

Science
for Public
Policy

Science for Policy

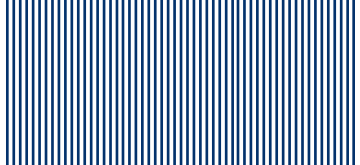
Coordinated by:

Vincenzo Pavone • Jordi Molas • Jordi Brandts • Rafael Serrano



CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

SCIENCE  POLICY



Science for Public Policy



Knowledge Transfer Report



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General State Administration publications catalogue: <https://cpage.mpr.gob.es> CSIC

EDITORIAL CSIC: <http://editorial.csic.es> (email: publ@csic.es)



Communications Department
President's Office CSIC
Calle Serrano 117 28006 Madrid
Email: comunicacion@csic.es

NIPO: 155-24-103-X
e-NIPO: 155-24-102-4
Depósito Legal: M-11803-2024

Non-commercial edition

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for Public Policy series:**
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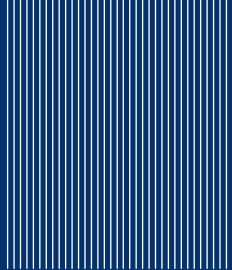
Printed in Spain

The paper used in this edition has been made from environmentally friendly paper that has undergone an ECF bleaching process and whose fibre comes from sustainably managed forests.



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Science for Better Public Policy Making



Eloísa del Pino
President of the CSIC

INCREASINGLY, many of the world's governments have turned to the scientific community for advice on how to respond to issues such as poverty and climate change, which are major issues of concern. The covid-19 pandemic is an example of this practice, as there was a response from scientists, who not only demonstrated their ability to bring new knowledge to the service of the public, but also their great interest and motivation to do so.

CSIC researchers, either individually or organised collectively, participate in several hundred governmental advisory committees at all administrative levels including at the European level, and in all areas of public policy, such as health, social issues, agriculture, fisheries, food, foreign policy, security, environment, energy, culture, digital and even science policy, among others. Thanks to this advice, public decision-makers can find out how much fishing quotas should be limited, how aquifers should be managed, how many vaccines will be needed to achieve herd immunity or what aspects should be financed in order to make further progress in the fight against cancer.

However, the relationship between politicians and scientists is not without its difficulties, which have been well described in the scientific literature. Some of the problems are of a practical nature. For example, the timing of science does not always coincide with the needs of political decision-makers; the language used by "these two communities", as the Argentinian sociologist Marcos Kaplan calls them, is often very different because there are problems of understanding; from the political-administrative sphere it is argued that science is not always so forceful or available when decision-makers need it; or that the scientific offer is too broad.



When decisions do not take evidence on board, they have negative effects, ranging from budgetary waste to the inability to solve public problems

A difficulty that could be described as most fundamental is the perception of the scope of this relationship: how far should politics go and how far should science go? This is a classic discussion that has already been raised by thinkers such as Max Weber, Isaiah Berlin or Jürgen Habermas.

Some argue that scientists should be like policy advocates, trying to directly influence the decisions governments make, restricting or biasing policy choice. Others propose that scientists should limit themselves to effectively presenting data for policy-makers to expand their scope of choice and help make decisions. According to this position, decisions should always be left to democratically elected politicians. Decision-makers also have to take into account other criteria, such as budgetary availability, administrative feasibility or electoral imperatives, which often constrain their capacities.



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A third position warns that decision-makers may be tempted to ignore the evidence and this can have serious consequences, ranging from budgetary waste to failure to solve public problems. The literature on public policy has described so-called *zombie* ideas, those that continue to feed policies despite the existence of compelling scientific evidence that they do not work; or *phantom* ideas, those that, backed by evidence, no politician implements because it would mean upsetting groups with strong vested interests in the hotspot of current policies. Some have gone further and described cases in which the lack of evidence has endangered the lives of people or the planet. It is essential to understand that public policy is, after all, the primary means by which governments allocate power in society in terms of resources, education, health or other benefits to particular groups.

This last reflection has led many to argue that what is truly democratic in the so-called *knowledge society* is to establish mechanisms for evidence to inform policy and for public decision-makers to have to explain why they sometimes ignore it. It is about institutionalising scientific advice, so that we decide which issues need scientific answers, how this advice has to be produced or what evidence will be considered valid. Making citizens aware of the value of science is essential for these practices to take root, which is why science literacy and citizen science are central elements of these strategies.

As a multidisciplinary scientific organisation, the CSIC has set up numerous programmes to promote the use of the knowledge created in its institutions. An example of this are the interdisciplinary thematic platforms (PTI), research and innovation instruments that address multidisciplinary challenges of high scientific, economic and social impact. Made up of teams from different CSIC centres, they are open to the participation of companies, public administrations, institutions and other social agents.

The CSIC has launched the Converge hub to connect researchers with companies and promote open innovation. This is a strategic initiative virtual space, promoted by the organisation's Vice-Presidency for Innovation and Transfer (VIT) and has been designed to boost the CSIC's collaboration with the innovation ecosystem and thereby generate solutions to global challenges in biotechnology, new materials, food science and plant varieties, among others.



The CSIC has launched the Cicerón programme to showcase the science it undertakes in its laboratories and bring it to the attention of policy makers, companies, journalists and other social agents. This initiative, which promotes the contribution of science and innovation in solving challenges related to health, the digital society, food and energy, consists of a series of thematic open days in which politicians, business people and journalists are invited to visit the CSIC and learn about its research aimed at addressing social challenges.

This book collection, *Science for Public Policy*, joins the initiatives that have been launched in recent years in the European Union, by the Spanish Parliament itself and the Ministry of Science and Innovation in an endeavour to make the relationship between science and politics more fruitful.

The Role of Social Sciences in Providing Scientific Advice



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SOCIAL sciences study social phenomena, including those that are conditioned and caused by issues or topics investigated in the natural sciences. There are several social sciences, and many methods are used but they all share the same analytical focus on the behaviour, attitudes, beliefs and practices of people and their organisations, communities and institutions.

While many of the conditions at stake in a political decision are not social, but are associated with biological, geological, medical, environmental, atmospheric, chemical and other conditions, it is always necessary to keep in mind that policy choices depend on the human factor. For example, when biochemistry and epidemiology show that some materials can be toxic to health, the social sciences can develop and evaluate policy options to reduce their production, their spread through the environment and waste management. The same can be true for nuclear waste, the production of sensitive data, fire management and the impact of pollution.

In this sense, social science, on the one hand, contributes to understanding the conditions and consequences that concern policy makers and, on the other hand, can provide methods and theories that can be applied to research into the role of science in policy-making. This role involves policy decisions in a wide variety of contexts and, therefore, researchers in political science and public administration focus on political networks, pressure groups, knowledge brokers and the development of institutional normative. Social science contributes to understanding conditions and consequences that concern policy-makers.



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Furthermore, social science can help to identify processes and criteria that serve to validate which sources of knowledge are reliable, as the use of scientific knowledge is highly contextual, conditioned by specific norms and habits. Finally, the use of science in policy is still a process that selects bodies and sources of knowledge, as well as different expert opinions.

In summary, we can identify two objectives of social science. The first is to accurately describe human behaviour and social conditions, including their causes and consequences, and, when policies are implemented to change those behaviours and conditions, to evaluate the consequences. The second aim is to focus its wide-ranging set of methods and theories to improve our understanding of the relationship between political processes and the production and use of scientific knowledge in these processes.

one



Institutionalisation of Scientific Advice

SCIENTIFIC advisory practices are becoming increasingly important and widespread. What many years ago used to be implemented on an ad hoc basis, to solve very specific problems, and with hardly any institutional channels of reference, has become a crucial aspect of Western democracies. Moreover, scientific advice has given rise to many initiatives and institutional forms, which seek to organise, systematise and regulate the transfer of scientific evidence from the world of science to the world of politics.

There are many ways and experiences of how the relationship between science and policy can be articulated, and how this relationship affects both scientific and policy agendas. Small-scale democratic experiments and scientific advisory committees have been set up. Studies collect and analyse empirical evidence on the institutionalisation of science advice and its functioning, the role of scientists in public life, and the nature and effect of outreach. A number of countries have also developed agencies, offices, governmental bodies and more or less independent bodies that aim to facilitate science and policy crosstalk.

Recently, during the pandemic and the volcano eruption on the Canary Island of La Palma, we have witnessed what science is capable of, how scientific knowledge is produced that informs the most urgent decisions, how important the handling of solid evidence can be, but also the incompleteness and possible biases of the available scientific knowledge, as well as the limitations of the decision-making processes in which such knowledge is used.

The purpose of this section is, on the one hand, to present and analyse different experiences of scientific advice. The focus will be on specific aspects, such as, for example, the involvement of scientists in institutions advising national parliaments and European institutions. On the other hand, the section emphasises the type of policy-relevant scientific knowledge and evidence generated by research and the different ways in which it is used. Scientific activity often generates policy-relevant evidence and results, but this does not mean that the most effective way of communicating and interacting with potential users is found and that such knowledge flows successfully.

In order to highlight both the diversity of possible experiences and the existence of different fields of knowledge that generate relevant empirical evidence, we have selected specific examples that, while far from being exhaustive, are intended to reflect on how scientific evidence can inform policy decisions. These cases also serve to address crucial questions, such as the nature of scientific information and the process of input and final product that characterises science-policy interactions, without ignoring the problems that arise. Likewise, from the perspective of the CSIC we can address the interactions and dialogues between scientists who produce knowledge in different areas with bearing on current realities and political decision-making.

Science as a Key Part of Consultation and Policy Making by Inter-governmental Organisations

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Luis Valdés

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GLOBALISATION, which has accelerated by leaps and bounds in the last decades of the 20th century, has made science and innovation generically global processes. Many of the main 21st century global challenges have scientific implications. Effective and sustainable management of most human activities therefore requires international and multilateral management frameworks in which scientific knowledge supports societal and political decision-making. To this end, policy-makers need valid and tested scientific advice on which to base their decisions.

