BBVA FOUNDATION INTERNATIONAL STUDY ON SCIENTIFIC CULTURE
UNDERSTANDING OF SCIENCE

The BBVA Foundation presents the results of its "International Study on Scientific Culture", based on a wide-ranging survey as regards both sample size (1,500 interviewees in each of the 11 countries analyzed) and the variety of issues broached.

Surveys of public perceptions of science have a tradition dating back to the mid 1980s, first in the United States and then in Europe. Their purpose is to assess citizens' familiarity with and understanding of science, and the different lenses with which they view it. This BBVA Foundation study not only reproduces the main measures and indicators used to date, it also adds some new measures into the mix along with conceptual and metrical innovations.

Studies of scientific culture look beyond conventional indicators of educational level to consider the knowledge acquired outside the education system and assimilated by the general population. They address the adult public in its entirety and avoid using the typical formal educational tests applied to the student population. This particular study also has an international character that permits comparison of how much the citizens of different countries know about science.

A collective attuned to and familiar with science and technology is better equipped to take individual decisions (as patients, consumers, in work and daily life) and, in the public sphere, is more open to both innovation and the opportunities yielded by today's global changes.

Scientific culture presupposes the existence of channels of access to scientific contents, and studies like this are an effective tool for detecting which channels find most acceptance with the public.

The study was conducted in 10 European Union countries: Italy, Spain, Austria, the Czech Republic, Poland, Germany, Netherlands, France, United Kingdom and Denmark, as well as in the United States. Information was gathered through 1,500 face-to-face interviews in each country (an approximate total of 16,500 interviewees) with the population aged 18 and over, conducted by TNS Opinion over October and November 2011. The design and analysis of the study are the work of the BBVA Foundation's Department of Social Studies and Public Opinion.

The BBVA Foundation International Study on Scientific Culture is divided into two parts: one cognitive and the other evaluative. The first part examines the level of understanding of science of citizens in 10 European countries and the United States. This means examining the extent of their interest and connection with science and, at the same time capturing dimensions of their cognitive map such as level of knowledge and understanding in regard to key scientific concepts, the way scientific knowledge is

generated and the great figures in science, among other subjects. Specifically, the following dimensions are explored:

1. Interest, practices and level of closeness to science, as gauged though the following indicators:

   1.1. Stated interest and information about scientific issues.

   1.2. Attentiveness to scientific information through different channels: TV, newspapers, Internet, radio.

   1.3. "Exploring science" activities: visits to science and technology museums and exhibitions, attendance at science conferences, membership of scientific associations, among others.

   1.4. Other connections with science and scientific professionals: knowing or working with a scientist, having a friend or relative who is a scientist, frequency with which science topics come up in day-to-day dealings with other individuals.

2. Level of scientific knowledge, measured through:

   2.1. Level of knowledge of scientific concepts and theories: subjective knowledge of key scientific terms and concepts, i.e., what do citizens think they understand when confronted with certain scientific concepts, and level of objective knowledge of scientific concepts and theories, according to a 22-item test with true and false answers.

   2.2. Understanding of how scientific knowledge is generated: science as experimentally tested and published knowledge.

   2.3. Familiarity with the great scientists of all times and countries.

Highlights of the study are as follows [1]:

Interest, practices and degree of closeness to science

- ***Respondents feel more interested than informed about scientific issues:*** Stated interest in news about scientific issues stands in the medium-to-high range (average of 6.0 in the United States and 5.6 in Europe on a scale from 0 to 10). But this interest does not automatically imply a similar level of information. Indeed the experience of surveys is that stated interest in science invariably differs from the stated level of information. This gap appears in all the countries surveyed and is particularly wide in Spain: although Spaniards' average interest is in line with the European average (5.7 on a scale from 0 to 10), their subjective level of information (average 4.7) stands some way behind.
- **TV is the main source of information on science topics**, with the newspapers in second place. Citizens in the U.S. are likelier to follow scientific information then their European counterparts. Within Europe, attentiveness is highest in Denmark, the United Kingdom and the Netherlands, and lower by a significant margin in Spain, the

[1] Mentions of Europe or the European average refer to the average of the European Union countries included in the study (10)

Czech Republic and Italy. Spain stands out as one of the European countries where people are least in touch with this kind of news: 23% of Spaniards say they often watch TV programs on science and technology topics against a European average of 41%, while 18% read news items or sections in the newspapers about science and technology topics compared to Europe's 32%.

- ***Scant involvement in "exploring science" activities:*** Citizens have little custom of visiting science museums or exhibitions though are likelier to do so in the United States than Europe (32% and 25% respectively). Within Europe, the 30% mark is only surpassed in Germany and the Netherlands (in Spain, meantime, 21% have visited this kind of center in the last 12 months). Participation in conferences or talks on science subjects is lower still (12% in Europe and the United States and 6% in Spain).
- ***Diverse degrees of connection with the scientific career:*** Respondents' direct, connection with the "scientific career" is very weak indeed. Although a significant percentage have met a scientist in person (40% European average, 44% in the United States), only a minority have a friend who is a scientist (22% and 20% respectively) and fewer still have thought at some point of taking up a science-related career (17% and 32% respectively), though note here the greater lead of the United States. Spaniards trail the European average in the extent of their connection with the scientific career: 22% have met a scientist in person, 17% have a friend who is a scientist, and 16% have at some point thought of working in science.
- ***Low and differing closeness to science among the European public:*** In order to obtain a single measure of closeness to science, we constructed an aggregate indicator spanning attentiveness to scientific information, involvement in "exploring science" activities, and connection with the "scientific career". This indicator comprises 20 separate measures (range 0 to 20), which we divide into four closeness brackets: "none", "low", "medium" and "high".
- The level of closeness to science found by the study is universally low, though the United States scores ahead of the European average: 29% and 22% respectively evidencing a high closeness to science against the 14% and 27% that register no connection whatsoever.
- Within Europe, the highest level of closeness corresponds to Denmark and the Netherlands (around 40%), ahead of the United Kingdom, United States, France and Germany (around 30%), with the Czech Republic, Spain and Italy trailing somewhere below 15%. Also, around 40% in the Czech Republic, Spain and Italy register no connection with science, against only 10% of the Danish and the Dutch.
- ***Men, young adults and, most notably, citizens with a higher educational level have a closer connection with science:*** In Spain, specifically, while 69% of the elderly adult population have no connection with science (European average 37%), the percentage drops to 28% among young people aged 18 to 24 (European average 20%). We can see then, that the difference in closeness between Spain and Europe attenuates significantly among the younger public.

Level of scientific knowledge:

- ***Denmark and the Netherlands register the highest knowledge levels and Spain the lowest:*** Summing correct answers to the knowledge "test", scores for European countries included in this survey and the United States come out broadly similar, in the medium to medium-high interval. Denmark and the Netherlands appear at the top of the knowledge map (over 15 correct answers to the 22 questions posed), followed by Germany and the Czech Republic; in the middle ground stand Austria, the United Kingdom, France and the United States (averages of 13 to 14 correct answers); with Poland, Italy and Spain occupying the lower reaches. Spaniards score lowest of all by the measure of objective knowledge (average of 11.2 correct answers vs. a European average of 13.4).
- Grouping knowledge "test" answers into three segments ("high", "medium" and "low") throws inter-country differences into clearer relief. The bulk of the population in all countries falls within the medium knowledge segment. However, major differences emerge when we consider the high knowledge segment, which extends to over 50% in Denmark, the Netherlands and Germany, compared to 25% approximately in Poland, Italy and Spain.
- ***Education and age influence knowledge disparities in Spain:*** The study allows us to plot the relationship in each country between educational level and scientific knowledge. In Spain's case, around 44% of the population with fewer years of study fall within the low knowledge segment compared to 6% of those who completed their studies at 20 or older. Age too acts as a determinant of knowledge among respondents in Spain. Hence 13% of young people aged 18 to 24 have a low level of scientific knowledge compared to 57% of the over 65s.
- ***Young Spaniards are closing the gap with Europe****:* The distance between Spaniards' scientific knowledge and the European average shortens considerably among the young adult population: 13% of 18 to 24-year-old Spaniards fall within the low knowledge segment compared to 10% on average in the same age group in Europe. In contrast, 57% of elderly Spanish adults are in the low knowledge group compared to the 22% average of elderly adults Europe-wide.
- ***Map of countries by closeness to science and scientific knowledge:*** Closeness to science bears a positive association with scientific knowledge, allowing us to classify countries into three groups (see figure 5):
    - **Denmark and the Netherlands**: countries with a higher level of closeness and scientific knowledge.
    - **Germany, Austria, France, United Kingdom and United States**: countries with a medium level of closeness and scientific knowledge.
    - **Poland, Italy, Spain**: countries with a lower level of closeness and scientific knowledge. The **Czech Republic** shares a low level of closeness with this group but deviates in its higher level of objective scientific knowledge.
- ***Testing, the main way to validate a scientific theory:*** The majority affirm that for a scientific theory to be considered true, it is vital that the results should be **tested**, both by the researcher concerned and other scientists. Importance is accordingly

attached to whether It has been tested through experiments and, also, whether other scientists have repeated the experiment with similar results (over 40% describe these two criteria as "very important"). The publication of results is considered another factor of weight. Between 20% and 30% in almost all countries refer to the importance of results being published in a scientific journal, and between 10% and 20% to them being reported in a mass communication media like the newspapers or TV.

- ***Over 40% of Spaniards are unable to name any eminent scientist:*** Another measure of familiarity with science is knowing the names of those who have contributed signally to its progress. Respondents were accordingly asked to mention three scientists of any country and historical period. The first thing that strikes us is the difference between countries in the percentage unable to name a single scientist; a fact presumably indicative of a weak scientific culture. Difficulties identifying even one scientist affect a similar percentage in Europe and the United States (27%), but rise to 46% in Spain.
- Among those able to identify at least one scientist, Albert Einstein is the name mentioned most frequently by citizens in the 11 survey countries. His 42% of mentions in Europe and 50% in the United States place him far ahead of his nearest rivals. Within Europe, the percentages mentioning Einstein run from 54% in Germany and 51% in Denmark to 30% in Poland and 32% in Spain. A long way behind, a consensus forms around the figures of Isaac Newton, Marie Curie, Louis Pasteur and Galileo Galilei.
- As a rule, national scientists figure more often and more prominently within each country. Spaniards however accord little recognition to great national figures: Santiago Ramón y Cajal is mentioned by around 5% and Severo Ochoa by 2.5%.

1. INTEREST, PRACTICES AND DEGREE OF CLOSENESS TO SCIENCE

1.1. STATED INTEREST AND INFORMATION CONCERNING SCIENTIFIC ISSUES.

Interest in news about scientific issues in the medium-to-high range

A useful starting point to explore citizens' connection with science is the interest they show in news items on scientific issues on a stand-alone basis and in comparison with news items in other domains.

Interest in science is one of the standard indicators in this kind of study – the first precondition for an individual to elect to follow science topics, through one or other channel, out of the multitude of news items competing for their attention.

