore, the economics section is scarcely involved in popularization work compared to other Humanities (on average 0.7 instead of 1.4 actions per researcher), whilst the subject matter is one that would be expected to feature frequent activities. Could that be evidence of the "autism" of some economics theoreticians denounced by part of the community?[3]

[3] See, for instance, the online journal Post-Autistic Economics: http://www.paecon.net

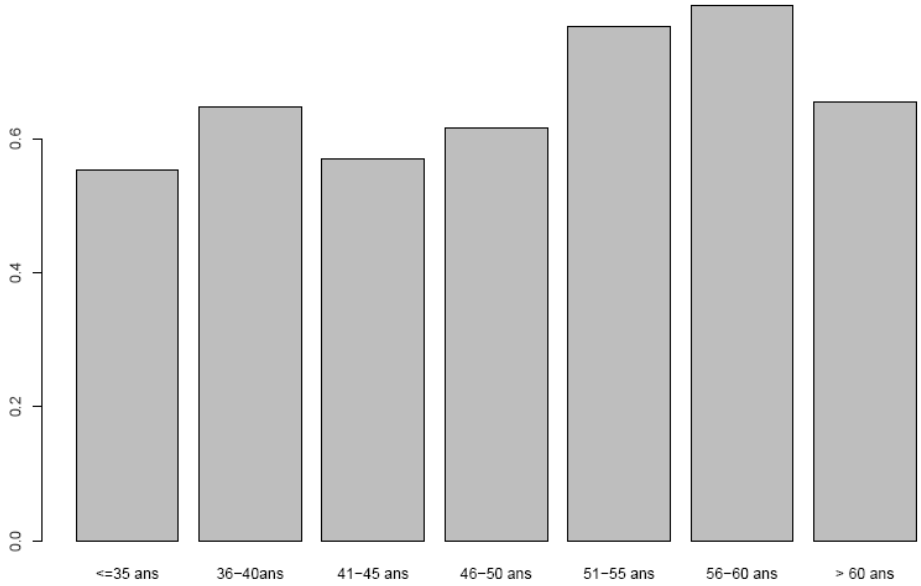

Figure 2. Average number of popularization actions according to age.

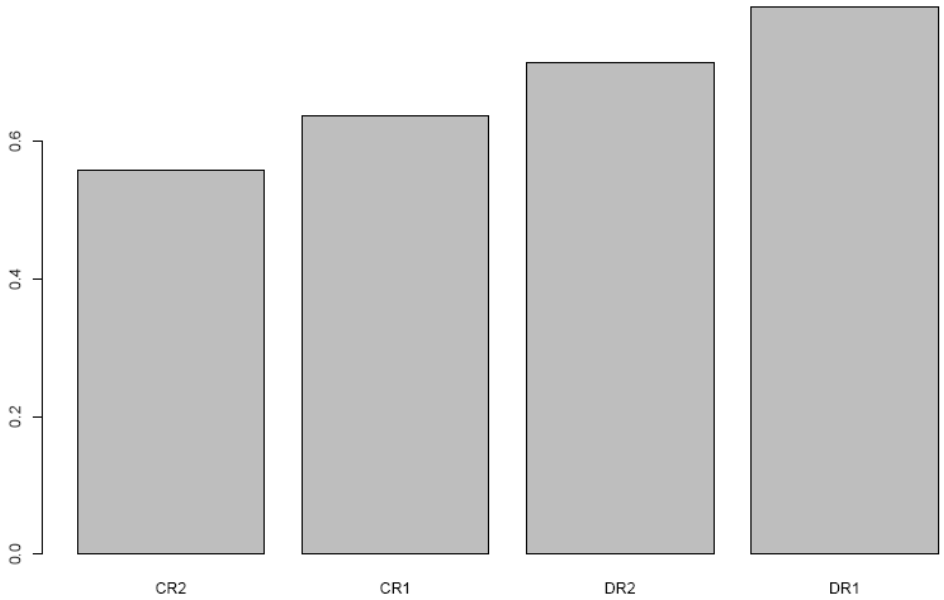

Figure 3. Number of popularization actions according to the researcher's position (average 2004-2005).