To adequately inform policy makers, it is necessary to build mutual trust and articulate frameworks and processes, such as the so-called *science-policy interfaces*. Through them, scientific knowledge and evidence are communicated in a faithful and understandable way. These interfaces are key to ensuring that policy decisions are based on the best available science and essential to facilitate the transformation of scientific knowledge into efficient policies.

There are many types of science-policy advice interfaces. These can range from simple informal channels of communication between scientists and policy-makers to well-established and complex mechanisms of collaboration and consultation. Among the latter, the scientific policy advice processes of most interest are those that are motivated by a demand from a governmental or inter-governmental agency, such as the United Nations (UN) and the European Union (EU), among others, and that aim to respond to specific policy or decision-making needs. A second type is undertaken as a voluntary commitment by an organisation or a group of experts, often driven by a desire to advance understanding of a particular issue.

In the first case, inter-governmental agencies, policy makers or other interested parties may initiate a consultation or request a scientific assessment that requires expert advice on a specific topic. For example, a government agency may commission a report on the maximum allowable catches of a fish stock, or on the risks and impacts of sea level rise in a region of the world. Often such requests are part of a regular process.

In the case of voluntary commitment, individuals or organisations may choose to undertake scientific assessments to improve their understanding of a particular issue, develop recommendations or inform decisions. For example, a working group set up on an *ad hoc* basis to assess the state of the European oceanographic fleet and recommend the construction of ships of a certain size.

Both voluntary scientific assessments and regular demand-driven processes can be valuable for improving our understanding of complex problems and for informing decision-making. However, assessments requested by government institutions are more likely to receive funding and have a greater impact on policy decisions, as they are often conducted in response to specific needs or concerns (table 1).

Table 1 Characteristics and differences of science-policy advice interfaces according to whether they are driven by a regular process or by voluntary commitment

Regular on-demand process of an (inter)governmental agency	Voluntary commitment
Motivated to respond to specific policy or decision-making needs	Driven by scientific curiosity or the need to make progress on a particular topic
Funded by inter-governmental agencies	Self-financed or institutionally supported
Rigid timelines; regular process	Flexible, non-periodic schedules
Limited scope focused on specific policies or decisions	Tend to explore a wide range of issues on a particular topic.
Involve a wide range of experts and stakeholders	Limited expert groups
Undergo rigorous review processes to ensure accuracy and reliability	May undergo peer review, but this is neither mandatory nor standardised
Reports are usually subject to formal requirements and public disclosure	Flexible or informal reporting requirements. Not usually subject to public disclosure
High impact decisions as they are linked to specific policies	Uncertain impact. No direct link to policy or decision-making processes

There are numerous regular science-policy advice interface processes in the UN and EU systems. The quadruple helix shown in Figure 1 gives the general outline in which these processes are articulated. It is worth noting that this model promotes team-work, collaboration and the exchange of ideas between each of its members, constituted or articulated by:

Figure 1 Scientific Knowledge and Policy interface

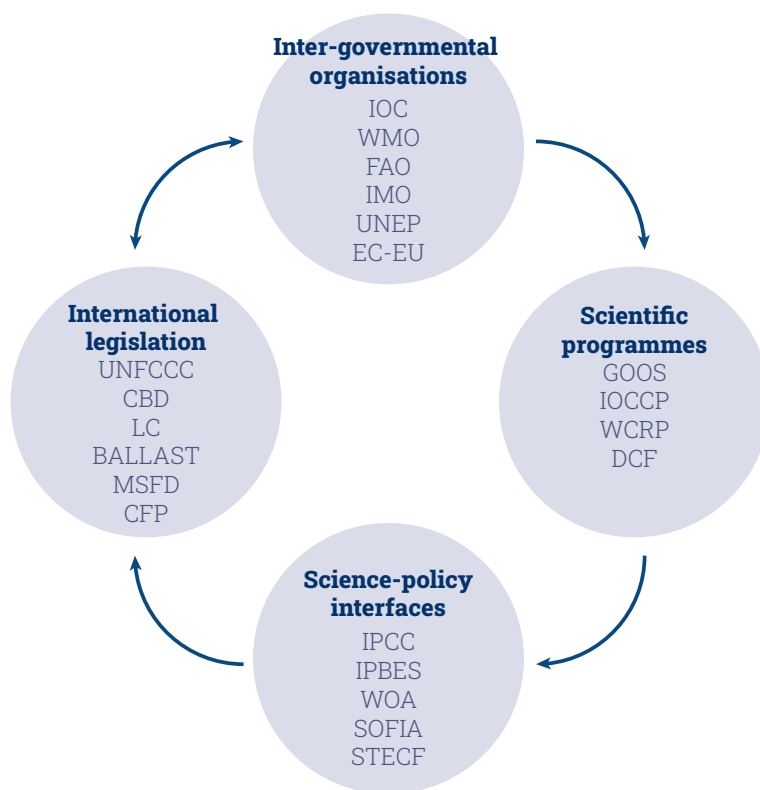


Figure 1. Quadruple helix model showing the UN architecture for advancing scientific knowledge in ocean science and environmental governance (the list of organisations and entities is not exhaustive). References to the European Union and the Commission have been included to illustrate the validity of the model for other organisations in the multilateral political system.
Source: Valdés et al.

1. **Inter-governmental organisations (UN or the European Union).** UN organisations are the backbone of the multilateral political system and give legitimacy to decisions. They are fundamental, as they articulate the needs of member states. They also allocate resources and act as promoters of international law.
2. **International law for the management of the environment and natural resources.** International conventions and treaties are legally binding for countries that have formally ratified them and are crucial for sustainable development and management. They establish frameworks and objectives to protect the environment by controlling human activities and impacts on the planet. The treaties and conventions are negotiated by and maintain a dialogue with inter-governmental organisations and stakeholders to adapt legislation to emerging issues, new scientific knowledge and socio-economic circumstances.
3. **Science for sustainability programmes.** They produce scientific knowledge on natural, social and human sciences for sustainable development, including understanding of ecosystem functioning and connections to human health, well-being and security. These programmes are necessary to enable decision-makers to base their policy decisions on sound scientific evidence.
4. **The science-policy interface.** Most of the knowledge produced by scientific programmes needs to be transmitted to policy domains through science-policy interface processes. These processes make science accessible and it is used to inform policy and, where appropriate, transformed into legal regulations or concrete actions by decision-makers.

Figures 2A and 2B represent concrete examples of the UN-sponsored quadruple helix on climate change (fig. 2A) and the advisory cycle in the management of commercial fish stocks in the European Union (fig. 2B) (a regular yearly process). In both

examples, the structures described above are recognizable: (1) inter-governmental organizations, (2) treaties or international law, (3) observation and research programs, and (4) science-policy interface processes.

Once this process is completed, scientific institutions send the reports and recommendations to governing bodies for consideration in making policy and management decisions. Although administrators are not bound by the recommendations, scientific advice has become increasingly important in management decisions.

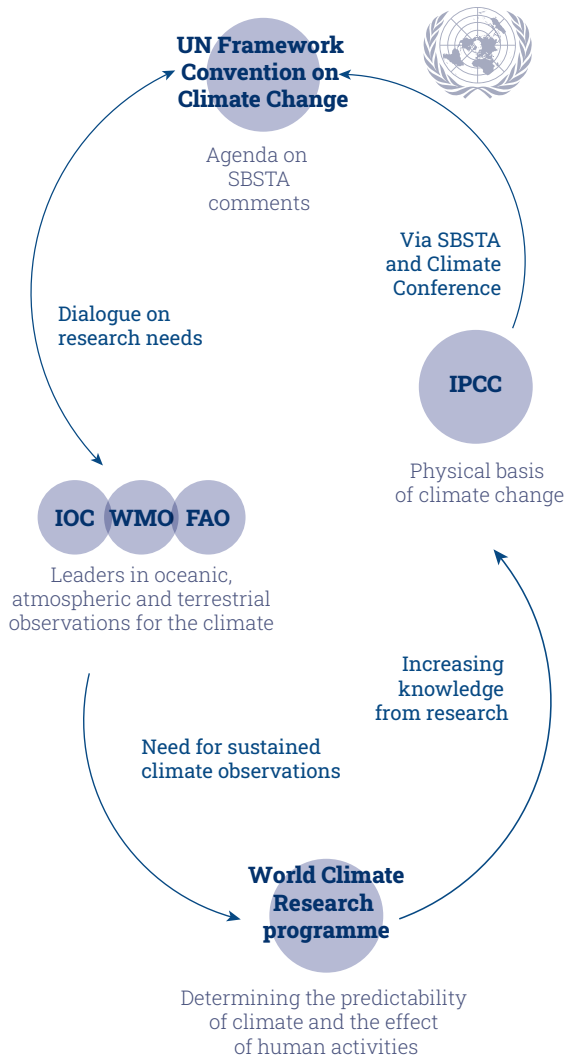
Although the whole process is well-articulated and well-oiled (each of the four blades of the propeller described above plays an active role, with socio-political and scientific relevance), there are challenges and limitations associated with these interfaces. Among them are possible conflicts of interest, limitations of scientific knowledge and uncertainty, as well as the difficulties of combining scientific evidence with political and social considerations.

On the other hand, it is not always easy to recruit experts to participate in these processes. It is a demanding and poorly rewarded task. The end product is often a report or a series of reports that are labelled as "grey literature". However, the prestige acquired by the assessment reports of the Intergovernmental Panel on Climate Change (IPCC) and the awareness of academic and scientific institutions to take on advisory and knowledge transfer as part of their portfolio has given a boost to this type of professional development and to consider it as part of the curricular career of technicians and researchers.

Scientific institutions at the national level therefore have a duty and responsibility to contribute to international policy-making. Countries must have trained scientific personnel, who advocate that science has something to contribute to international policy-making.