In a majority of survey countries, the degree of interest stated in scientific issues (on a scale from 0 to 10 where 0 means absolutely no interest and 10 means a great deal of interest) stands in the medium-high interval, equating to average scores of between 5 and 6 points. Set against the overall interest map, we find that interest in scientific issues trails interest in health, environmental and economic issues and is on a par with the levels stated for international and political issues, albeit with some differences between countries (see table 1). In Spain, concretely, average interest in news about scientific issues stands at 5.7 (close to the European average), some way below health (7.9), environmental (6.7) and economic (6.7) issues and just a fraction ahead of international issues (5.6). Spaniards are, with Poles and Czechs, those expressing least interest in political issues (around 4.5).

Interest in scientific issues is medium to high in the United States and Europe as a whole. It is possible to segment survey countries by this measure into three large groups:

- High interest (average of almost 6 or more): Netherlands, Denmark, United States and France
- Medium interest (average from 5.4 to 5.7): Italy, Spain, Austria, United Kingdom, Germany, Poland
- Low interest (average below 5 points): Czech Republic.

Table 1: Every day there is a great deal of news about a wide variety of issues. I am going to read a list of issues to you, and I would be grateful if you could rate them according to your level of interest. Scale from 0 to 10 where 0 means you have absolutely no interest and 10 means you have a great deal of interest in these issues. Base: all cases

	Health issues	Environmental issues	Economic issues	International issues	Scientific issues	Political issues
Total Europe	7.4	6.6	6.1	5.7	5.6	5.2
Netherlands	7.5	6.8	6.8	6.7	6.4	6.5
Denmark	7.4	6.9	6.8	6.5	6.1	6.7
France	7.7	6.7	5.9	5.9	5.9	5.0
Spain	7.9	6.7	6.7	5.6	5.7	4.4
Italy	7.1	6.6	6.3	5.6	5.7	5.3
Austria	7.2	6.8	5.9	6.2	5.6	5.6
United Kingdom	7.6	6.6	6.2	5.7	5.6	5.1
Germany	6.9	6.7	5.7	5.9	5.5	5.7
Poland	7.1	6.0	5.5	5.1	5.4	4.6
Czech Republic	6.9	6.1	5.5	5.0	4.3	4.3
United States	7.8	6.9	6.9	5.6	6.0	5.8

Respondents feel more interested than informed about scientific issues

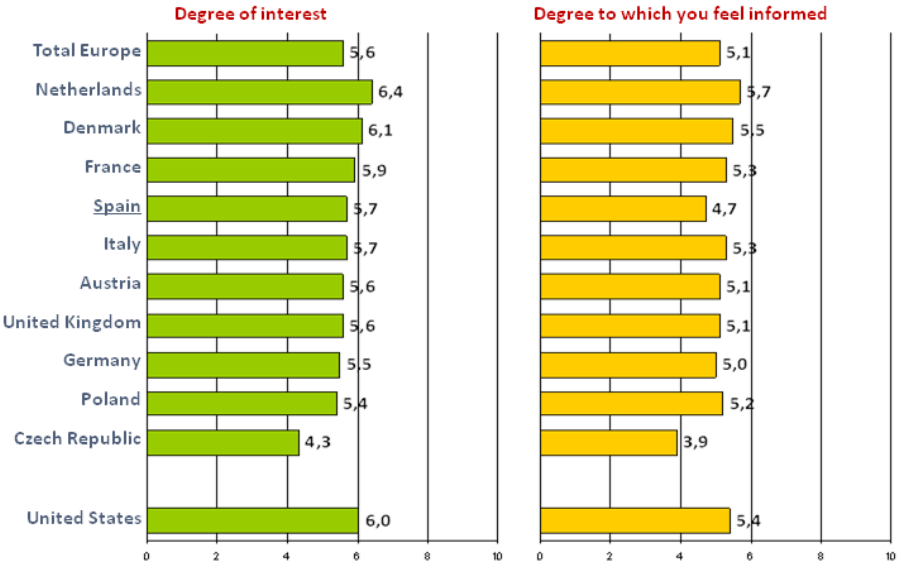
Besides their interest in science, respondents were asked about how informed they felt they were on scientific issues. As invariably happens, stated interest in science stood some way above the stated level of information.

Specifically, the extent to which citizens felt informed about science issues was no more than medium (close to 5 points in a majority of cases), with the Dutch and Danish expressing a slightly higher level. Spaniards' subjective level of information was below the European average. In fact the citizens of Spain and the Czech Republic were those feeling least well informed, with average scores of under five points and under four points respectively.

As we can see from figure 2, almost all countries exhibit a difference of between half a point and one point between the level of interest expressed by respondents and the degree to which they feel well informed, the gap being widest of all in Spain.

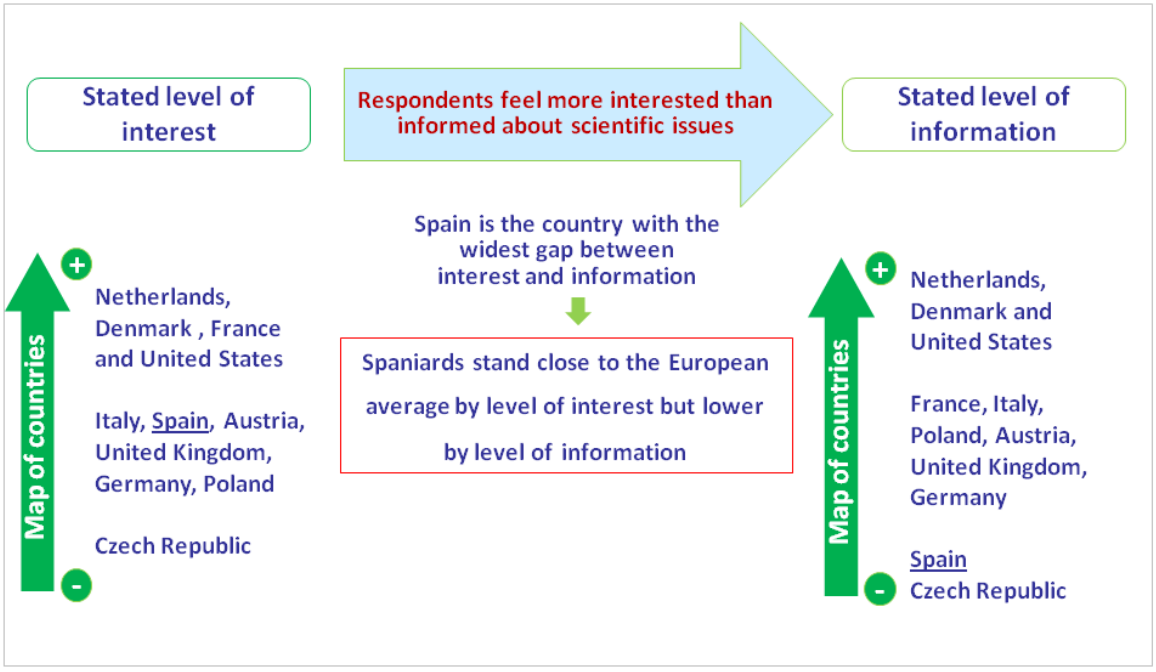
Figure 2: Declared interest and information about scientific issues

Average on a scale from 0 to 10. Base: all cases



Degree of interest question: Every day there is a great deal of news about a wide variety of issues. I am going to read a list of issues to you, and I would like you to rate them according to your level of interest. Scientific issues. Average on a scale from 0 to 10 where 0 means that you have absolutely no interest and 10 means that you have a great deal of interest.

Degree of information question: Now I would like you to tell me how well informed you consider yourself to be concerning these issues. Scientific issues. Average on a scale from 0 to 10 where 0 means you consider yourself not informed at all, and 10 means you consider yourself well informed



1.2. ATTENTIVENESS TO SCIENTIFIC INFORMATION VIA DIVERSE CHANNELS

Citizens follow scientific information mainly through television

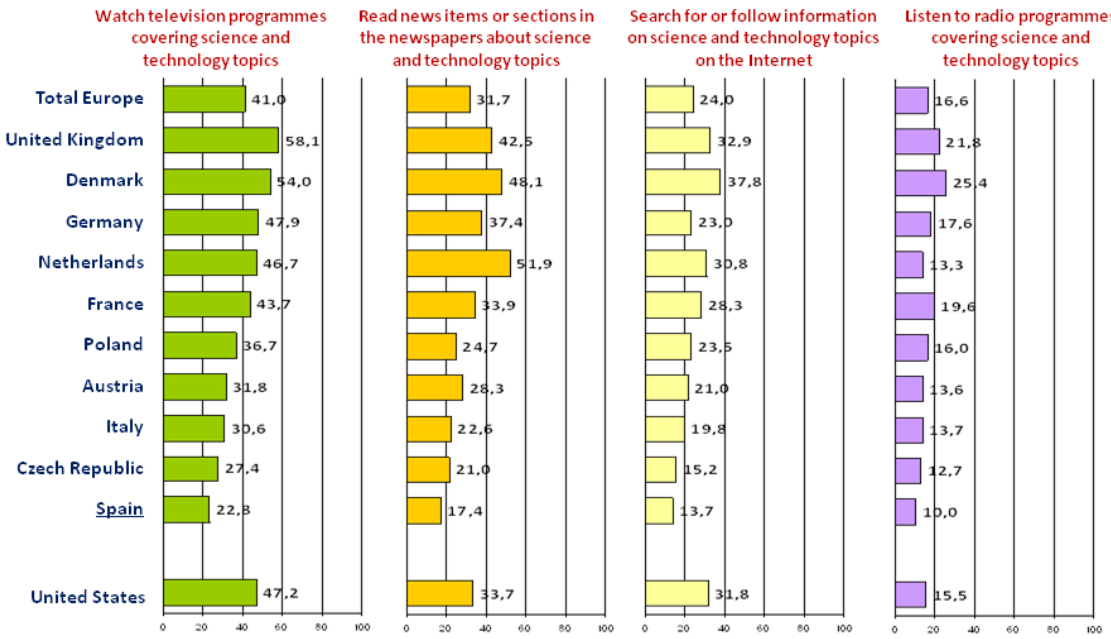
Aside from the relative interest expressed in scientific matters, citizens in the survey countries relied on some media more than others to keep up with science news.

Of the alternatives offered – television, newspapers, Internet and the radio – TV was the most popular for following science and technology topics. The next most common source, at quite a distance, comprised newspaper articles or supplements, followed by searches on the Internet. Radio, finally, was the least used medium for following scientific news.

As we can see from figure 3, attentiveness to scientific issues is higher in the United States than Europe, taking the average of the countries surveyed. Within Europe, contact with such information is highest in Denmark, the United Kingdom and the Netherlands and lower by a considerable margin in Spain, the Czech Republic and Italy.