Position and age of researchers

Popularization activities tend to increase with the age of researchers (see figure 2) and range from 0.53 actions per researcher in the age bracket below 36 years to 0.8 for the 56-60 age bracket. The peak at 36-40 years of age seems statistically trustworthy but is not easy to interpret.

	actions	number	gross	isolated
Paris A	1.48	8.91	0.00	0.00
Paris B	0.51	8.54	−0.66	−0.37
Ile-de-France Est	0.66	5.59	−0.56	−0.29
Ile-de-France Sud	0.41	9.30	−0.73	−0.41
Ile-de-France Ouest et Nord	0.82	6.40	−0.44	−0.25
Nord-Est	0.69	2.96	−0.54	−0.24
Rhône Auvergne	0.61	7.14	−0.59	−0.27
Centre Poitou-Charente	0.93	2.71	−0.37	0.15
Alsace	0.39	4.92	−0.74	−0.42
Alpes	0.56	6.62	−0.62	−0.32
Provence	0.75	7.33	−0.50	−0.18
Languedoc-Roussillon	0.37	5.89	−0.75	−0.51
Midi-Pyrénées	0.49	6.62	−0.67	−0.38
Aquitaine-Limousin	0.62	4.06	−0.58	−0.23
Paris-Michel-Ange	0.43	3.43	−0.71	−0.34
Bretagne et Pays de la Loire	0.85	3.80	−0.43	−0.03
Nord, Pas-de-Calais et Picardie	0.49	2.20	−0.67	−0.44
Normandie	0.62	1.20	−0.58	−0.10
Côte d'Azur	0.61	2.36	−0.59	−0.34

Table 6. Average number of actions per researcher for each region (*statreg*), followed by the percentage of the number of researchers working there (*number*), *gross* and *isolated* are the supplementary percentage of actions per researcher with reference to the region Paris A, in gross terms and leaving the rest unchanged.

One can also analyze the influence of the evolution of careers through the position of researchers. The CNRS features two bodies of researchers: the "chargés de recherche" (CR) or junior scientist and the "directeurs de recherche" (DR) or senior scientists; each of these is further divided in two groups (1st and 2nd class).[4]

Popularization activities increase very steadily with the position (see figure 3), the average number of actions ranging between 0.5 for a CR2 to 0.8 for a DR1.

Geographical regions

The CNRS is divided into 19 regional delegations, of which 6 for the Paris area alone. Table 6 shows the average number of actions for the different regional delegations. The Paris A delegation lies considerably ahead of all the other delegations (1.48 actions per researcher, as against 0.9 for the second, Centre Poitou-Charente).

Teaching and gender

No significant difference can be seen between men and women (0.64 actions a year for both sexes).

More than half CNRS researchers is also involved in teaching. One can either hold the view that teaching and popularization both belong to the same approach of knowledge dissemination, or, on the contrary, that teaching is an activity that researchers undertake at the expense of popularization. The data seems to indicate a positive correlation, in favor of the "same approach" hypothesis. This correlation, which is statistically significant, is all the same rather weak (in the order of 10%).

[4] Owing to their scant presence, the positions "Directeur de Recherche de Classe Exceptionelle or Emérite" have been incorporated in the position of DR1.

Individual influence of each variable

In this section we wish to investigate the effects of the different characteristics of researchers and their popularization activities. We have conducted a statistical analysis intending to single out the individual effects of each one of these characteristics all other things being equal[5]. For example, for a (hypothetical) average researcher, we have analyzed the effect of his belonging to the Paris region, how much this increases (or diminishes) his or her average popularization activities in a year (compared to a researcher in the provinces). The following examples illustrate the potential interest of this approach.

Age and position

Let us start by separating the effects of the age of the researchers and their position, two variables which are definitely closely correlated. A statistical analysis shows that their position is the most pertinent characteristic. Indeed, when these two variables are included in the analysis, age is shown to be scarcely significant in terms of popularization activites. Somehow, the four position categories seem to be enough to account for the variations in popularization activities. Other things being equal (including age!), a researcher who is a 1st class Junior Scientist does 0.31 more popularization actions more than a 2nd class Junior Scientist, while a 2nd class Senior Scientists does 0.30 more, a 1st class Senior Scientist accounts for +0.56 and a "Directeur de Recherches de classe exceptionnelle", a *top-level Senior Scientist* +1.5.

Region

By examining the average number of actions by the researchers of the region Centre Poitou Charentes (table 6), one finds a considerable deficit compared to the region of reference Paris A. On the other hand, if one makes a statistical analysis of the influence exerted by the fact that a researcher belongs to this region, all other things being equal, the effect is found to be positive. This difference is accounted for by the different distribution of the researchers of the eight Scientific Departments between the two regions. In the Centre one finds more researchers from the departments that are less active in popularization (for example 24% from Chemistry compared to 17% at a national level), and less from the more active departments (SHS at 9% instead of 17%). These differences lead to a mechanical decrease in the average number of actions in this region, which very much needs to be compensated if one wishes to obtain the isolated effect of belonging to this region, for instance in order to examine the effect of regional communication policies. The origin of this remarkable regional popularization activity remains to be clarified by a qualitative survey at a local level.