Figure 2 How it works across institutions

Example A: Science-policy architecture for climate knowledge in the UN system



Example B: Annual work cycle for advice and decision making for the Common Fisheries Policy

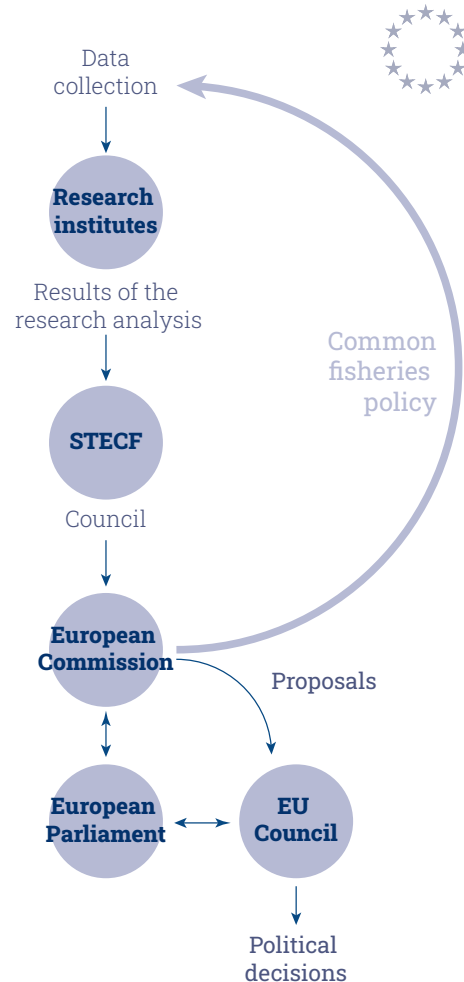


Figure 2. A: Example of the science-policy architecture for climate knowledge, advice and decision-making in the UN system (statistical data are from IPCC AR4). B: Diagram illustrating the annual work cycle for EU Common Fisheries Policy (CFP) advice and decision-making through scientific advice; the basic data collection programmes under the DCF (data collection framework) are carried out by the scientific institutions of the Member States, which report annually on their implementation. Sources: A: Modified from Valdés, 2017; B: Modified from STECF - Common Fisheries Policy (<https://stecf.jrc.ec.europa.eu/>, last accessed 4/04/2023).



The aim of science diplomacy is to have a say in political decisions and to participate in representative missions in inter-governmental and international organisations. In this sense, science diplomacy of particular relevance, which is understood as the process whereby states represent themselves and their interests in the international arena in terms of acquiring, using and communicating scientific knowledge.

In conclusion, considering that the challenges for society are huge, and that science can and must be part of the solution, it is appropriate to encourage the participation of CSIC experts in international governance and in the definition of regional and global science policies. The aim is to provide opportunities for the development of research talent and to ensure that the organisation's scientific results are returned to society, while at the same time enhancing and improving the impact and social and political perception of CSIC research and interest in Spanish science.

Scientific-Technical Advice to the Legislative Body: Establishing the Science and Technology Office of the Spanish Congress

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THE former Technology Advisory Office to the US Congress is considered to be the international pioneer in the field of technology advice. This specific type of advice focuses on experts providing recommendations to policymakers about the potential impacts of science and technology, as well as their ethical implications.

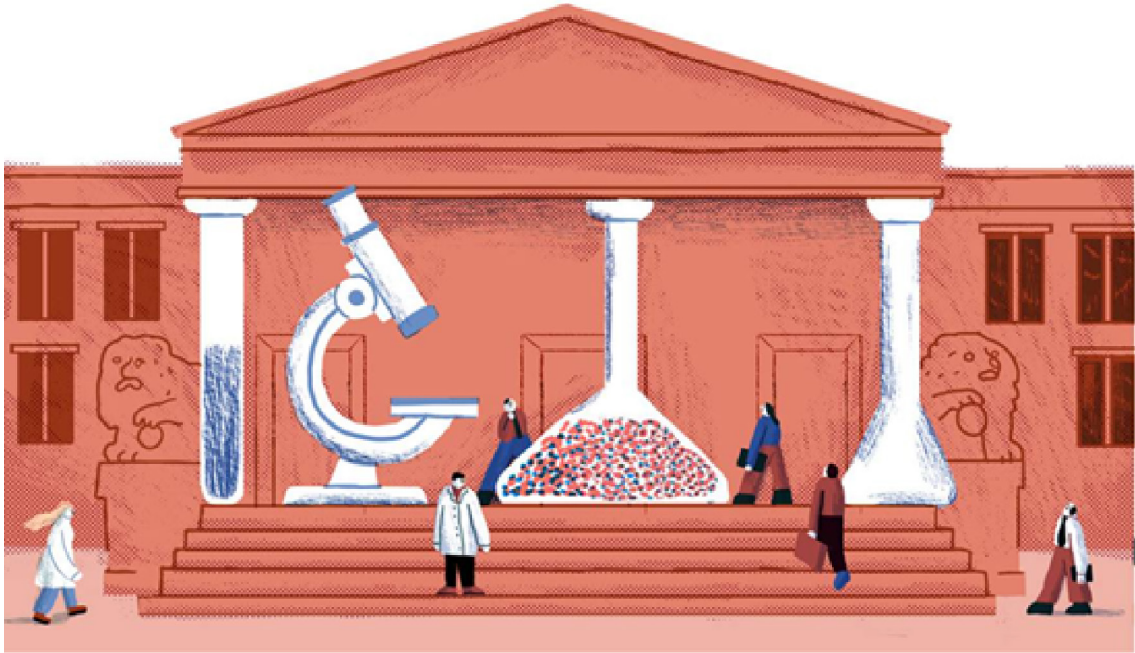
The literature on technology advice and the different institutional structures and experiences for its exercise in various countries converges with that of legislative science advice, which is more broadly conceived as practices that mobilise scientific knowledge in support of legislative initiatives. The US Office of Technology Advice (OTA) became the model for many technology advice units that were set up in Europe during the 1980s and 1990s.

One of the most widely studied institutional experiences is that of the British Parliamentary Office of Science and Technology (POST), created in the United Kingdom in 1989, taking the US OTA as a reference. This office evolved autonomously, developing its own model, adapted to the conceptions and needs of British legislatures. Other science and technology advisory units that emerged and developed in different ways have come to devise their own methods and forms of organisation and relationship with society and the political class, as well as their own conceptions and missions. Today, the European Parliamentary Technology Assessment Network (EPTA), created in 1990, brings together science and technology assessment institutions linked to twenty different parliaments around the world.

The expansion of the institutionalisation of science and technology assessment to the south and other parts of Europe has been a major challenge. Addressing this challenge was one of the objectives of the 7th European Framework Programme project PACITA (Parliaments and Civil Society in Technology Assessment). Between 2012-2015, this project, which in Spain involved the participation of the Catalan.

Foundation for Research and Innovation (FCRI), focused on fostering and expanding European capacity in the design of public policies informed by scientific evidence, on promoting communication and a committed relationship between scientists and the rest of society, and on defending and guaranteeing respect for ethical principles in scientific practice. The European institutions have promoted a significant number of initiatives to foster a culture of evidence-informed policy-making. In 2015, the European Commission's Joint Research Centre (JRC) (<https://joint-research-centre.ec.europa.eu>) and the European Parliament's STOA (Panel for the Future of Science and Technology) committee launched the Science Meets Parliaments initiative at the European Parliament in Brussels, with the aim of establishing strong ties between the scientific and legislative communities at European, national and regional levels. Subsequently, the Science Meets Regions pilot initiative deepened in 2019 on a number of topics of interest to most EU member states. The European Commission, as the executive arm of EU policy, has its own independent scientific advisory mechanism to support decision-making, in the form of the Chief Scientific Advisors Group and SAPEA (Science Advice for Policy by European Academies).

In recent years, the European institutions have given a noteworthy boost to the science-advice policy agenda. In 2020, the JRC launched a series of meetings, seminars and reports describing science policy systems in various countries. The report on the Spanish ecosystem is expected to be published in 2023. The year 2022 also witnessed a re-launch of interest in the competency and skills frameworks that scientists and policy makers need to collaborate effectively, the publication of a JRC working paper inviting pan-European debate on evidence-informed policy, and the launch of a project to strengthen science for policy ecosystems in seven EU countries (Belgium, the Czech Republic, Estonia, Greece, Latvia, Lithuania, the Netherlands and Latvia), which may be extended to others in the future.



CINTA ARRIBAS (SINC)

In this context of close monitoring and strengthening of science for policy systems in Europe, the initiative to create a Science and Technology Office in the Spanish Congress was taken for the first time in Spain. Previous attempts to institutionalise scientific and technological advice and to create such parliamentary offices had failed. The use of scientific evidence in public policy conception and design processes is a product of specific social, institutional and historical contexts.

According to authors Leonhard Hennen and Linda Nierling, Spain did not have a suitable habitat for science and technology advice or an appropriate opportunity structure in 2015. According to these experts, this consists of: a highly developed and specialised research and development system; a strong commitment from the government and parliament including the provision of the necessary structures and resources; a high level of awareness in the political class regarding the need for independent scientific support for the design of good policies and a high level of commitment from the scientific community; and, finally, the demand and interest of society to participate in decision-making processes connected to or affected by science and technology.

Although attempts to create a parliamentary science and technology advisory unit at the central state level were initially unsuccessful, Catalonia succeeded in setting up a science and technology advisory council in its regional parliament (CAPCIT) in 2008. The sociologists Knud Böhle and António B. Moniz point out that CAPCIT had no staff or budget of its own and describe the impact of the initiative as “limited”, but, they stress, “its value as the only institutional interface structure between a regional science system and a regional parliament in Spain”.

For Laura Cruz-Castro and Luis Sanz-Menéndez, IPP researchers, socio-economic conditions of the kind identified by other authors are necessary but not sufficient for the emergence of scientific-technical advisory structures in parliaments. There is also a need for “political entrepreneurs” willing to take the initiative (Cruz-Castro and Sanz-Menéndez, 2005). The institutionalisation of science and technology advice can be considered, as Böhle and Moniz believe, a “democratic innovation”, and both the political structures and the maturity of the research system and society are essential to create an ideal scenario of opportunity.