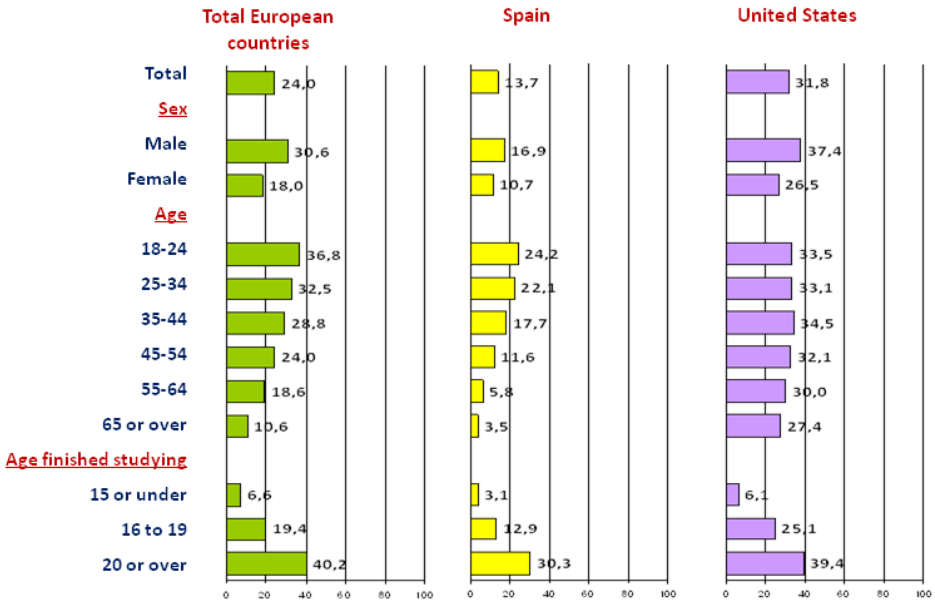
Figure 3: Could you tell me how often? "Percentage answering very often + quite often"

Base: all cases



Attentiveness to science and technology issues varied significantly both between and within countries (see figure 4). Focusing on Internet searches for scientific information, we find that gender, age and education are all clear determinants of activity frequency. Men score higher than women in the frequency of their online science consultations in European countries, Spain and the United States. Age too is a clear differentiating factor – more in Europe and Spain than in the United States – with the frequency of Internet use for science-related searches increasing significantly as the age group diminishes. Finally, educational level is the variable most strongly determining online searches for science news, which increase with years spent in education.

Figure 4: Could you tell me how often you search for or follow information on science and technology topics on the Internet? "Percentage answering very often + quite often". Base: all cases



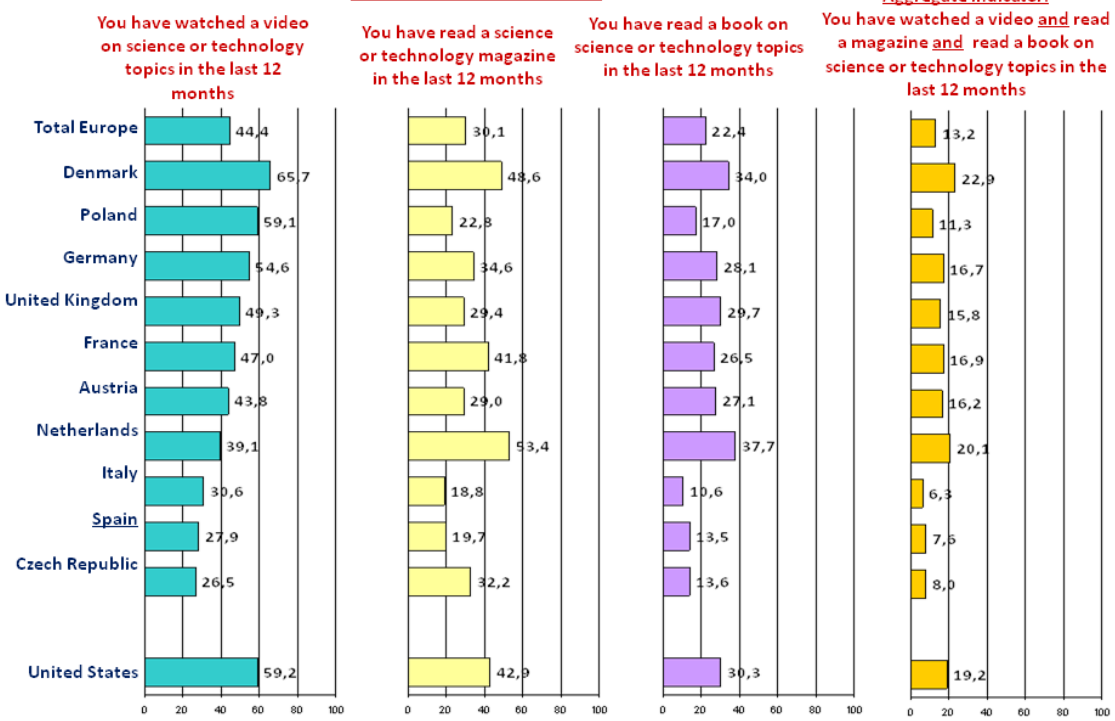
Limited access through more specialist media

A question about the use of other media like videos, specialist magazines or books on science and technology subjects confirmed the prevalence of on-screen information over the written word. Further, the percentage saying they had watched a video or read a magazine or book on science subjects in the last 12 months varied significantly from one country to another (see figure 5).

Again the Danes stand out for their greater contact with this kind of information, alongside the Dutch (in the case of science magazines and books), while Italians and Spanish are the least likely of all to consume scientific information through more specialist channels.

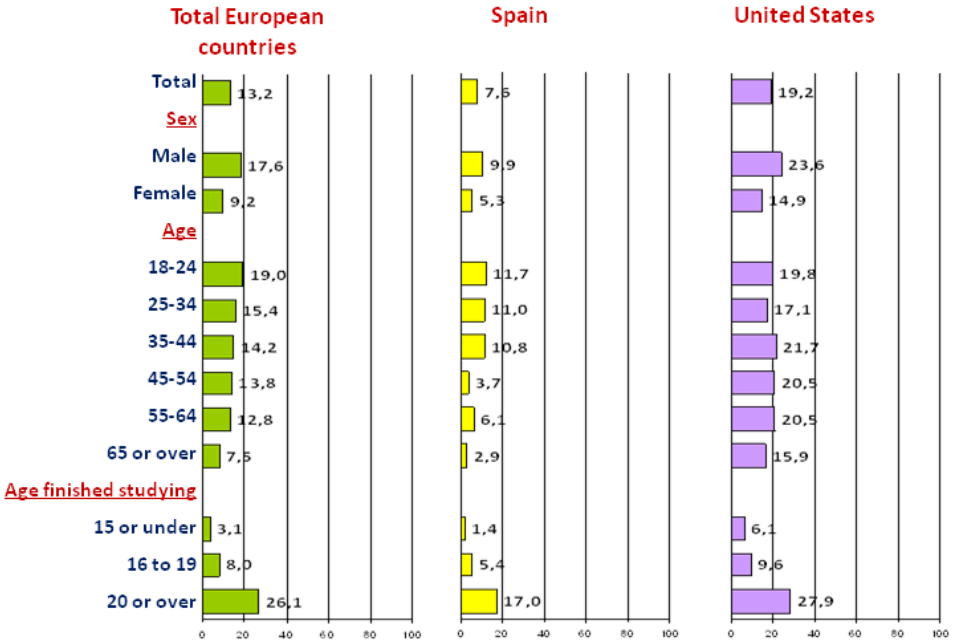
In order to identify which segment is the most attentive to scientific issues, we constructed an aggregate indicator of respondents following science and technology topics through these three media (videos, magazines and books). What is shows, as we can see from the last chart in figure 5, is that the segment comprising the most active followers of science issues is actually very small. It also serves to confirm the differences between countries, with this most active group summing over 20% of respondents in Denmark and the Netherlands and under 10% in the Czech Republic, Italy and Spain.

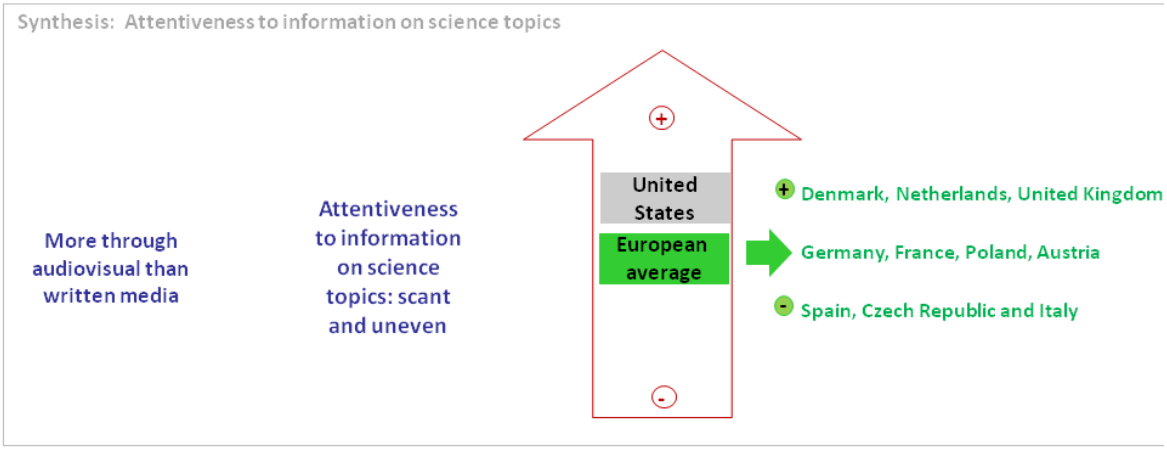
Figure 5: Could you tell me which of the following situations apply to your personal situation?
"Percentage answering yes" Base: all cases



The most active group in following science information is a small minority in all population segments, though certain marked differences do emerge. Men and, above all, individuals with a higher educational level report the highest attentiveness through specialist videos, journals or books. Age, finally, is not a determinant for attentiveness in the United States, but certainly younger age groups are more active than their older counterparts in Europe and, particularly, Spain (see figure 6).

Figure 6: Percentage that have watched a video and read a magazine and read a book on science or technology topics in the last 12 months. Base : all cases





1.3. "EXPLORING SCIENCE" ACTIVITIES

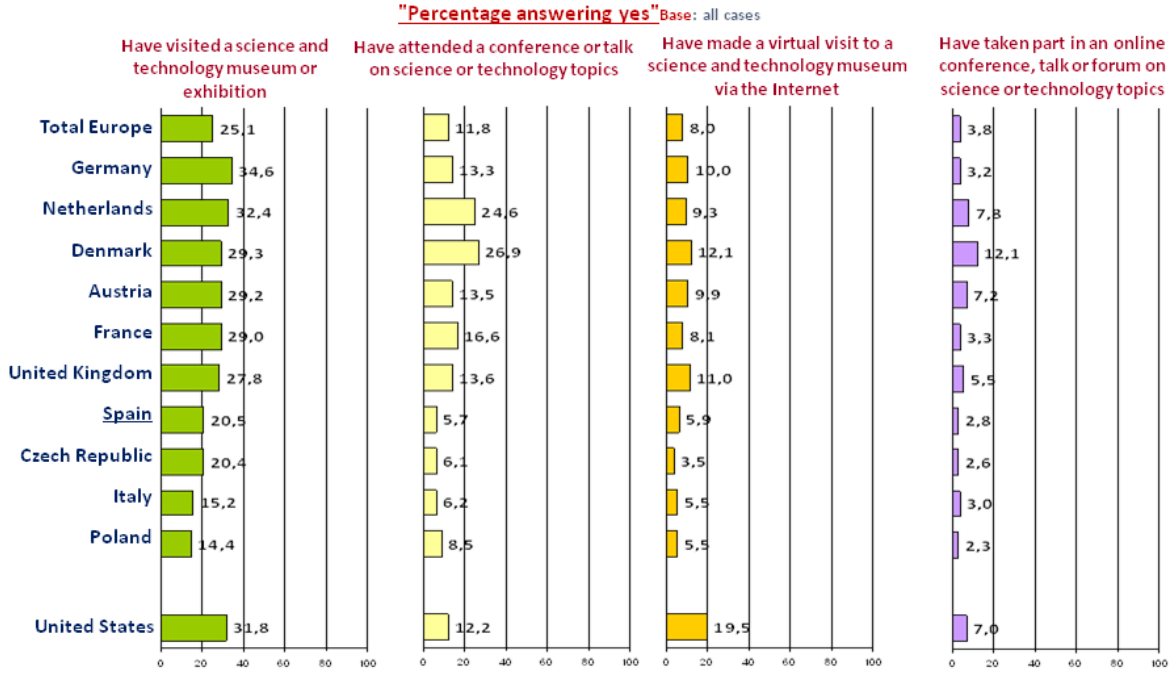
Little involvement in "exploring science" activities

To get a fuller picture of the connections citizens form with scientific issues in general, they were asked about their involvement in a series of science-related activities.