Laboratories

A statistical analysis also enables us to investigate the influence of laboratories on popularization practices. Our data include almost 300 units with more than 10 CNRS researchers. A detailed study of the influence of each laboratory is not our objective. We have strived to reveal whether the existence of a "laboratory culture" can be found in popularization practices.

Naturally, researchers working in the same laboratory usually belong to the same field, or to the same region. These factors must therefore be removed in order to avoid adding further correlations to a hypothetical laboratory culture factor. We have therefore subtracted from the popularization actions of researchers the ones that can be accounted for by these other characteristics, in order to be left with the ones that may reveal, besides the specific characteristics of researchers (not accounted for in this study), the influence of the immediate environments, namely the lab. A standard statistical analysis (test F)

[5] The variable that we have sought to make explicit is a *counter* variable (integer, either with vanishing or positive values). To make the estimate we have used a Poisson model, adjusted for this type of variable. The statistical analysis made with the open software "R" (http://www.r-project.org/).

shows significant differences (more than 99.999%) between the averages of the remaining actions, revealing a considerable variety among labs with regards to popularization[6].

The following are a examples of laboratories that significantly stray from the average: the UPR9010 (Center for Energy Ecology and Psychology in Strasburg), is collectively a very busy laboratory: its researchers accomplish 3.5 actions per year, and only 2 researchers in 10 have not done any popularization in two years (as against an average of 7 in 10). On the contrary, several laboratories have an anti-popularization culture: the 21 researchers of the UMR8558 (Center for Historical Research, School of Higher Education, Paris A), present negative residuals (they therefore do fewer actions than expected according to their characteristics), just like 30 of the 34 researchers at the UMR 8104 (Chemical Pharmacology, Paris A)[7].

One still needs to explain these different collective attitudes towards popularization: one can hypothesize a "laboratory culture" that promotes public outreach, as well as the greater or lesser ease with which certain subjects can be popularized.

Evolutions in 2004-2006

Researchers declared more actions in 2005, the total number increasing from 5291 to 6658 (+26%, that is from 0.57 popularization actions per researcher to 0.71)[8]. This increase concerns all Departments except for Chemistry and ICS. Two researchers in three maintained the same level of activity while 20% increased their activities (+2.14 actions on average), and 14% diminished them (-2 on average). The activity in 2006 was comparable to that in 2005, with a slight decrease (0.69 actions on average).

The "World Year of Physics" effect can also be witnessed in 2005, with a more marked increase in the related Departments (+0.17 per researcher, that is + 32%) compared to the others (+0.13 per researcher, that is +22%). At the regional level, the Ile de France increased its activities more than the average (+0.24 per researcher as opposed to +0.15).

In short, we propose a "virtual portrait" of the researcher that most increased his/her popularization between 2004 and 2005: a young 2nd class Senior Scientist, who lives in Paris and who took part in the World Year of Physics celebrations. For example, a forty years-old physicist, DR2, working in Paris increased the number of his/her activities by +0.4 (on average one action instead of 0.6 in 2004), while a CR1 of the same age who was not a physicist and working in the provinces will only have declared +0.15 (on average 0.65 instead of 0.5).

Comparisons with practices in the US and UK

It is interesting to compare CNRS statistics with those for other countries. We have only found data for the United States [2] and the United Kingdom [22],[16]. For the United States 2004 report by the NSF "Science and Technology: Public Attitudes and Understanding" [2] merely states that "A recent poll of scientists found that 42 percent engaged in no public outreach. Asked why, 76 percent said they did not have time, 28 percent did not want to, and 17 percent did not care". It is difficult to compare such vague figures (which types of researches make up the sample? Which is the period of time covered?) with our own results. Notwithstanding, the size of inactive researchers is roughly the same as ours, since we find 43% of researchers not involved in popularization activities if not as an exception. Another survey [21] on the relations between researchers and journalists questioned some 670 US scientists, mostly physicists (59%) and biologists (32%). 26% Declare they have never been interviewed nor have they written an

[6] Technically, the hypothesis whereby all laboratories are identical (that is, their average popularization activities – calculated by taking the average activities by their researchers – are not significantly different at a statistical level) is contradicted by a variance analysis. The variance among the 295 laboratories (with at least 10 CNRS researchers) is on average 10.4, while it is 6.86 inside the laboratories (5052 researchers).