The socio-economic and institutional conditions seemed right in Spain when a small group of institutional entrepreneurs, made up of scientists and science managers and communicators, founded the association Science in Parliament (CEEP) in 2018. CEEP is defined as a citizen initiative created with the aim of contributing to the establishment of a parliamentary office for scientific and technological advice (Santillán et al., 2021). The promoters of CEEP were motivated by the desire to contribute to society beyond the conventional boundaries of disseminating scientific knowledge. The association gained support from key organisations, institutions and groups, including the Presidency of the Spanish Congress of Deputies and the Spanish Foundation for Science and Technology (FECYT). Social media played a key role in disseminating and gaining support for this initiative, according to Emilio Jurado Gómez (2022), member of Science in Parliament.

In November 2018, the CEEP, accompanied by a large number of people, held two consecutive conference days in Parliament to present the potential of the initiative and its objectives. A few days later, the Presidency and the Bureau of the Congress, together with the Minister of Science, Innovation and Universities, committed to creating the Science and Technology Office of the Congress. After the social and political upheavals resulting from the crisis caused by the SARS-CoV-19 pandemic and a period of design, the so-called Office C (oficinac.es), set up and staffed in collaboration with the FECYT, effectively began its work in 2022. To date, the activities of Office C have consisted of drafting scientific evidence reports on topics of relevance and interest to the Congress, documents to be discussed within the framework of programmed discussions between parliamentarians and the corresponding scientific community.

Office C has also set up a matchmaking programme for Members of Parliament and scientists, and a training programme for students interested in the practice of consultancy. Thus, for the drafting of its first four reports, which have been very well received and disseminated, the Office's team has interviewed 123 scientists. Office C takes the British POST office as a reference model, but, like the latter, it is foreseeable that it will evolve and adapt the initial model to the specificities and needs of the Spanish legislatures.

Office C is therefore the first institutional structure for scientific and technical advice to the Spanish Parliament and one of the key elements of the Spanish ecosystem of science for policy. An ecosystem that, like all such ecosystems, is complex and encompasses institutions and bodies ranging from knowledge generators in universities and research bodies to policy evaluators in governmental or independent agencies and units, including "synthesisers" (Gluckman, 2018) and transmitters of expert knowledge in academe, and scientific and professional associations or think-tanks and various advisory units and councils, among others.

The Institutionalisation of Scientific Advice: The Case of DigClass at the Joint Research Centre of the European Commission

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Leire Salazar

Joint Research Centre (JRC),
European Commission

THE Joint Research Centre (JRC) is the directorate general in charge of scientific output in the European Commission. It is responsible for informing the entire process of public policy making in the European Union, including its design, implementation and evaluation. According to the JRC's own vision, the knowledge generated is independent and evidence-based. Most of the people working in the JRC, including many of the administrators, come from the scientific environment, while the management and attached staff often come from other directorates-general of the Commission. The JRC has a governing board (with representatives from Member States and countries associated to Horizon Europe, the EU's framework programme for research and innovation for the period 2021-2027) that assists and advises the Directorate General and the Commission on the strategic role of the JRC and its scientific, technical and budgetary management. The board members also represent the interests of the JRC in their respective countries.

The institution is structured around six headquarters in five EU countries. At the operational level, the work is organised around several directorates, some thematic (which carry out substantive and disciplinary research) and others of a cross-cutting nature, which are responsible for planning, coordination, resource allocation, logistical support or issues related to the evaluation of the work plan and the use of resources. Among these cross-cutting activities, anticipatory activities include multiple exploratory, sometimes interdisciplinary, programmes that seek to identify themes and approaches that respond to complex challenges for the EU.

Examples include the Exploratory Research (ER) programme, which integrates individual researchers into existing teams to incorporate novel topics, and the Centre for Advanced Studies (CAS), which hosts entire teams addressing topics not previously addressed by the JRC, but with the potential to become important in the future. In the Social Classes project, in the Digital Age (DigClass) for example, we analyse how technological change may affect socio-economic inequalities and intra- and intergenerational life chances, and explore the design of social protection tools that respond to new needs.

This is done through approaches and methodologies of sociology, economics, political science and political economy, and taking advantage of the channels offered by the institution to collaborate with other areas, which are normally inaccessible to social scientists.

Since January 2023, the JRC's work has been structured in 33 portfolios that respond directly to the six substantive priorities set by the Commission for the period 2019-2024. These priorities are: a European green deal; a Europe fit for the digital age; an economy that works for people; a stronger Europe in the world; promoting our European way of life; and a new push for European democracy.

The portfolios reflect the research carried out by scientists from various fields, located in different administrative units and sometimes in different directorates, and approached from different perspectives, with the idea of breaking disciplinary silos. At DigClass, in particular, we contribute to three different portfolios: innovative policy, inclusive and resilient society, education, skills and employment. While this novelty greatly enriches the way we look at complex problems and favours the adoption of a cross-disciplinary view of the issues, it also entails some challenges in structuring collaborations between teams with different traditions and in allocating resources.

The JRC maintains scientific collaborations with external institutions, including individual experts as well as larger teams, companies or laboratories. Outsourcing of tasks takes place when there is no in-house expertise or for large-scale activities such as data production, field work or development of research infrastructures. At DigClass, we rely on scientists from the best European research centres, both to complement our own production and to give visibility to our topics of interest in the Commission and in academia through seminars and other scientific meetings. The JRC also encourages the use of its facilities by external researchers and is trying to bring its work closer to a wide range of users, including the public.



PROYECTO DIGCLASS

The JRC's output takes the form of either articles in scientific journals, or technical papers, summaries of research results prepared *ex profeso* for policy-makers, material for preparing speeches and high-level meetings, etc. At DigClass, for example, we have reported our research in scientific articles, technical papers and policy briefs. The institution manages to reconcile the two types of task, the research tasks, which are comparable to those of the wider European academic ecosystem, and the scientific advice for policy-makers.

The JRC has its own budget to develop its work plan and to contribute to the advancement of knowledge in long-standing areas, but it also receives funding through agreements with the Commission's thematic DGs (DG-EMPL, DG-EAC, etc.), which usually result in more or less stable funding and can really have an impact on the development of public policies. On the one hand, the scientific impact of the institution can be clearly assessed through bibliometric indicators. In the period 2016-2020, for example, almost 5% of the JRC's scientific publications were among the top 1% most cited worldwide and 29% were in the top 10% most cited. The policy impact achieved, on the other hand, is difficult to measure. Each year, between 400 and 500 cases of public policy support are assessed through an internal procedure: 75% assist in the implementation of existing legislation and the remaining 25% in the preparation of new initiatives.

The most obvious case of success is where the evidence produced by the JRC serves as the basis for designing or implementing a legislative initiative in the Commission. In other cases, the contribution made by the scientific advice is less visible, the attribution of authorship is widely shared with other scientific actors or is more diffuse, or the contribution is partial or too specific to give rise to very strong recommendations. In the case of DigClass, we have had the opportunity to transfer our results to the European Commission's Directorate-General for Employment, Social Affairs and Inclusion (DG-EMPL), but it is foreseeable that our real impact will materialise later on, if stable funding arrangements and budget allocations are established.

Research is organised on the basis of a biannual work programme which is approved by the College of Commissioners. This time horizon allows it to adapt more quickly to the changing needs of the economic, social and political context, especially in the volatile international economic and geopolitical environment, and to incorporate new themes and approaches. On the other hand, this model, which involves a constant process of institutional redefinition and reorganisation, entails some challenges. It generates a large volume of meetings and written documentation, which can lead to staff fatigue; or if the changes in the work programme are significant, the institution's scientific competencies may not be automatically aligned with the new needs.

The JRC occupies a unique position and has enormous potential in the ecosystem of scientific advice in Europe. The production of "slow science", compatible with a relatively quick reaction to specific requests from the Commission's thematic directorates-general, can bring much-needed nuance and depth to the design, implementation and evaluation of public policy, which is rare in other types of institutions.

The Incorporation of Experimental Behavioural Studies into Public Policies

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SINCE its institutionalisation more than a century ago, one of the main occupations of the different social sciences has been to inform the design, implementation and evolution of public policies. For this purpose, researchers have used a wide range of research methods and techniques, from observation to experimentation, from case studies to representative surveys

By combining different methodologies, social scientists conduct rigorous research to understand how public decisions are made, their consequences and citizens' perceptions of them. Several groups investigate how citizens are directly involved in decision-making. In terms of effects, researchers analyse, for example, issues such as the introduction of paternity leave and other allowances on gender norms or the influence of different aspects of public health service provision on user satisfaction and service quality. With regard to beliefs and perceptions, an important and highly topical issue is the study of the credibility of scientific communication on climate change.

In the last two decades, the social sciences have broadened their range of methodologies through the development of experimental methods in combination with more traditional ones. Experimentation has come hand in hand with a new emphasis on studying human behaviour in depth, integrating contributions from different scientific disciplines to answer questions such as: Why do citizens pay taxes? Why are minorities discriminated against in the labour market? Why do citizens voluntarily donate their money to social purposes? The experimental method can also be used with an empirical orientation to answer questions such as: What effect has the implementation of a policy had? Does the amount of unemployment benefit affect the entry of unemployed people into the labour market? Do remedial classes increase the performance of secondary school students? To answer these questions, experimental methods seek to observe changes in the study variables after the implementation of the policy and ensure that these changes are due to the intervention in question and not to other factors. To do this we can use what is called a counterfactual, a situation identical to the one studied except for the absence of the intervention that the policy assumes. Experimental techniques have so far been a successful tool to address these problems.



PEXELS

Most experimental evaluations of public policy take the form of a field experiment, i.e., a direct intervention on the context and the people to be studied. Field experiments are carried out in a natural environment, where the different actors interact in normal situations of their everyday life when performing the task under investigation. The fact that they are carried out in this natural context is the main reason why many researchers use them to analyse and evaluate public policies. When participating in a field experiment, participants are most often unaware that they are taking part in the study, which substantially reduces one of the biggest threats in social research: the reaction of participants when they know that they are being evaluated.