The percentage who had visited a science and technology museum or exhibition in the last 12 months was low overall, with the United States some way ahead of Europe (32% and 25% respectively). Within Europe, scores exceeded 20% across the sample, ranging from 30% plus in Germany and the Netherlands to around 15% in Poland and Italy. Attendance at conferences or talks on science matters was around 15% or less in most survey countries excepting Denmark and the Netherlands (around 25%) (see figure 7).

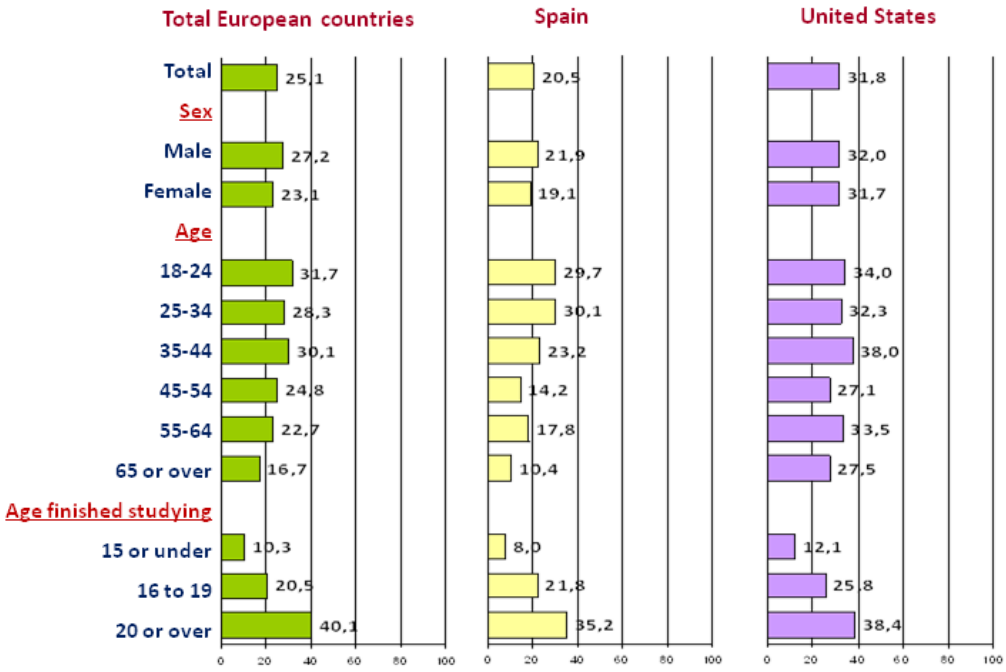
Online involvement in these same activities (museum visits or conferences) extended to no more than a small minority, below 10% in most cases. United States respondents were the likeliest to report a virtual visit to a science and technology museum or exhibition, and the Danish the likeliest to have participated in an online science-related talk.

Figure 7: Could you tell me which of the following situations apply to your personal situation? In the last 12 months:



Involvement in science-related activities also varied between population groups. Gender was not a determining factor for visits to science and technology museums. Age, meantime, marked something of a difference – more so in Europe and Spain than in the United States – with this kind of visit being reported more frequently among young than elderly interviewees. But the variable of most influence across all survey countries was educational level, with visits clearly increasing with study years completed (see figure 8).

Figure 8: Have you visited a science and technology museum or exhibition in the last 12 months?



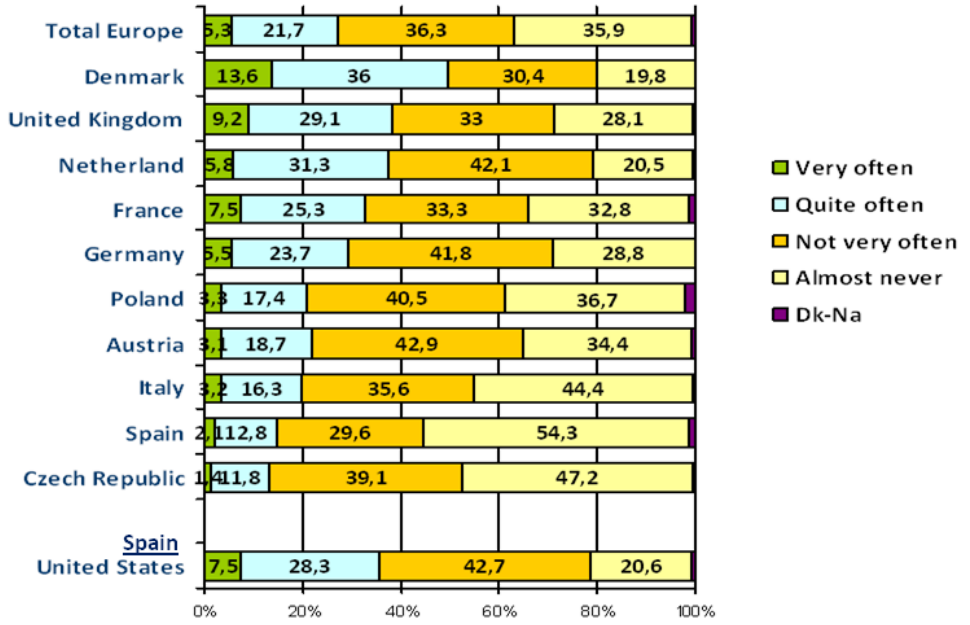
1.4. OTHER CONNECTIONS WITH SCIENCE AND SCIENCE PROFESSIONALS

Science topics receive scant and uneven attention in everyday conversations

A key factor in examining people's connection with science is the extent to which scientific topics form part of their dealings with other individuals; whether they come up or not in their conversations with relatives, friends or work colleagues.

In general terms, scientific topics were found to come up with low-to-medium frequency. Again, however, we can point to substantial differences between countries, with the United States scoring higher than the European average (see figure 9). Within Europe, the Danes are those conversing most frequently on this kind of subject (50% saying they do so "often" or "quite often", followed at a distance by the British and Dutch with almost 38%). The Spanish stand at the opposite extreme, with over 50% (versus a European average of 36%) affirming that science topics almost never arise in their daily conversations. Further, only 15% of Spaniards say they converse often or quite often about scientific topics compared to the European average of 27%.

Figure 9: Could you tell me how often science and technology issues form part of your conversations with family members, friends or work colleagues? Base: all cases



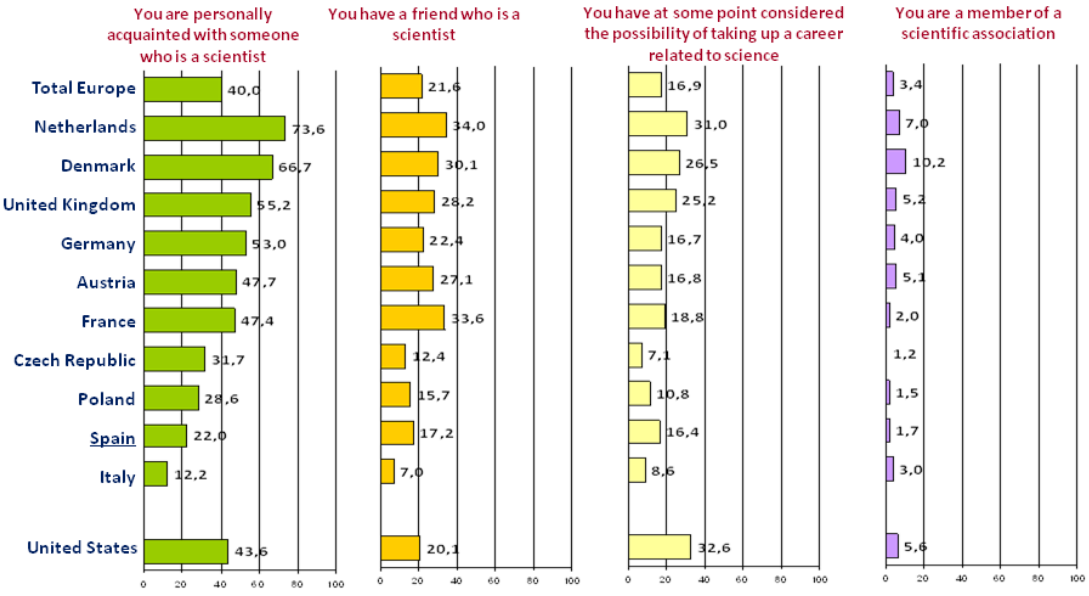
Differing degrees of connection with the scientific career

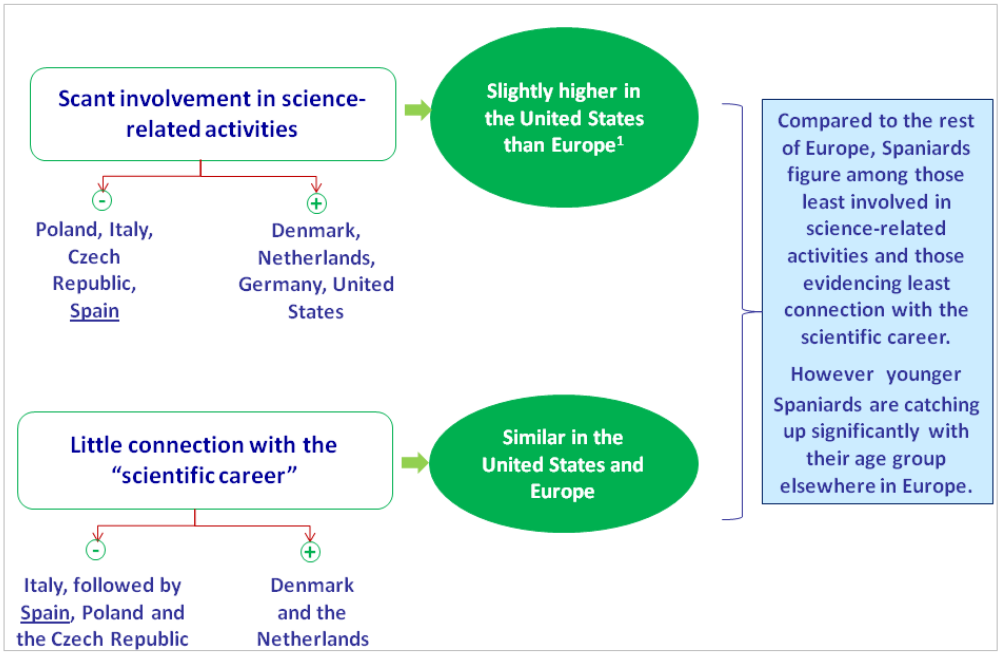
The study also looks at whether citizens feel some kind of connection with the "scientific career", either through personal experience or because they have a friend, relative or acquaintance working in the science sphere.