[7] On average 3 researchers in 10 have a positive residuals. Pure chance gives a laboratory with 34 researchers one chance in 2000 to count negative residuals alone.

[8] In order to make comparisons easier we have only considered the researchers present over the three years (that is 8749 out of approximately 10400). Significantly, as previously mentioned, the electronic questionnaire itself and the types of actions have changed since then. This may partly account for the increase.

article for the general public, 45% of them do so less than once a year, 14% once a year, 16% more than once a year. There may, however, be a bias in this case, since those who reply to a questionnaire by mail are likely to be more motivated than the average respondent.

On the other hand, studies in the UK are very detailed, which makes drawing comparisons more interesting. In 2001 a first survey reported the percentage of active science communicators to be 56 (including those that only take part in "Open Door" events), while the latest study in 2006 found a considerable increase, since the percentage rose to 74[9]. It is difficult to compare these studies rigorously with the CNRS study, since the composition of the sample is different. Hence, the English sample does not include social scientists while it includes one fourth of clinical researchers which are practically not represented inside the CNRS. Notwithstanding these differences, it is still hard to account for the enormous difference in the proportion of active researchers. Let us bear in mind that over one year only 30% of CNRS researchers declared one popularization action.

Lastly, one should note that the Royal Society report uses the same three categories that we have previously detected: no activity, some activity and great activity. However, the *sample* is very different, since the researchers classified as being "very active" undertake more than 10 actions per year. They amount to 11% of researchers in the UK, while the same level of activity can only be found in 0.3% of CNRS researchers…

Conclusions

What conclusions can we draw from this statistical analysis of popularization activities? First of all that most researchers do no popularization (51% of researchers have not done any popularization in three years, two thirds have at most undertaken one activity). There also seems to be a great variety of practices, both at the individual level (we have identified three subpopulations with clearly distinct attitudes towards popularization), as well as across disciplines (Humanities researchers are twice as active as the average), laboratories and regions. Lastly, the number of actions seems to have increased since the early 1990s.

One could carry out a more in-depth study of the different determinants for popularization activities measured by these individual statistics. For instance the social "demand", which depends on the discipline and the way in which it has managed to stimulate a demand for popularization, the visibility of researchers in their own institutions, journalists, etc. But activity is also affected by the individual willingness to devote part of one's time to these activities, which is likely to be connected to the amount of time left over after "technical" activities that are perceived to be the priority have been completed, as to personal taste, to the researcher's perception of being appreciated by their peers and superiors, etc.

Besides the usefulness of popularization for society that has been previously mentioned, one can reflect upon its usefulness for researchers themselves. In this respect, a recent suggestion by Baudoin Jurdant appears to be of some interest. Jurdant reacts to the reply by a French physicist who is very much involved in popularization, Michel Crozon, to a question on the motivation for his popularization work: "I do popularization to understand better my own work". While Crozon was probably thinking only of the scientific and technical content of his work, Jurdant extends this comprehension to social and epistemological aspects. Popularization could thus make up for the scarce reflexivity of hard sciences and is inherent to the "technical" practice of these sciences [24]. One can indeed concur with the idea that an extensive popularization activity, involving dialogue and interaction with the public, will make reflection a routine practice for researchers in hard sciences, who will thus be able to contribute to general culture. Our statistics show that this remains a distant objective…

Lastly, let us point out to some of the drawbacks of this type of statistical analysis:

- the definition of an action: given the statistical nature of this study very different activities are counted as "one action" (i.e. participation in an open door event, writing a popularization book, or the participation in a science café. Clearly these activities require different levels of commitment, thus making the interpretations of propensity to do popularization rather relative.

[9] One must point out that this figure does not include those that only take part in "Open Door" events, which leads us to assume that the real figure is higher. Unfortunately, this last figure, which would enable us to compare our data with the 2001 data for the UK is not disclosed in the report.

We hope that the amount of data provided contributes to leveling off these effects between the different determinants considered and the two year period.

- data based on claims: these data are based on statements made by the researchers. One should ascertain that they have properly filled in this, admittedly, minor part of the their yearly report.
- a qualitative study: we find it crucial to extend this analysis by carrying out a qualitative study of researchers' popularization practices, by means of detailed interviews. This would enable us to better understand the motivations of researchers who do no popularization as well as of researchers who are active, as well as describe the innovations made and the problems they incur in. Some lines of research are suggested by some surprising findings of our statistical analysis: is there a communication policy that can account for the good results achieved by the Centre delegation? What is the cause for the lack of popularization work in certain laboratories? Which lessons can be learned from the "good" examples provided by some regions or laboratories? Is the geographical proximity between Paris researchers and the management of communication at CNRS a factor in favor of their popularization activity?