One of the best known and pioneering examples of the use of randomised field experiments in social science is the Mexican anti-poverty programme Progresa. In 1997, the government implemented a conditional cash transfer programme aimed at improving the conditions of people living in poverty and reducing intergenerational transmission. What is interesting is that the experimental evaluation of this programme was carried out in parallel to its practical implementation and informed the various reforms over time. Since then, several governments and international institutions have incorporated experimental evaluations into their policy design.

One specific type of field experiments are virtual ones. Most people in industrialised countries have access to the internet. This trend provides new opportunities to conduct experiments, including those aimed at policy analysis and evaluation. Because of their low cost and huge potential sample size, these experiments are ideal for testing complex designs that combine a large number of treatments, as well as for exploring the interaction between these treatments and the personal characteristics of the participants.

The traditional laboratory can also provide scientific evidence for policy design and evaluation. The main strength of the laboratory is that researchers have a precise and strict control over the environment, the experimental manipulation and the measurement of independent and dependent variables. Because of this high degree of control and the possibility of replicating results obtained in other contexts or by other colleagues, the laboratory is the prototypical location for conducting experiments. Laboratory experiments are particularly useful for testing theoretical hypotheses from which to design more effective public policies or for testing pilot versions of an intervention before taking them to a less controlled context.

Finally, multi-factorial survey experiments, including vignette studies, choice experiments and conjoint analysis, have become increasingly important in recent years. In multi-factorial survey experiments, participants are confronted with hypothetical decision situations and asked to evaluate different scenarios or to choose between different alternatives. Each scenario or alternative, which is randomly assigned to participants, varies systematically between treatments. This design makes it easier to obtain the large-scale data needed to analyse complex situations with many treatments and representative samples that increase the generalisability of the results. On the down side, however, it highlights the social desirability of some answers and the reaction of respondents to certain questions and answers, which can be a problem when experimental treatments are too obvious. It is also not favourable that there is always a doubt as to what extent the intentions revealed in hypothetical scenarios correspond to behaviour in the real world. Still, survey experiments are especially useful in the policy design phase to inform about citizens' preferences in an articulate way. In 2007, a team led by Pablo Campos of the CSIC's Institute of Economics and Geography (IEGD) used a decision experiment to study the value placed on reforesting the Los Alcornocales natural park in Cádiz with cork oak or eucalyptus trees, integrating questions about biodiversity, market value and carbon dioxide (CO₂) absorption into the decision-making process.



The utilisation of social experiments as scientific inputs to policy decision-making is increasing in various domains. The combination of different types of experiments, as well as their complementarity with more traditional methods of policy analysis, contributes to improving and expanding the information produced by social science, including relevant data for policy analysis in the public and private spheres.

One of the best known and pioneering examples of the use of randomised field experiments in social science is the Mexican anti-poverty programme. Progress. / PIXABAY

Geological Advice in Emergency Management: Intervention of the Geological and Mining Institute (IGME) in La Palma Volcanic Eruption

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SINCE their conquest in the 15th century, the Canary Islands are the only territory in Spain where historic volcanic eruptions have taken place. Eight have been recorded on the island of La Palma alone, the last of which was of Cumbre Vieja in September 2021, following five years of very low level seismic activity at depths of between 15 km and 20 km. On 11 September 2021, eight days before the Cumbre Vieja eruption began, seismic activity increased to depths of between 2 km and 3 km and the ground deformed by several centimetres. On 13 September, the Special Civil Protection and Emergency Response Plan for volcanic risk in the Canary Islands was activated.

Volcanic eruptions, such as the one on La Palma, are complex geological processes that must be studied and monitored from a holistic viewpoint from disciplines such as geology, physics, chemistry, geography, mathematics, engineering and history. Specifically, geological studies are fundamental, as they analyse the process as a whole, from the structure of the Earth, where magmas are formed (geophysics) and the variations in their composition (geochemistry and petrology), through the mechanical factors and stress fields that condition the movement of magma and the formation of magmatic chambers and conduits (volcanotectonics), to the eruptions themselves and the volcanic deposits formed during them (physical volcanology). This research allows the interpretation of historical and model data, as well as signals recorded by equipment monitoring the activity of volcanoes.

In Spain, the Directorate General for Civil Protection and Emergencies, which reports to the Ministry of the Interior, is responsible for acting as the Operational Coordination Centre for Emergencies of National Interest, among other functions. The IGME participates in the State Coordination Committee of the State Volcanic Risk Plan. This plan in the Canary Islands led to the approval of the PEVOLCA in 2018, which includes a Scientific Committee for the Evaluation and Monitoring of Volcanic Phenomena (CCES), including the IGME, among other institutions.

The IGME research teams have played a key role in the monitoring of the volcanic emergency on La Palma. They have not only provided observational monitoring data, but also scientific interpretations of the volcanic activity, valuable information that has helped the emergency managers to make decisions. At the same time, the scientists have provided daily updated information to the group of responders and, occasionally, to the steering committee. This involvement of the scientists has not been the result of chance, but rather the result of their specialisation in emergencies related to geological hazards.

The IGME research staff is made up of experts in volcanology, who take part in numerous national and European competitive projects, and are signatories to agreements with Canary Islands and national public administrations. Their main lines of research include the study of volcanic deposits, historical eruptions, submarine volcanism, volcanic susceptibility and hazard, including direct and indirect volcanic films, analysis of the structures that favour the ascent of magma and the opening of emission centres at the surface, as well as volcano-magnetism.

Furthermore, in recent years, studies have been carried out on geological heritage and its use as a geo-tourism resource. On the other hand, the IGME has researchers and technical experts in floods, landslides, earthquakes, sedimentology, hydrogeology and geothermics. These personnel have been part of the PEVOLCA Scientific Committee since 2014, which has allowed them to gain experience in its operation and to get to know the actors involved in the Committee and in the Directorate General for Security and Emergencies (DGSE) of the Government of the Canary Islands. They have also participated in several volcanic eruption missions of the European Civil Protection Mechanism and the United Nations, such as those of the Fuego volcano in Guatemala (2018) and La Soufrière in Saint Vincent and the Grenadines (2021).



IPNA staff on site during the Cumbre Vieja eruption on the Canary Island of La Palma.
/ CÉSAR HERNÁNDEZ

The existence of a Territorial Unit of the IGME in the Canary Islands has made it possible to create stable contacts with the Civilian Protection Unit staff of the Governmental Delegation in this autonomous region and with the staff of the DGSE of the Canary Islands Government, as well as with other local agents. In fact, at the time of the eruption at Cumbre Vieja on La Palma, IGME teams were working on a European project with the DGSE with the aim of creating a citizen observatory on landslides. Following this initiative, the DGSE had activated IGME staff the previous year to advise during the coastal landslide emergency in Valle Gran Rey (La Gomera). In this way, the DGSE requested a report on possible landslides caused by increased seismicity in La Palma in 2021, which is why the IGME was already working on the island when the eruption began.

The IGME has a Geological Emergency Response Unit (URGE), a group made up of volunteer personnel who are available and trained to act in emergencies caused by geological hazards. The group has been collaborating for years with the Military Emergency Unit in different exercises (SUR 2016, GAMMA 2017, CANARIAS 2020). In the case of La Palma, the URGE was activated on 14 September following the change to a yellow alert due to the risk of volcanic eruption.



The URGE staff were joined during the eruption by a team from the IGME's Aerial Work Service, made up of pilots, who were themselves geologists and experts with knowledge of Canary Island geology, and who were already working closely with the drone service of the DGSE's Emergency and Rescue Group (GES). Groups of experts from Information Systems, the InSAR laboratory and geological risk modelling (INSARLAB), the geological heritage group, as well as the IGME central laboratories specialising in water, petrological, geochemical and mechanical analysis were also integrated. This team participated voluntarily in the emergency, which meant that their research projects were put on hold. These scientists and technicians not only displayed a great sense of public service to the society of La Palma and responsibility in aiding in emergency management, but also



respect for those affected. To the media channels, they transmitted a single message coinciding with that of the Scientific Committee, but they also explained and publicised the phenomena that were occurring. A total of forty people from the IGME were involved, including staff on the ground, in the office and in the laboratory.

The tasks carried out during the eruption, in addition to the advice of the PEVOLCA Scientific Committee, have included direct observation in real time (by field staff and drones), interpretation of the study and advance of the lava flows, the accumulation of pyroclasts and their effects on infrastructures, soil and groundwater, the analysis of hyper-concentrated flows, and the interpretation of satellite data on ground deformation.

The oceanographic vessel Ramón Margalef, during its campaign to study the seabed after the arrival of the lava flow from the Cumbre Vieja volcano / CÉSAR HERNÁNDEZ

Although the volcanic eruption ended on 13 December 2021, the emergency continues at level 1, mainly due to the high temperatures persisting in the lava and the volcanic cone, and to the emissions of volcanic gases that are harmful to life in some areas in the west of the island. In this situation, the IGME continues to participate in the PEVOLCA Scientific Committee and, since 4 February 2023, in the Advisory Committee of the La Palma Island Emergency Plan (PEINPAL), as well as in other working groups with the Cabildo (local government) of La Palma.

At the same time, recovery work has begun, with the IGME advising local, regional and state public administrations in various fields. These include the IGME's involvement in:

- Developing a model for the cooling of lava flows, to be applied to the layout of new roads, spatial planning and analysis of crop recovery, especially of banana plantations.
- Establishing an inventory of sites of geological interest for their protection or for geo-tourism and a proposal for delimiting areas to be protected.
- Advising the Cabildo of La Palma on opening new geo-tourism trails with geological interest and recommendations for geo-conservation. One of these trails, the Cabeza de Vaca crater-cone trail, is one of the main tourist attractions related to the eruption and is already benefiting local businesses.
- Studying the possible effects of the volcanic process on groundwater.
- Analysing the fracturing and deformation that has affected some dwellings outside the lava field.



Staff of the Aerial Works Service of the IGME observed the lava flows advancing on La Palma.