The connection respondents express with the "scientific career" is very weak. Although a large percentage in some countries have met a scientist in person at some point in their lives, only a small proportion have any direct connection with the scientific career. In most countries, only a small minority say they have a scientist friend, and an even smaller percentage say they have a relative who is a scientist or have thought at some point of taking up a science-related career. Finally, only the tiniest percentage claim membership of a scientific association (see figure 10).

Here too we can detect significant differences within Europe. The closest connection with the scientific career is found among the Danish and the Dutch, followed by British and French, while the Italians are those expressing the least connection, followed by Spaniards, Poles and Czechs.

Figure 10: Could you tell me which of the following situations apply to your personal situation? "Percentage answering yes" Base: all cases





[1] Mentions of Europe or the European average refer to the average of the European Union countries included in the study (10)

1.5. CLOSENESS TO SCIENCE: AN AGGREGATE MEASURE

Levels of closeness to science are low overall as well as differing sharply within Europe

In order to obtain a single measure of closeness to science, we constructed an aggregate indicator spanning attentiveness to scientific information, involvement in "exploring science" activities, and connection with the "scientific career".

This indicator comprises 20 separate measures and accordingly has a range from 0 to 20[2]. The full distribution of the closeness scale throws up the contrasting positioning of the countries surveyed. Scores are grouped into the following categories of closeness: "none" (0), "low" (average score from 1 to 3), "medium" (average 4 to 7) and "high" (average 8 or more).

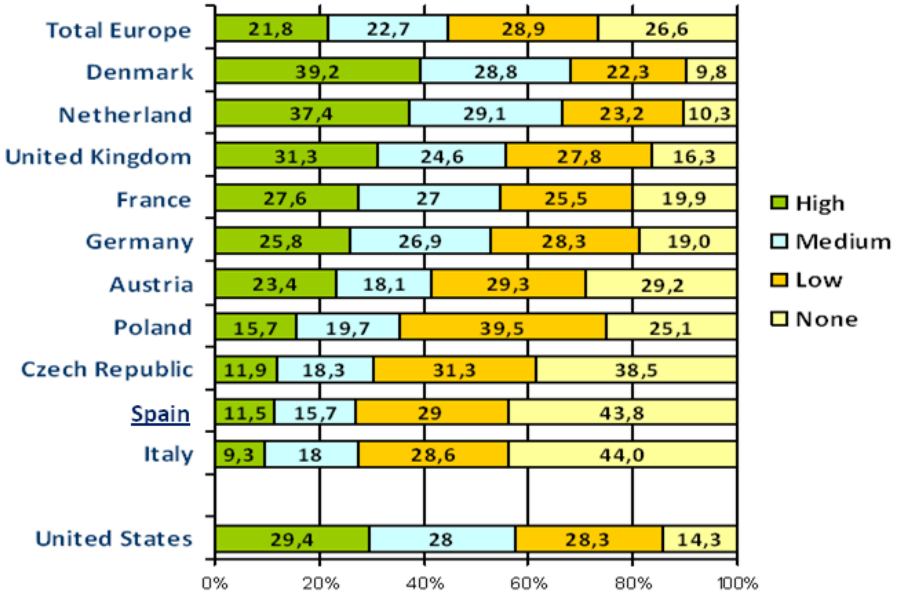
The level of closeness to science found by the study is universally low, though the United States scores ahead of the European average: 29% and 22% respectively registering a high closeness to science against the 14% and 27% registering no connection whatsoever.

Within Europe, the percentage of the population with a high level of closeness is clearly greater in Denmark and the Netherlands (around 40%), ahead of the United Kingdom, United States, France and Germany (around 30%), while languishing below 15% in the Czech Republic, Spain and Italy. Also, around 40% of respondents in the Czech Republic, Spain and Italy report no connection with science, against only 10% of the Danish and the Dutch (see figure 11).

In effect, setting countries closest to science against those most remote we observe an almost inverse distribution, such that the segment closest to science in Denmark and the Netherlands has a similar weight (around 40%) to the segment in Spain, Italy and the Czech Republic scoring lowest by this measure; conversely, the segment registering no connection with science in Denmark and the Netherlands is about equal (around 10%) to the segment closest to science in Spain, Italy and the Czech Republic.

[2] This scale has a reliability of 0.8 for all Europe, as measured by the Cronbach's alpha coefficient. Component indicators are: 1- Could you tell me how often you read news items or sections in the newspapers about science and technology topics?; 2- And how often do you listen to radio programs covering science and technology topics?; 3- And how often do you watch television programs covering science and technology topics?; 4- And how often do you search for or follow information on science and technology topics on the Internet?; 5- Could you tell me how often science and technology issues form part of your conversations with family members, friends or work colleagues?; 6- In the last 12 months, have you visited at least once a science and technology museum?; Could you tell me which of the following situations apply to your personal situation?: 7- You have watched a video on science or technology topics in the last 12 months; 8- You have read a book on science or technology topics in the last 12 months; 9- You have attended a conference or talk on science or technology topics in the last 12 months; 10- You are a member of a scientific association; 11- You have read a science or technology magazine in the last 12 months; 12- You have made a virtual visit to a science and technology museum via the Internet in the last 12 months; 13- You have downloaded an article on science and technology from the Internet in the last 12 months; 14- You have taken part in an online conference, talk or forum on science or technology topics in the last 12 months; 15- You hold a university degree in science: physics, chemistry, mathematics, biology, engineering, medicine, etc.; 16- You have at some point considered the possibility of pursuing a career related to science, 17- You are working or have worked as a scientist on some occasion; 18- You have a family member who is a scientist; 19- You have a friend who is a scientist; 20- You have at some point met someone who is a scientist.

Figure 11: Distribution of level of closeness to science (0-20). Base: all cases

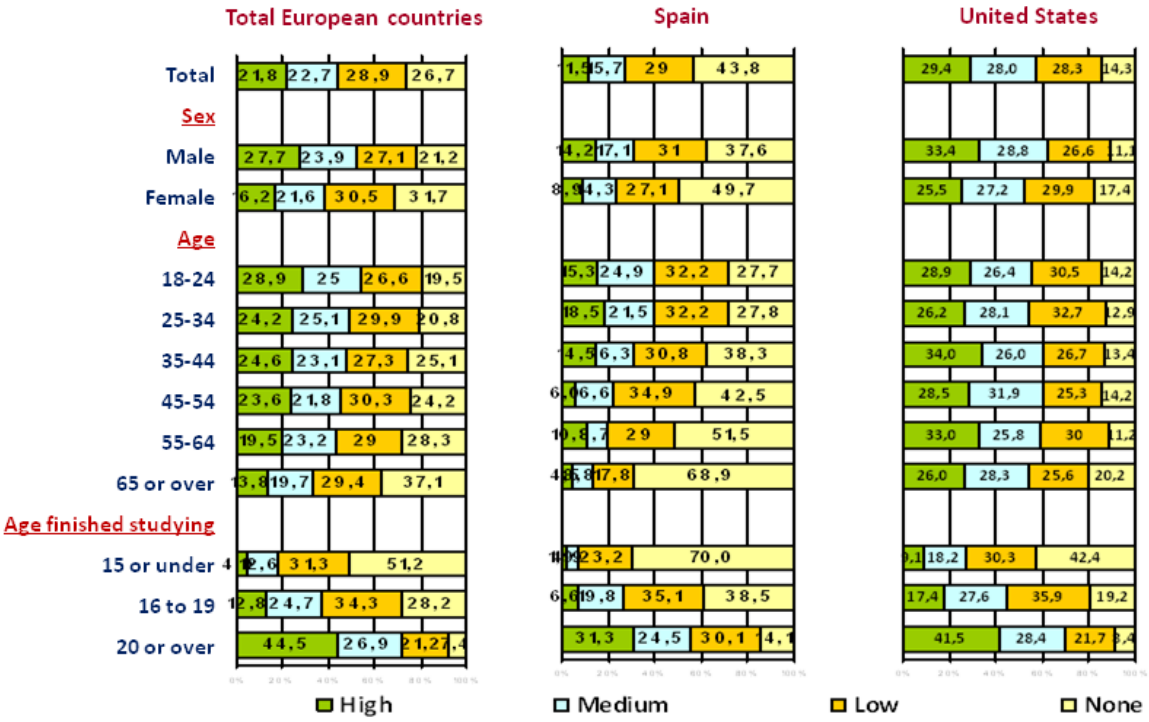


Men, young people and, especially, citizens with a higher educational level evidence the closest connection with science

Closeness to science not only varies between countries but also within each country along the lines of gender, age and, most of all, educational level. As we can see from figure 12, which for illustrative purposes presents data for the set of European countries, Spain and the United States, men, young adults and, especially, those having completed most years of studies score higher on average on the closeness scale than women, elderly adults and the less educated. Differences by age group are more accentuated in Europe and Spain in particular than they are in the United States.

In Spain's case, age and educational level are strong determinants of closeness. Hence around 70% of elderly adults register no connection with science against under 30% of the population aged 18 to 34. Likewise, 70% of respondents with a lower educational level register no connection with science against just 14% among their more educated peers. Consequently the closeness gap between Spain and the European average is widest among older adults and those with the fewest years of education.

Figure 12: Distribution of level of closeness to science (0-20). Base: all cases



2. LEVEL OF SCIENTIFIC KNOWLEDGE

In this chapter, we examine the cognitive dimension of social perceptions of science, i.e., the extent to which citizens are familiar with and understand science and its method. We accordingly assess the main dimensions used as standard in social perceptions of science studies, namely:

2.1. Level of knowledge of scientific concepts and theories:

2.1.1. Level of subjective knowledge: the understanding interviewees think they have of selected scientific concepts and terms.

2.1.2. Knowledge test: level of objective knowledge of selected scientific concepts and theories, i.e., the extent to which interviewees can identify correct statements regarding theories and principles drawn from disciplines like biology, physics, etc.

2.2. Understanding of the way scientific knowledge is generated:

2.2.1. Grasp of the concept of "probability".

2.2.2. Validation of science: science as experimentally tested and published knowledge.

2.3. Familiarity with the great scientists of all ages and countries

2.1. LEVEL OF KNOWLEDGE OF SCIENTIFIC CONCEPTS AND THEORIES

2.1.1. LEVEL OF SUBJECTIVE KNOWLEDGE

Major differences between countries in citizens' understanding of scientific concepts

In order to measure the cognitive dimension of perceptions of science, the "International Study on Scientific Culture" starts by examining interviewees' declared understanding of certain specialist terms. Each subject is offered a series of key scientific concepts and has to state whether they understand them completely, partly or not at all. What is being measured, therefore, is not their objective knowledge but what they subjectively perceive that knowledge to be.