Acknowledgements

This work would not have been possible without the precious assistance of the Human Resources Management of the CNRS (particularly Françoise Godefroy, Arnaud Pes and Yavuz Demir).

Translated by Amanda de Felice

Refereces

[1] See for example a report of the last Eurobarometer at: http://ec.europa.eu/research/rtdinfo/special_euro/02/article_3150_fr.html.
[2] http://www.nsf.gov/statistics/seind04/
[3] S. de Cheveigné, *Quand l'Europe mesure les représentations de la science: une analyse critique des Eurobaromètres*, colloque Sciences, Médias et Société, 15-17 juin 2004, Lyon, ENS-LSH, http://sciences-medias.ens-lsh.fr/article.php3?id_article=57.
[4] S. Jasanoff, *Public Knowledge, Private Fears*, Review of *Misunderstanding Science? The Public Reconstruction of Science and Technology* by Alan Irwin and Brian Wynne, *Social Studies of Science* **27** (1997) 350.
[5] J.D. Miller, *Scientific literacy: a conceptual and empirical review*, Daedalus, Spring, 29 (1983).
[6] M.V. Bauer, N. Allum and S. Miller, *What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda*, *Public Understanding of Science* **16** (2006) 79.
[7] R.A. Logan, *Science Mass Communication: Its Conceptual History*, *Science Communication* **23** (2001) 135.
[8] M.F. Weigold, *Communicating science*, *Science Communication* **23** (2001) 164.
[9] A. Irwin and B. Wynne, *Misunderstanding Science? The Public Reconstruction of Science and Technology*, Cambridge University Press (1996).
[10] B. Wynne, *Reflexing complexity*, *Theory, Culture and Society* **22** (2005) 67.
[11] J. Wilsdon, B. Wynne and J. Stilgoe, *The Public Value of Science*, Demos Foundation, available at http://www.demos.co.uk/.
[12] W Wagner, *Vernacular knowledge*, *Public Understanding of Science* **16** (2007) 7.
[13] Ph. Roqueplo, *Le partage du savoir, science, culture, vulgarisation*, Seuil (1974).
[14] S. Jasanoff, *Reconstructing the Past, Constructing the Present:: Can Science Studies and the History of Science Live Happily Ever After?*, *Social Studies of Science* **30** (2000) 621.
[15] The Role Of Scientists In Public Debate, 9 February 2001. http://www.ipsos-mori.com/polls/2000/wellcometrust.shtml
[16] *Factors affecting science communication: a survey of scientists and engineers*, http://www.royalsoc.ac.uk/page.asp?id=3180
[17] http://www2.cnrs.fr/sites/band/fichier/3f1d5636c99a3.htm

[18] D. Kunth, *La place du chercheur dans la vulgarisation scientifique*, Rapport CNRS (available at http://sciences-medias.ens-lsh.fr/scs/article.php3?id_article=276)
[19] S. de Cheveigné, private communication.
[20] P. Jensen, *Who's helping to bring science to the people?*, *Nature* **434** (2005) 956.
[21] J. Hartz and R. Chappell, *Worlds Apart: How the Distance Between Science and Journalism Threatens America's Future*, http://www.freedomforum.org/templates/document.asp?documentID=13649
[22] P. Greco, *The world, out there*, JCOM0503(2006)E1.
[23] B. Jurdant, *Parler la science*, in Carlos Vogt (Org.), *Cultura Cientifica. Desafios, Edusp*, FAPESP, Sao Paulo pp 44-55 (2006), et *Alliage*, http://www.tribunes.com/tribune/alliage/accueil.htm, Autumn 2006.
[24] J.-M. Lévy-Leblond, *La science en mal de culture: Science in Want of Culture, Futuribles* (2004); *La Pierre de touche. La Science à l'épreuve*, Gallimard (1996).

Authors

Pablo Jensen is a physicist working at the Ecole Normale Supérieure de Lyon. He has been interested in popularization both from an effective practice (creation of scientific cafés, publication of a popularization book) and by analyzing other researchers practices for the CNRS. E-mail: pablo.jensen@ens-lyon.fr.

Yves Croissant is Professor of Economics At the University Lumière Lyon 2. His research interests are micro econometrics and public economics. E-mail: yves.croissant@let.ish-lyon.cnrs.fr.