/ CÉSAR HERNÁNDEZ

In summary, the combined work of scientific and technical staff with expertise in volcanic geology and other related geological disciplines has provided advice to the Canarian public administrations based on scientific knowledge of the geological process, its direct and indirect hazards and resources. Previous experience in emergency management has enabled emergency managers to respond better. This advisory work should not be limited to emergencies, but also to the periods between eruptions, when work must be done on readiness, recovery, training and improving scientific knowledge. Thus, advice can be given while also reducing the uncertainty inherent to these processes. For this reason, scientists should not focus their attention only during emergencies, but rather participate in all phases of the disaster risk management cycle as well as in the decision-making process of the Administration.

Scientists' Reaction to the Covid-19 Crisis

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IN early 2020, the outbreak of a pandemic caused by a new virus, SARS-CoV-2, led to a critical and unprecedented situation worldwide. In Spain, the government decided to react to the outbreak by providing protection to the public and especially to the medical staff. . The search for vaccines, the ability to diagnose infection quickly and effectively, anticipating the presence of waves of the virus and its variants, and prophylactic protection using appropriate personal protective equipment (PPE) were some of the strategies required to curb the pandemic. In the absence of these means, confinement of the population was the measure proposed by the authorities to guarantee maximum containment of the virus. The CSIC played a decisive role, not only by making its research resources available to develop technological solutions (through an instrument launched by the organisation: the interdisciplinary technological platform PTI Global Health), but also by advising the government and informing the population.

Our team at the Institute of Agrochemistry and Food Technology (IATA) soon realised that the PPE manufacturing industry had relocated to countries outside Europe, where production chains were cheaper, creating a shortage; a situation that became more critical with confinement. The shortages affected not only PPE, but also the key filtration materials used to manufacture this protection equipment.

We responded to the cue and started working on a topic we knew about: nanofibre technology. Although we knew nothing about filtration, we knew that, due to their very low porosity, nanofibres could be used in filtration applications. We had never worked on this application before, nor were they being used by industry in this area, so we had to learn everything about filtration and masks quickly. With the financial support of CSIC and the Generalitat Valenciana, and in collaboration with our group's spin-off Bioinicia SL, we developed the technology fast, patented it, and set about manufacturing and certifying safe masks, so

that they could reach the population as soon as possible. At the end of August 2020, we made the first sales of these masks via the internet. From that moment on, we started to develop models with virucidal, bactericidal and biodegradable or compostable capacity, in different sizes. We also started to manufacture masks for children and inclusive masks, for example, for the deaf. We started developing hygienic, surgical and FFP2 masks, which were totally innovative, with raw materials and manufacturing processes available in Spain.

Our work, in addition to being a technological milestone, meant covering a need that the population urgently required. During this process, it was essential for us to become a national reference in terms of dissemination. Society and public bodies demanded information from us and we provided answers to questions such as which mask was the most effective for each situation. Our involvement in social networks, radio, press and television, as well as the training we provided to public bodies, took us out of the laboratory and begin to disseminate scientific knowledge to counter misinformation, fake news and self-interested opinions. Society understood, perhaps for the first time, that CSIC scientists do research not just to acquire scientific knowledge, but also to be transformational vectors at the service of citizens in a crisis.



CSIC and Bioinicia Proveil Mask. / YAIZA GONZÁLEZ

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Society's Role in Scientific Advice

INTERACTION between science and society also generates scientific knowledge, as demonstrated by the many research projects that include public participation in their design and implementation. Thus, it is impossible today to reflect on scientific advice without considering the role that citizens can and should play. From proposals for so-called science tribunals, to juries and citizens' summits, there are many initiatives that not only want to incorporate the public into scientific practice, but also to take more account of citizens' knowledge and priorities so that it becomes increasingly difficult to ignore scientific evidence in the design of public policy.

In these interactions, the social sciences in particular are paying increasing attention to highly controversial phenomena with a potentially large impact on public policy, such as the spread of *fake news*, scientific misinformation, and the rise of denialist and conspiracy movements. In turning our attention to the type of knowledge, language and practices that are generated in the interaction between society and science, we must consider elements such as the importance and character of scientific communication, or other central issues such as diversity and gender in the definition and development of scientific studies. These are all key aspects that allow us to better understand and manage both the nature of these interactions and their subsequent incorporation into public policies.

Public Participation in Science and Technology



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FOR the last three decades, recent advances in science and technology have often been accompanied by a variety of evaluation mechanisms, aimed at gathering public opinion and informing the public of the latest developments in science and technology and of the potential benefits and risks of their implementation. These participation and evaluation mechanisms are generally referred to as *public engagement* activities in science and technology.

Initially, studies on public understanding of science adopted an approach known as the deficit model and considered that any kind of hostility or resistance to scientific progress was due to a problem of lack of public knowledge. In other words, they believed that the higher the level of scientific literacy, the stronger the support for science and technology. Conversely, a low level of knowledge would be associated with a high level of scepticism or even hostility towards science and technology. The aim of these studies was precisely to gather the different views of citizens in order to inform and help policy makers to develop appropriate measures and actions, to promote scientific progress and to facilitate public acceptance of new technologies.

The Chernobyl nuclear disaster in the 1980s and the mad cow disease crisis in the mid-1990s triggered public scepticism towards science and technology. It was no longer clear that science was the engine of progress and development, a position that exploded in Europe, leading to hostility towards genetic engineering techniques that altered the genetic material of micro-organisms, plants or animals: the so-called *genetically modified organisms* (GMOs).

Inspired by the deficit model, many public administrations developed information campaigns to improve the level of scientific knowledge of citizens and thus reduce scepticism and hostility towards certain innovations, but without much success. The failure of these campaigns and the work critical of the deficit model facilitated a rethinking of the relationship between science, technology and society.



The Surprise project, led by IPP, allowed citizens to voice their priorities and researchers to analyse social factors influencing citizens' positions / ISTOCK

It soon became clear that public scepticism was due more to factors other than the level of scientific knowledge. Within a few years it became clear that increasing public scientific knowledge did not always increase consensus. Moreover, the fact that science was generally more supported did not automatically translate into greater support for new technological applications. This is evidenced by the fact that medical biotechnologies always achieved a higher level of public acceptance than agricultural biotechnologies.

Later, a wave of so-called contextualist studies delved deeper into the impact of social, political and cultural as well as economic factors in public opinion on science and technology. Thus, for ex-

ample, institutional trust, i.e., the willingness to believe the opinions of those with decision-making responsibility, was found to be an important factor. The similarity of ethical values between citizens and experts was also found to facilitate increased trust and thus support.

Finally, technologies that were seen as highly beneficial, such as medical technologies, gained much more support than others whose usefulness was doubtful. The new contextualist approaches, moreover, gave citizens a more active role, because they considered citizens to be knowledgeable about the factors influencing the development and implementation of science and technology, a knowledge necessary to complement that provided by experts.

This recognition opened the door to the involvement of citizens, who began to be perceived as relevant actors in both the evaluation of technology and the generation of knowledge. This led to the emergence of participatory approaches, based on the so-called *participatory evolution* of technologies, which not only insisted on the importance of fostering dialogue between science, politics and society, but also proposed involving citizens and placing them at the heart of scientific activity, i.e. in the design, construction and implementation of scientific projects.

Participatory approaches therefore advocate the need to generate active participation of society from the earliest stages of technology development, when everything is still undecided. In this way, citizens' values can inspire the design and trajectory of technological innovation, which in turn generates less rejection and provides valuable information for regulating the introduction of new technologies. Some authors have gone so far as to consider that these participation mechanisms can even mitigate the effects of a new deficit, the democratic deficit, which is increasingly present in societies that are becoming more and more technocratic.

One example of a participatory science project was the Surprise Project, led by a team from CSIC's Institute for Public Goods and Policies (IPP), which analysed the opinions and recommendations on security, surveillance and privacy of more than 1,100 citizens in nine European countries, including Spain. Under the EU's 7th Framework Programme for Research, Development and Innovation, the researchers assessed how citizens valued sacrificing their privacy for the sake of security.

The participatory mechanism of this project was a modified version of the so-called citizens' summits, tools for participation and voting on policy-relevant issues. The initiative, which brought together 200 citizens in each of the nine European countries involved, not only generated reliable scientific data, but also allowed citizens to express their priorities and researchers to analyse the social factors that influenced citizens' positions. Through its participatory design, the researchers discovered that citizens were demanding new security measures because they were dissatisfied with existing security policies, but that they were not willing to give up their privacy in exchange for more security. In reality, what they were asking for was not more security measures, but different policies that would be coordinated at the European level by public bodies, restrict surveillance of suspects while simultaneously respecting human rights and existing legal provisions.

Participatory approaches have not been without their critics. Several authors stress the importance of studying the ethical values of scientists themselves and criticise the social construction of the publics involved in participatory mechanisms. Furthermore, they insist on the need to assess and question not only the technologies, but also the knowledge and practices of evaluating and regulating them, as well as the definitions of the problems themselves as they are posed in these participatory mechanisms. These more recent approaches argue for the importance of conflict in a democratic society and argue that the pursuit of dialogue is not always the best way to address these issues, as they do not see participatory mechanisms as necessarily serving to reinforce the democratic process.