Taking the percentage that claim to understand each term completely, we can say that a significant portion of the citizens of the 11 survey countries regard themselves as knowledgeable about concepts like the power of gravity, DNA, the greenhouse effect and the hole in the ozone layer. A rather smaller proportion believe they understand terms like gene, mathematical equation, cloning, molecule, atom, ecosystem, genetically modified food and stem cells (see table 13).

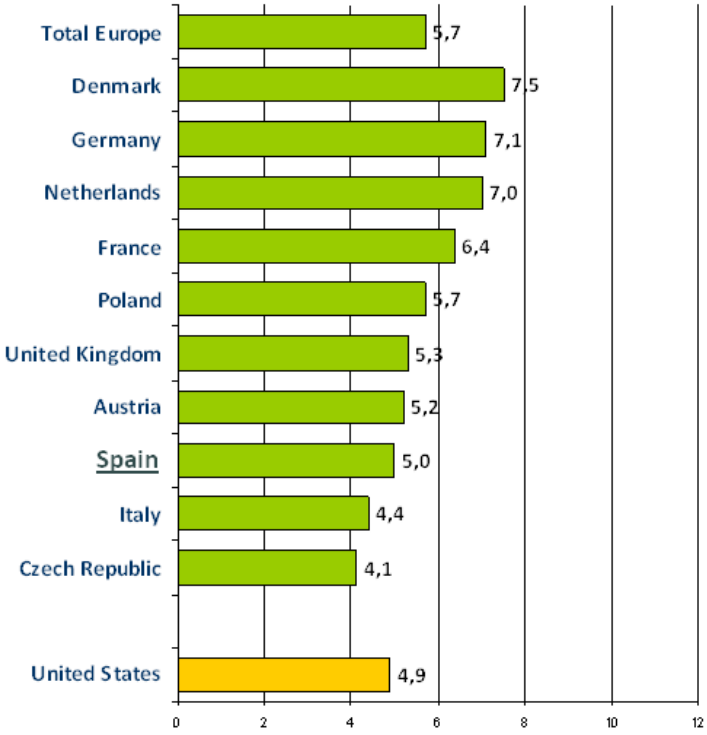
Table 13: The news media often employ specialist terms and expressions. I would like you to tell me in each case if, when you hear or read the term or expression, you understand it completely, partly or not at all. Base: all cases
"Percentage saying they understand completely"

	TOT EU	DK	DE	NL	FR	PL	UK	AT	ES	IT	CZ	USA
Power of gravity	55.7	80.0	72.5	63.9	39.9	54.1	57.9	59.8	51.9	47.0	50.9	63.1
Hole in ozone layer	53.4	64.2	65.8	62.8	61.7	48.6	49.1	50.2	48.1	42.0	36.1	39.6
Greenhouse effect	53.3	67.1	65.1	67.4	61.7	47.2	49.4	47.1	45.6	44.1	31.7	39.3
DNA	52.8	69.8	60.5	67.7	62.6	49.9	50.5	45.6	45.9	42.2	34.7	44.9
Gene	47.9	67.6	57.9	63.9	55.1	49.5	45.4	43.2	38.8	34.3	33.4	42.9
Cloning	47.3	61.6	56.1	62.1	59.8	44.9	41.5	36.7	41.5	36.4	27.3	35.4
Genetically modified food	45.7	55.1	55.6	52.0	60.9	43.4	40.5	41.0	37.4	34.9	20.0	32.8
Mathematical equation	44.7	55.3	54.2	45.3	42.1	56.4	43.2	40.4	40.4	32.0	46.9	45.2
Atom	44.7	56.0	58.2	53.2	49.0	49.9	37.9	42.0	36.6	31.6	40.1	39.3
Molecule	44.3	60.0	51.4	59.3	53.5	46.2	40.0	38.6	37.0	31.9	41.3	37.6
Ecosystem	44.1	56.5	57.8	53.8	49.6	40.7	36.7	44.0	39.9	33.5	31.3	35.8
Stem cells	40.2	55.6	52.3	51.3	44.6	36.9	33.0	31.6	38.3	32.3	20.7	33.0

Citizens' perceived level of understanding varies significantly from one country to the next. In order to explore this synthetically, we constructed a summated scale of the concepts they claim to understand completely. This scale ranges from 0 to 12 in keeping with the 12 terms presented. The average level of subjective knowledge stands higher in European countries than the United States (see figure 14). By country:

- The set of countries where respondents claim to understand completely over half the concepts inquired about comprises Denmark, Germany, Netherlands and, at a distance, France.
- Next comes the group with subjective knowledge of between 5 and 6 concepts: Poland, United Kingdom, Austria and Spain. The United States too falls within this group.
- Finally we have the countries where respondents say they understand fewer than 5 concepts: Italy and the Czech Republic.

Figure 14: Average of concepts reportedly understood completely (0-12). Base: all cases



2.1.2. KNOWLEDGE TEST

Marked inter-country differences by level of objective knowledge

As well as subjective understanding, the BBVA Foundation study scored respondents for their level of objective knowledge of selected scientific concepts and theories according to their number of correct responses to statements drawn from disciplines like biology, physics, etc. For each statement, like, for instance, "The gene is the basic unit of heredity of living beings", respondents could answer totally true, probably true, probably false or totally false. In some cases, the hypothesis presented was true and in others it was false.

Citizens of survey countries showed themselves more familiar with basic scientific concepts, and less sure about more complex questions drawn from physics, biology and biotechnology in particular. As a rule, they were also shakier on recent areas like those related to genetic engineering (see table 15).

- Over 80% of citizens in the majority of counties surveyed know that "Hot air rises (T. true)", that "The continents on which we live have been moving for millions of years and will continue to move in the future (T)", "The oxygen we breathe comes from plants (T)" and "The gene is the basic unit of heredity of living beings (T)"
- Over 70% in a majority of countries know that "Earth's gravity pulls objects towards it without them being touched (T)" and over 60% are able to answer correctly that "Energy cannot be created or destroyed, but only changed from one form to another (T)"; "Almost all microorganisms are harmful to human beings (F: false)"; "Generally speaking, human cells do not divide (F)"; and "The earliest humans lived at the same time as the dinosaurs (F)".

- However, levels of knowledge tail off considerably, as well as differing more between countries, with regard to statements like: “Human stem cells are extracted from human embryos without destroying the embryos (F)”; “Antibiotics destroy viruses (F)”; “Atoms are smaller than electrons (F)”; and “Today it is not possible to transfer genes from humans to animals (F)”.

Table 15: Could you please tell me for each of the following statements to what extent you think it is true or false. Base: all cases

“Percentage answering correctly” (totally true or probably true – probably false or totally false as appropriate)

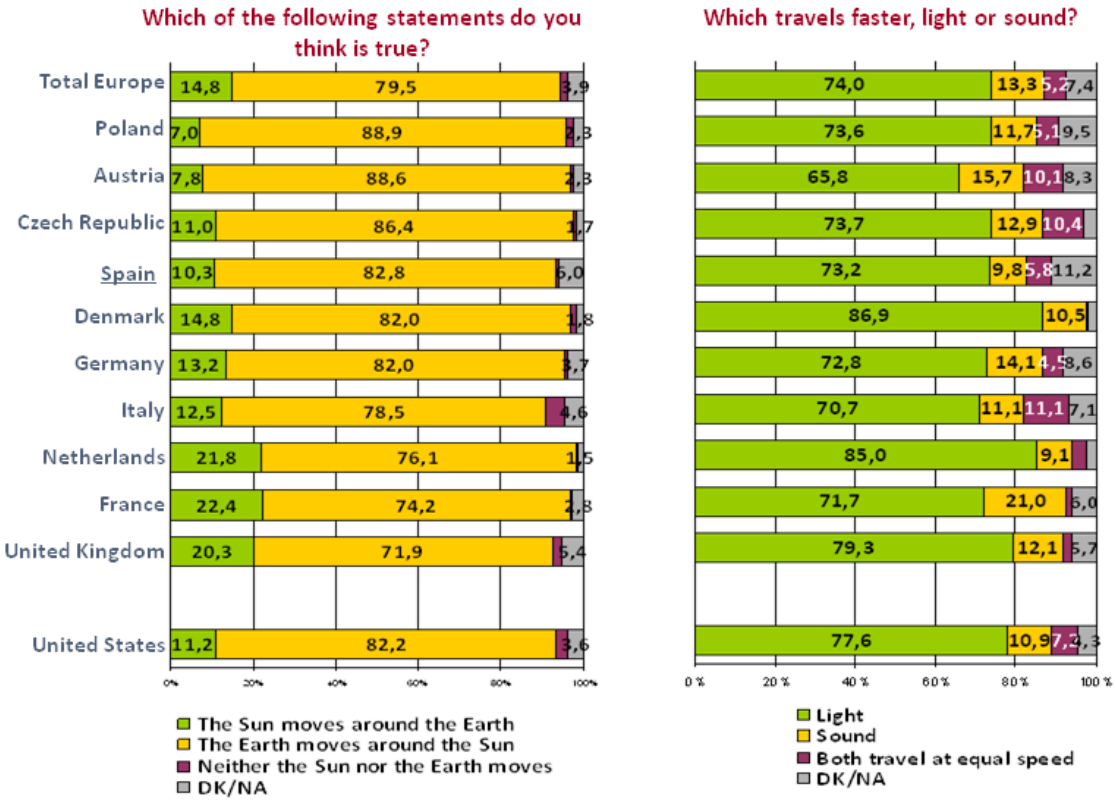
	TOT EU	DK	NL	DE	CZ	AT	UK	FR	PL	IT	ES	USA
Hot air rises (T)	91.0	97.7	96.2	95.7	95.6	95.0	96.2	93.0	88.1	83.5	82.0	95.0
The continents have been moving for millions of years and will continue to move in the future (T)	86.0	96.5	92.6	93.1	86.4	90.4	88.8	91.4	76.1	79.1	77.3	80.1
The oxygen we breathe comes from plants (T)	83.0	89.5	86.0	92.2	84.7	90.1	84.3	79.6	82.1	75.9	76.8	94.2
The gene is the basic unit of heredity of living beings (T)	82.0	93.3	89.1	91.9	88.5	73.7	84.4	79.9	80.9	75.2	71.4	81.7
Earth’s gravity pulls objects towards it without them being touched (T)	78.5	87.9	77.6	89.3	83.9	87.2	82.6	67.0	78.9	71.5	74.4	80.4
Energy cannot be created or destroyed, but only changed from one form to another (T)	65.5	62.4	61.2	64.5	71.4	64.6	66.2	68.7	56.1	63.2	73.6	80.1
Almost all microorganisms are harmful to human beings (F)	63.2	83.3	83.0	73.6	74.1	68.0	69.5	65.5	51.9	53.2	44.9	56.2
Generally speaking. human cells do not divide (F)	62.5	76.9	78.1	74.4	71.7	65.7	65.8	67.4	56.0	51.4	43.2	57.6
The earliest humans lived at the same time as the dinosaurs (F)	61.0	69.6	69.6	75.7	77.1	71.9	59.9	68.8	52.2	42.1	51.6	42.5
Plants have no DNA (F)	59.7	72.0	74.0	65.7	61.7	61.7	67.6	64.5	53.5	49.2	45.1	64.4
The greenhouse effect is caused by the use of nuclear power (F)	57.7	82.5	69.9	70.1	63.7	64.5	62.9	62.9	46.5	49.7	34.4	46.5
All radioactivity is a product of human activity (F)	55.8	72.4	65.6	69.5	62.8	64.5	59.5	57.4	44.2	45.6	41.3	61.6