Studying Disinformation Campaigns and Contributing to Public Security Policies

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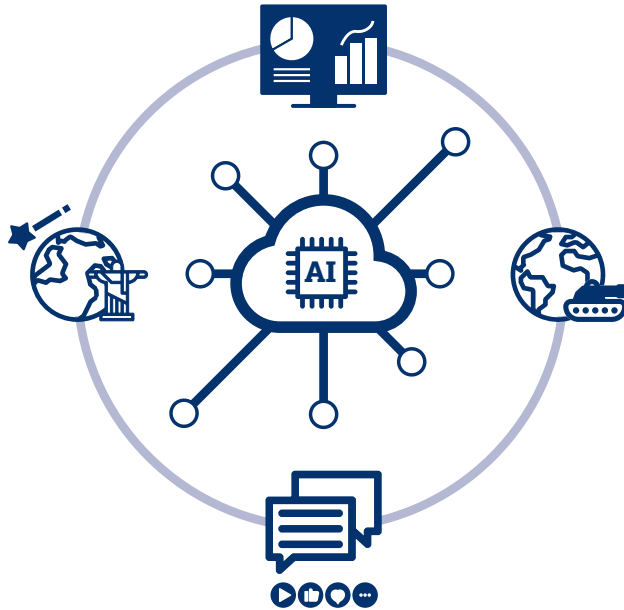
DISINFORMATION and misinformation are among the many adverse effects of online content generation. Today, we can all improvise as journalists, commentators and authors of digital content. Anyone can become an influencer thanks to social networks, which amplify the dissemination of content in the form of videos, photos and memes. The problem is that a lot of this information is unreliable or has been manipulated or fabricated. The term *fake news* refers to information whose degree of reliability varies according to the level of manipulation of its content. In other words, we are talking about both true news taken out of context and claims that are not backed up by any scientific support or evidence. Recent studies show that fake news reaches more people and spreads more quickly on social media than substantiated news.

Fake news is often part of disinformation campaigns, i.e. information operations that are driven by pressure groups or foreign intelligence services and orchestrated for political or economic reasons. These campaigns counter or complement the official propaganda carried out by national governments. For example, in the case of Russia, national propaganda claims that the main reason for starting war with Ukraine on 24 February 2022 was “the genocide of the Russian-speaking population by the Nazi government of Volodymyr Zelensky”. This propaganda is disseminated through news channels such as *Russia Today (RT)*, currently unavailable on TV sets and online channels in the EU, but not in Latin America, where RT broadcast in Spanish represents one of the foreign news services with the largest audience (25 million followers in 2018).

Consequently, the 2021 National Security Strategy (ESN21), the political framework of reference for national security policy in Spain, considers disinformation campaigns a risk and a threat, as they are part of "hybrid strategies", characterised by "grey zone operations", i.e., actions that, despite significantly altering peace, do not cross the thresholds that could lead to an armed response. In order to investigate these issues, the CSIC participates in the activities undertaken by the Forum against Disinformation Campaigns in the Field of National Security.

Among the interpretative frameworks most commonly used in disinformation campaigns are conspiracy theories, analysed at the IPP, and denialist movements. Prominent examples of denialism (which tends to revise history to omit something that actually happened) deny the existence of the SARS-CoV-2 virus or speak of its possible artificial origin. Denialists claim that the covid-19 pandemic was "a global scam to promote the sale of dangerous vaccines that can modify people's DNA or cause damage to their reproductive system". Proponents of these theories spread their messages across multiple platforms and social media. Artificial intelligence (AI) systems developed by the Cybersecurity and Privacy Protection Research Group (GICP) of the CSIC's Leonardo Torres Quevedo Institute of Physical and Information Technology (ITEFI) allow the dissemination of these types of messages to be monitored on channels such as Twitter and Telegram by identifying new denialist accounts from an initial set. AI applications have also been developed to detect misleading headlines and recognise writing styles to check for manipulation in messages from official accounts on social networks.

Work is already underway to integrate these AI tools into dashboards to increase the responsiveness of public authorities to all kinds of events, from anti-social movements to anti-democratic uprisings. In this regard, we must stress the importance of collaboration between different public bodies.



These should include Public Research Organisations in collaboration with the business sector, so as to reduce Europe's technological and industrial dependence on the military sector. The EU strategy calls for the development of response instruments against any form of foreign interference through hybrid threats or disinformation campaigns. Furthermore, the Spanish government has committed to reaching 2% of gross domestic product (GDP) in the defence budget by 2029. These investments could generate new tools to support public security policies that integrate different information sources.

From the experience of the development of the Misinformation Widget (MsW) within the EU Horizon 2020 funded TRESCA project, led by IFS and GICP (ITEFI), we know that creating such dashboards requires collaboration between experts in cyber security, human-machine interaction and AI ethics. We also know that real-time visualisation and analysis of this data helps to discern the relevant facts and facilitates decision-making processes by providing a holistic and constantly updated view of events

in social networks. In other words, interdisciplinary collaboration makes it possible to harness both intelligence derived from big data and psychosocial insights into group dynamics, human psyche vulnerabilities and how best to develop reliable AI-based applications. Another example of leveraging open data sources is the Conflict Forecast project, led by the IAE and the University of Cambodia, which predicts the risk of a conflict breaking out in a specific place in the world.

The creation of dashboards that include REST API (an application programming interface that conforms to a so-called REST architecture) such as MsW also makes it possible to produce reports for local and regional governments that want to improve their ability to predict and anticipate historical and political events by improving the lack of precision of traditional research methodologies such as opinion polls. Based on the experience of this and other research projects developed at the CSIC, specific tools could be designed for Spain, as well as other countries, to anticipate such events.

Science Communication and Public Policy: Improving Science–Society Interactions – Opportunities and Challenges

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SCIENTIFIC research nowadays is, more than ever, a collaborative effort that must play a decisive role in the face of major global challenges in the fields of the environment, health, social justice, democracy and education. Indeed, there is a growing demand from public policy to boost the interaction between science and society, with the underlying idea that research results must be more clearly aligned with the needs of citizens and produce a greater social impact. In partial response to this demand, science is ceasing to be conceived as the exclusive domain of scientists and highly qualified experts, recognising that citizens are not merely recipients or users of knowledge, but also participants in its production and dissemination. One of the areas in which the interaction between science and society presents great opportunities and challenges for public policy is that of science communication.

Science communication cannot be understood solely as a linear and vertically structured process in which scientists generate new knowledge, science journalists operate as intermediaries or mediators, translating scientific knowledge into accessible formats that are disseminated to the public, and the general public passively consumes this information. As a result of mass access to the internet, the digitisation of scientific information, open access to large volumes of data and the rise of collaborative platforms and social networks, the communication interface between science, society and the media has undergone profound changes. These changes are reflected in the great diversity of actors involved in science communication, including not only scientists, journalists, policy makers, professional associations and educators, but also new actors that have rapidly become important cogs in the science communication wheel (communicators, citizen science groups and the general public). Likewise, the range of information sources and channels has increased significantly, resulting in a great diversity of actors competing for attention and visibility in highly saturated information environments.

Unlike science, which is governed by a normative structure expressed, according to the American sociologist Robert K. Merton, in the form of an *ethos* (a set of values that should permeate or inspire scientific activity), and journalism, where there is a convention of truth, objectivity and plurality, the diversity of actors involved in science communication means that it lacks common ethical norms and principles. Consequently, the coexistence of very different interests, behaviours and perspectives on social priorities and the way scientific findings are communicated and debated is accentuated, including scientific misinformation and the rise of highly controversial phenomena such as the anti-vaccine movement and climate change denialism.

The emergence of social media has favoured the democratisation of scientific communication and accelerated its dissemination on a global scale and in real time. However, it is also calling into question the nature of the relationship between science and society, public participation, the way in which the general public can identify reliable scientific information and, consequently, the process of science communication. Against this complex background, a better understanding of science communication processes, their effectiveness, actors, audiences and socially relevant topics emerges as a pressing need for evidence-based science policy-making. In other words, in a hyper-connected society, where a plurality of social groups coexist dispersed in different communication networks, the challenge lies in recognising how communication power is distributed among the different groups and the role played by each one.

Tools and indicators can be developed from science to monitor and report on science communication processes. Although a multitude of indicators for measuring science and innovation have proliferated over the years, accompanied by manuals and recommendations (e.g. *Frascati Manual*), these indicators have paid little attention to science communication processes. This can be explained to some extent by the difficulty of collecting data systematically. This situation has changed drastically in recent years with the possibilities afforded by data science.



Tools and indicators can be developed by science to monitor and report on scientific communication processes. / MAX PIXEL

The emergence of data providers such as Altmetric.com, Plum Analytics or Crossref Event Data, which collect a wide variety of activities and interactions in social networks and online media regarding research results; or databases such as Overton and platforms such as EurekaAlert! which collect science communication outputs such as press releases, blog posts, policy reports or broadcast articles.

By improving our knowledge about science communication and science-society interactions in social networks, we can support the development of public policies that contribute to building a more open, transparent, inclusive, collaborative and sustainable global communication system. Such knowledge can be used to design communication strategies that highlight the benefits and impact of research in the most effective way for each type of audience, to report on the quality of scientific communication (such as the degree of correspondence between scientific findings and the information that is communicated) or to reflect more accurately on the role and social commitment that scientists must have as communicators. In short, the aim is to provide evidence that allows for a more productive interaction between science and citizens.

Public Participation



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IT is indisputable that public administrations are increasingly using different participatory tools and institutions to listen to citizens. These may be deliberative institutions, in general, or more specific citizens' assemblies addressing climate change, open government strategies or participatory budgeting but, in all cases, the growth of these institutions has not stopped, and continues at all territorial levels and on practically all continents.

However, not everything is valid and not everything works. This development has not banished the reticence shown by different quarters, sometimes with good reason, such as distrust of citizens' capacity to be sufficiently prepared or willing to participate, distrust of institutions that would seek a "wish list" from which to choose the proposals that most interest them or are easiest to implement, or of the difficulty of being able to listen to both organised groups and individual citizens in a harmonious way.

For all these reasons, robust empirical research is needed, which will show us what works, what tools are most appropriate for each objective or what kind of problems may arise. These lines of research have been well developed on both sides of the Atlantic, and are known as democratic innovations because of the reality they cover. Although they are very different from one another, they all share the need to include citizens as key social actors in the process.

The CSIC has developed a wide range of research projects in this line, ranging from those with a more clearly applied vocation to those that aim to contribute to understanding the underlying dynamics that occur therein. Among the former, we can highlight, for example, the Assodem project. This initiative was developed in two phases, between 2016 and 2020 with funding from the Ministry of Economy, Industry and Competitiveness, and between 2020 and 2022, with support from the Junta de Andalucía research plan. The project studied the most widespread participatory institution in Spain, the consultative councils (probably more than 4,000 at the different levels of government, which



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would mean more than 100,000 participants), the study and reform of which was also part of the 3rd Open Government Plan. In addition to numerous scientific publications and a set of practical newsletters aimed at the users of these councils, the project ended with a set of recommendations on how to improve their effectiveness. For example, one of the clearest results of the project was that plenary councils, which had working committees and were not organised exclusively through their more traditional space, functioned better.