	TOT EU	DK	NL	DE	CZ	AT	UK	FR	PL	IT	ES	USA
Ordinary tomatoes, the ones we normally eat, do not have genes, whereas genetically engineered tomatoes do (F)	54.3	71.0	73.4	66.0	59.7	62.9	55.4	53.1	47.8	49.9	35.4	47.6
It is the father's gene that determines a newborn baby's sex; whether it is a boy or a girl (T)	51.6	45.3	51.7	44.1	52.8	54.9	56.3	53.4	44.7	62.0	47.1	75.1
Lasers work by sound waves (F)	48.1	60.6	60.7	49.9	44.6	46.9	56.3	58.4	38.8	42.0	32.9	53.5
The light that reaches the Earth from the sun is made up of a single color: white (F)	44.2	60.4	58.5	49.0	44.4	37.4	54.2	44.5	40.5	37.9	28.8	54.7
Today it is not possible to transfer genes from humans to animals (F)	40.7	50.4	52.9	45.6	52.9	49.5	48.4	40.8	40.1	30.0	27.6	42.8
Atoms are smaller than electrons (F)	38.1	47.6	39.0	37.5	55.4	40.7	33.9	45.9	42.0	34.8	30.4	49.9
Antibiotics destroy viruses (F)	36.4	43.1	46.5	36.0	26.2	33.8	42.0	49.3	27.5	32.9	24.3	46.5
Human stem cells are extracted from human embryos without destroying the embryos (F)	28.8	30.7	39.9	42.6	40.9	38.3	28.1	19.8	25.3	25.2	17.4	54.4

To this battery we added two further knowledge questions whose format was different but which also offered one correct and one incorrect answer.

A large majority in every country knows that the Earth moves around the sun, and not vice versa, and that light travels faster than sound (see figure 16).

Figure 16: Level of scientific knowledge. Base: all cases

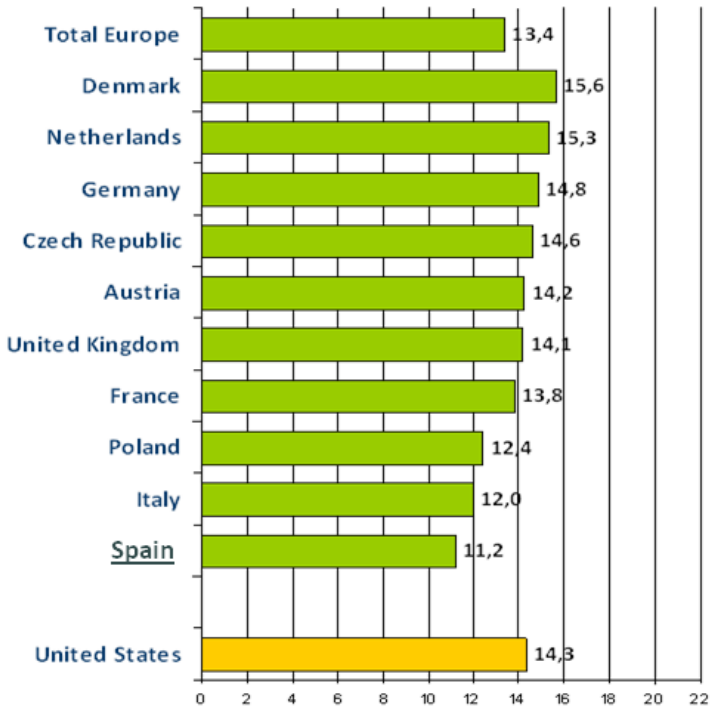


Denmark and the Netherlands register the highest knowledge levels and Spain the lowest

To more plainly illustrate inter-country differences, we constructed a single knowledge measure by summing the correct answers to the 20 questions in the knowledge battery and the additional two about the Earth's movement and the speed of light[3].

On the resulting scale from 0 to 22, all countries score higher than the median value (11 correct answers out of 22). The United States comes out slightly ahead of the European average. On the whole, countries occupy positions similar to those observed in the maps of closeness to science and subjective knowledge of scientific terms, albeit with some peculiarities. Specifically, Denmark, the Netherlands, Germany and the Czech Republic appear at the top of the knowledge map, followed in the middle by Austria, the United Kingdom, France and the United States, and with Poland, Italy and Spain occupying the lower reaches. Spaniards score lowest of all by the measure of objective knowledge (average of 11.2 correct answers vs. a European average of 13.4). The Czech Republic stands out as occupying a higher position on the objective knowledge scale than on those of closeness or subjective knowledge.

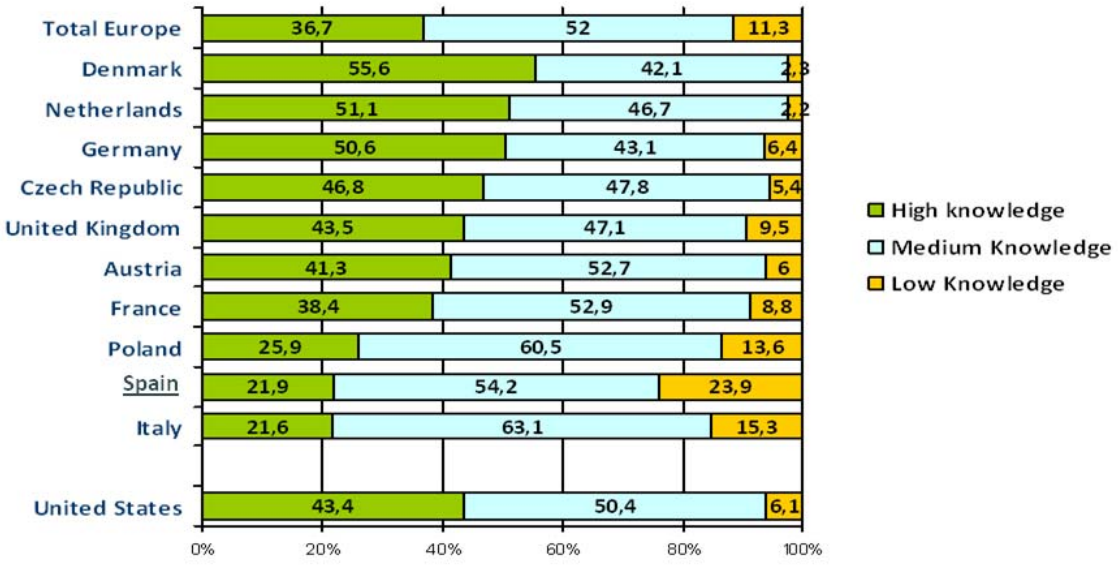
Figure 17: Average objective scientific knowledge (0-22). Base: all cases



[3] The scale has a high confidence level as evidenced by a Cronbach's alpha coefficient of 0.90 for the European sample as a whole.

Grouping knowledge "test" answers into three segments ("high": 16 to 22 right answers; "medium": 8 to 15 right answers and "low": 0 to 7 right answers) throws inter-country differences into greater relief. A majority of respondents in Europe and the United States fall within the medium knowledge segment. Where major differences emerge is in the relative size of the high knowledge segment: over 50% in Denmark, the Netherlands and Germany, around 40% or higher in the Czech Republic, Austria and the United Kingdom, France and the United States, and around 25% in Poland, Italy and Spain. Also, compared to countries like Denmark or Netherlands where only tiny percentages (2%) are excluded from scientific knowledge – low knowledge level – over 20% of Spaniards are in this situation. The low knowledge segment extends to around 15% in Italy and Poland and less than 10% in the remainder of the survey countries (see figure 18).

Figure 18: Distribution of the knowledge scale (0-22). Base: all cases



Educational level and degree of connection with science are strong differentiating factors for scientific knowledge

Inter-country diversity in knowledge levels does not mean that levels are homogeneous within each country or that nationality is the main differentiating factor. Within each society, levels of knowledge are influenced by sociodemographic characteristics like sex, age and educational level: the trend in the majority of countries is for men, young adults and those of a higher educational level to score higher on the science "test"; while women, elderly adults and those with fewer years of study come further down the scale.

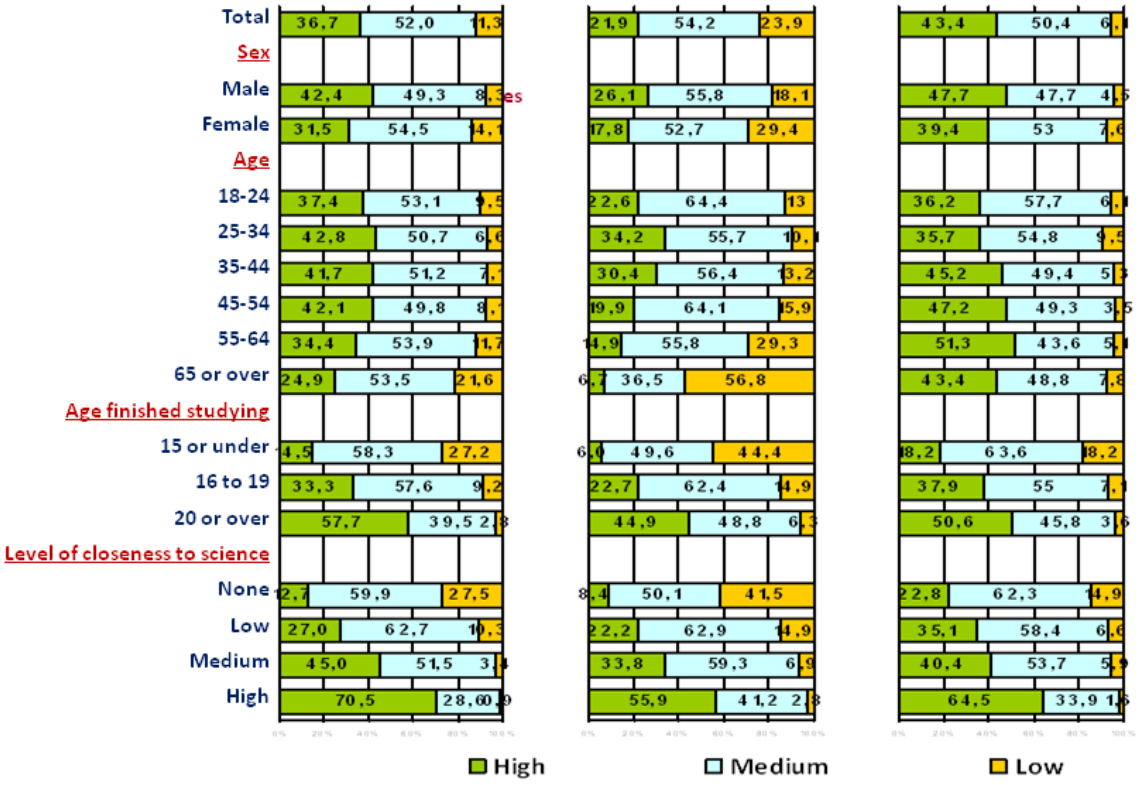
Of the sociodemographic variables analyzed (sex, age, education), educational level (measured as the age when respondents finished studies) was found to be the strongest differentiating factor for knowledge in all the countries surveyed.