Among the projects with a more analytical vocation, the project Incorporating Innovative Personnel into the Productive Fabric, IPI, stands out, which studies the relationship between the ideology of the governing parties and the implementation of participatory institutions. On the one hand, it is necessary to know (as is the case with other public policies) to what extent the motivations more closely linked to efficiency or different political priorities are important in their implementation, to what extent this relationship is different in Spain and in other neighbouring countries, and how the left could play a role as the first driving force behind these processes, which have subsequently been maintained by governments of all political colours. Moreover, the project is showing that, as with other public policies, there may be greater differences between what the parties claim to want and what they end up doing in practice.

Finally, between the two types, the CSIC is currently participating (through the IESA and the IPP) in the European Euucommet project. In its more European dimension, the project has a strong applied component, as it aims to contribute to the design of deliberative participatory processes that can be developed online and that can transfer the debate from the local to the European level (or vice versa), allowing the automatic translation of several languages and comparing the advantages and disadvantages of simultaneous or asynchronous debate between participants. For its part, the CSIC team is particularly concerned with the impact of these processes on public policy: what factors make citizens and politicians more favourable to the recommendations of these processes being taken into account? Among other tools, a survey of political elites (developed first in Spain and now in five other European countries), has already found that Spanish politicians are more favourable to deliberative processes where they have been able to intervene, in which a specific topic is debated and where the participation of citizens and associations can be counted on.

Public Knowledge at the Service of a Diverse Citizenry within a Complex Social Structure

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PUBLIC policy-makers have a difficult task ahead of them. In addition to the difficulty of negotiating and legislating to legitimise government action, there is also the challenge of responding to socially complex demands from a socially diverse public, and situated within a relational and interdependent system.

The inveterate mission of public policies is to redress social inequalities. However, whereas in the past, the issues involved were related to universal problems, which to a large extent extended to all citizens, nowadays, the central themes of social policies are aimed at achieving targeted goals. In this way, situations of vulnerability that concern certain groups within a relational and interdependent social structure are improved. In the words of researchers Olivier Jacques and Noël Alain, today's public policies must move towards focused criteria within universalism, so that they can respond to problems or demands expressed by a part of society, which will set the public agenda.

Two factors have been fundamental in this change: the process of social individualisation and the agency of citizens, which means that the state and policies must attend to their particular circumstances with specific responses. Thus, for example, if the collective struggle in defence of the eight-hour day once made sense, the current debate revolves around the right to rest, the reduction of salaried working time or the implementation of teleworking. And for each of these dimensions, each social group will have a different preference and need for different responses, because they are affected differently according to their working, social and personal conditions.

Let us take a few examples. Given the diversity of citizenship, teleworking is a desirable option for some workers, while it may be a disadvantage for others. Feminist research has already seen it as a disadvantage, because women teleworkers were worsening their working conditions and promotion opportunities. During the pandemic, laws regulating telecommuting as a matter of urgency were both praised and criticised by many groups.

For some families it meant a guarantee of health security, but for others it meant an impoverishment of their quality of work and family life. For single-parent female-headed households with few resources, it was a serious setback because they did not have the external support that usually allows them to manage family and work life. This new situation further limited time for personal use or rest and increased the mental overload resulting from the extra work and care commitments.

The pandemic has also revealed what kind of changes need to be undertaken in terms of work-life balance, reflecting this interdependence and complexity of the social and economic situation.

Spain has one of the most advantageous legislations in Europe, reconciliation policies are mostly focused on work-related aspects (working hours, rest days, etc.). The measures taken in the labour market and in workplaces are essential, but insufficient to make progress in equal opportunities. The data we have, derived from the unique experience of men and women living together at home during the pandemic, are enlightening. Men have resisted devoting more time to home and family care. The gender roles are changing so slowly that public policies need to be more persuasive in order to radically transform the gender-based organisation of care. The inequality suffered

by working women is still not redressed by reconciliation measures. Stimulating co-responsibility and the fair redistribution of time (productive work and care work) requires more accurate information in order to evaluate and validate the proposals developed by public policies. Such data must come from scientific research.



Women teleworkers' working conditions and promotion opportunities are worsening / PIXABAY

Social science has the task of supporting social policy by analysing who is targeted, what needs it aims to address, which groups might be harmed, which interests will be satisfied or which others will be left unmet or compromised. Empirical findings make it possible to identify new problems, to analyse the emerging vulnerabilities of a constantly changing society, and to give a voice to those who lack privilege to influence the policy agenda. In this sense, scientific advice is a powerful tool for informing policy decisions, assessing the effects of measures to anticipate correctives, and estimating the satisfaction that the coverage of that social demand will generate in the citizenry. It is relevant to know empirically to what extent the proposed measures contribute to creating well-being and, at the same time, to identify harm to other vulnerable groups or individuals. The role of science is to produce knowledge about diversity and to build, from empirical evidence, validated arguments to legitimise, review, improve, adjust or, in some cases, shelve proposed measures.

Considering the scientific facet, there is still work to be done too, because the mission of seeking valid and critical knowledge is often far removed from political reality. Research can be critical, but not proactive, omitting the actions considered to be recommendable. Even when research adopts an applied approach, it sometimes overlooks how to materialise the knowledge produced into specific measures that are viable and useful for public policies. The scientific community may not know how to implement the evidence found, or how to pass it on to the people in charge of managing social policies. In this respect, knowledge transfer may be hampered on both sides if the relationship between policy and science does not become more fluent.



Policies for work-life balance still fail to redress the inequality suffered by working women. / PEXELS

Gender Inequalities in Opinions on Public Policy



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IN the 20th century, the activity of governments and the policies they develop are under constant scrutiny of their citizens and the media. In this context, citizens' views play a key role in the functioning of any democracy. No self-respecting government would wish to forgo the privilege of public support for its policy decisions and the development of specific reforms and policy changes. With women making up half of the citizenry, governments are concerned about whether there are gender differences in public opinion, as their weight in electoral outcomes can be crucial in times of increasingly competitive elections. One example is the lower propensity of women to vote for radical right-wing extremist electoral options as compared to men.

Most of the studies on the subject have been carried out mainly in the United States. They conclude that there are significant gender differences in citizens' opinions of government policies. In general, women are more critical and aware of the existence of gender inequalities than men, and this has also been confirmed in the case of Spain. According to the March 2023 barometer of the Spanish Centre for Sociology Research (CIS), up to 77.4% of the women interviewed stated that there is still a lot or quite a lot to be done to achieve equal rights and opportunities between men and women. The percentage of men is 14 percentage points lower (63%). Moreover, women's preferences on public policy issues seem to differ from those of men. According to different studies, women are generally much less in favour of military intervention in wars, the death penalty, violence by the police, or gun licensing.

But the differences in men's and women's public opinion that are perhaps most electorally relevant are those relating to women's greater support for the welfare state in general and for redistributive and service policies in particular. There are also studies that show relevant differences between men and women in their evaluation of policies related to the environment: women show greater concern for the environment and pollution than men.

Why are women more supportive of redistributive policies and policies to protect the weakest and most disadvantaged in the societies in which they live? There is no agreement in the literature on this issue. Several arguments have dominated discussions on this issue so far.

Women are more supportive of redistributive policies and policies to protect the weakest. / iStock



Let's start by considering self-interest. Since women still suffer from significant economic and social disadvantages compared to men, it is natural for them to endorse policies that help to reduce these disadvantages, such as gender-based violence, reproductive rights, equal division of domestic labour and equal pay. These are issues that progressive or more typically left-wing parties tend to be more committed to. The March 2023 CIS barometer shows that 18% and 32% of those interviewed stated that PSOE and Unidas Podemos, respectively, are the parties that are currently doing the most in Spain to support equal rights and opportunities for women (compared to 4.6% for PP and 2.5% for Vox).

Other authors have highlighted the predominance of women as employees in the public sector and their greater dependence on and use of social services. Another variant of this thesis is maintained by some studies in the discipline of economics, which attribute women's greater propensity to support redistributive policies and the welfare state to the generalised increase in divorce rates in Western societies. Women tend to lose the most purchasing power as a result of divorce, which makes them more vulnerable and in greater need of redistributive policies. Finally, reference is also made to the fact that women live longer than men, which makes them more dependent on pensions and more in need of health services such as hospitals.

Another reason that helps to explain these differences in public opinion is the fact that women are socialised in contexts where gender stereotypes still predominate. These are preconceived ideas about the most typical characteristics, roles, behaviours and attitudes that men and women display in the family, at work and in society more generally. Often these ideas are activated subconsciously and are the product of the traditional roles that men and women occupy.

Thus, women tend to identify more with the qualities of what is known in social role theory as the communal model, such as warmth, understanding, empathy, the ability to listen, affection. For example, according to a study I carried out in December 2020 on a representative sample of the Spanish population, between 35% and 40% consider that warmth, listening skills, understanding, affection and empathy are traits more typical of women (in comparison, between 2% and 4% think that these traits are more associated with men). In addition to stereotypes about women's behaviour and personality compared to men, the psychological impact of the experience of being a mother is also cited to explain women's preference for higher levels of public spending and social services.

Finally, the American sociologist Mary Kate Lizzote argues that all of these reasons can be encompassed in the idea of "social values", evaluative expressions of desirable behaviour or values that can be applied to a wide variety of objects. Values reflect what individuals think about how society should treat people and how people should behave. In this view, Lizzote argues that gender differences in public opinion about certain policies can be explained by the fact that women are generally more concerned about the welfare of others than men.

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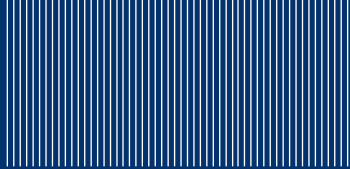
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