As we can see from figure 19, showing the distribution for all European countries, Spain and the United States, knowledge disparities by sex, age and, above all, education, acquire considerable importance. In Spain concretely, we can see that age and education are stronger determinants of average knowledge than in European countries as a whole.

The distance between Spaniards' knowledge and the European average is considerably wider among elderly than young adults. Specifically, 13% of young Spaniards fall within the low knowledge segment compared to 10% on average in the same age group in Europe. In contrast, 57% of elderly Spanish adults are in the low knowledge group compared to the 22% average of elderly adults Europe-wide.

Closeness to science (attentiveness to scientific information, involvement in science-related activities and connection with the scientific career) clearly stands in positive relation to level of knowledge, such that knowledge is increasing with degree of closeness. In the case of Spain, 56% of those evidencing a "high" closeness to science have a high level of scientific knowledge, compared to just 8% of those in the "none" group. In effect, closeness, alongside years of education, are the variables that most influence knowledge level.

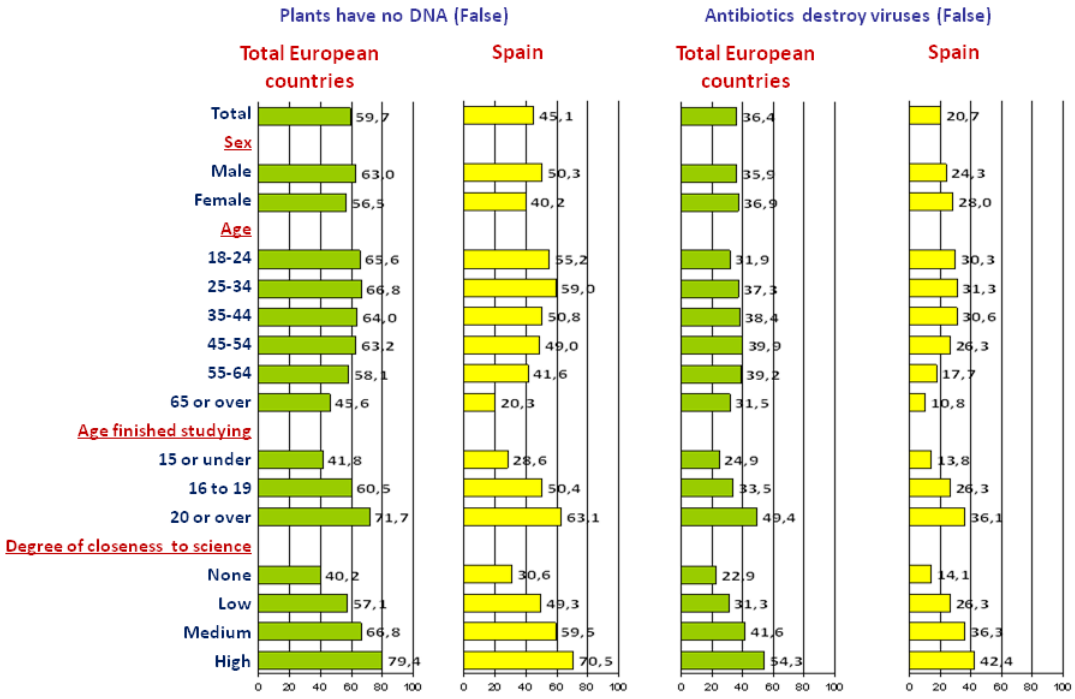
Figure 19: Distribution of knowledge scale (0-20). Base: all cases

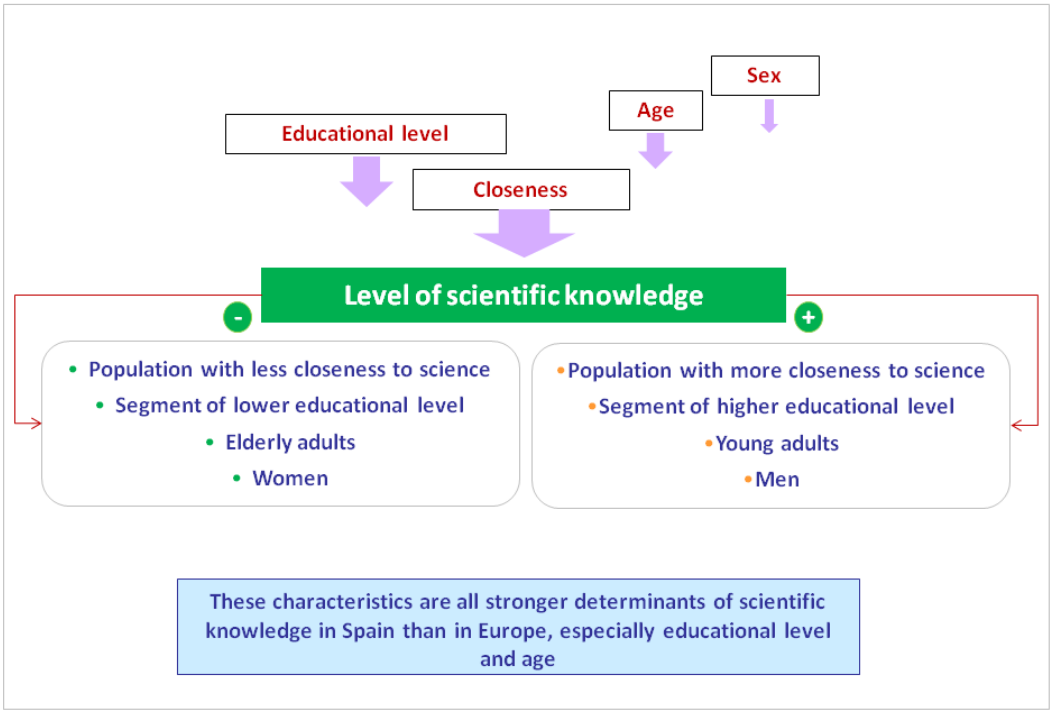


The influence of sociodemographic and attitudinal characteristics on knowledge levels is also apparent when we look at specific items on the scientific knowledge scale (see figure 20). Taking the set of European countries and Spain on its own, we find that the strong positive link between closeness to science (attentiveness to information, involvement in activities, connection with the scientific career) and scientific knowledge is borne out by the fact that the percentage of those giving correct answers to two items on the knowledge scale is almost double among those evidencing a high degree of closeness than those evidencing none. The importance of education as a differentiating factor for knowledge is also confirmed by the fact that the number of correct answers rises significantly among those who finished studying at an older vs. a younger age. Age too is a determinant of knowledge, and significantly more so in Spain than elsewhere in

Europe: the percentage correctly labeling as false the statement that plants have no DNA was 59% in the 25 to 34 age group against just 20% among those aged 65 and over. Sex, finally, had only a moderate influence, with men slightly ahead of women in the percentage responding correctly to these items.

Figure 20: Level of scientific knowledge
"Percentage answering correctly". Base: all cases





2.2. UNDERSTANDING OF HOW SCIENTIFIC KNOWLEDGE IS GENERATED

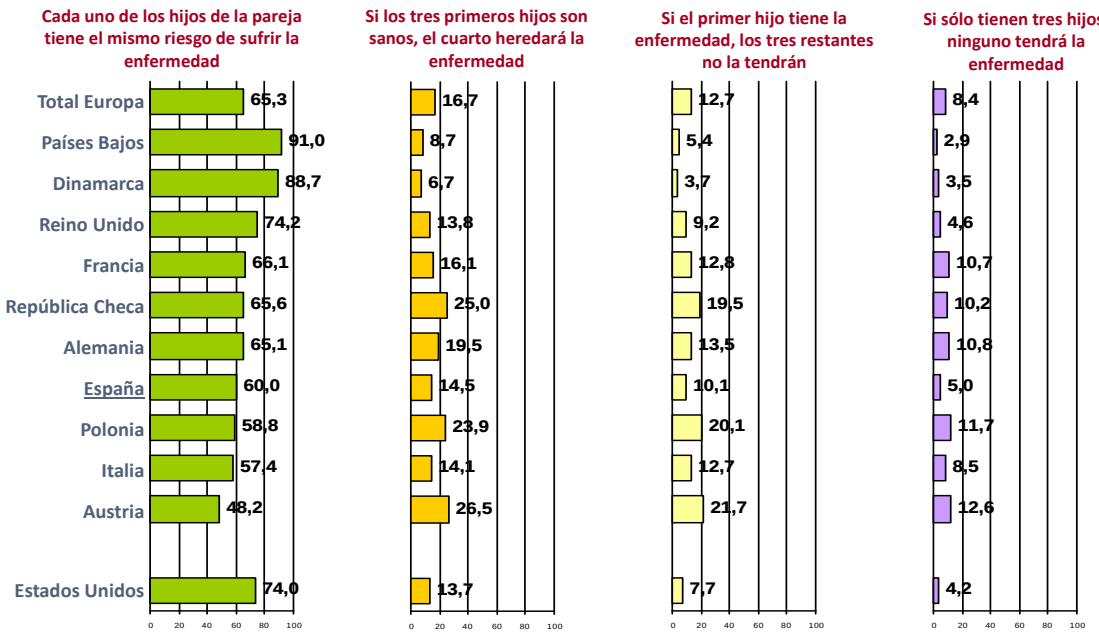
2.2.1. GRASP OF THE PROBABILITY CONCEPT

As well as knowledge of scientific concepts, the BBVA Foundation study examined respondents' grasp of key characteristics of the scientific method, including the concept of probability.

Interviewees were presented with the following situation: "A doctor tells a couple that according to their genetic tests, they have a one in four chance of having a child with a hereditary disease". They then have to choose one of the following alternatives to express what the doctor meant by this[4]: If their first three children are healthy, the fourth will inherit the disease; If the first child has the disease, the next three will not; Each child the couple has will have an equal chance of suffering the disease; If they only have three children, none of them will suffer the disease.

A majority in almost all countries said what the doctor meant was that "Each child the couple has will have an equal chance of suffering the disease". This response was a little more popular in the United States vs. the European average. Within Europe, it found the widest support in the Netherlands and Denmark, and the least support in Austria. In Spain, it was the choice of 60%, a little below the European average (65%) (See figure 21). Only minority percentages across the sample answered that what the doctor meant was one of the other three options.

Figura 21: Un médico le informa a una pareja que según su análisis genético tienen una posibilidad entre cuatro de tener un hijo con una enfermedad hereditaria. ¿Cree usted que lo que el médico quiere decir con esto es que ...?
«Porcentaje que contesta afirmativamente» Base: total de casos



[4]Alternatives are not mutually exclusive, since interviewees were asked to reply "yes"-"no" to each of the explanations offered.

In order to track understanding of the probability concept across all survey countries, we constructed an indicator of those answering correctly that when a doctor tells a couple they have a one in four chance of having a child with a hereditary disease, he or she means that "each child the couple has will have an equal chance of suffering the disease", while rejecting the other options (he or she means neither that "if their first three children are healthy, the fourth will inherit the disease" nor that "if the first child has the disease, the next three will not" nor that "if they only have three children, none of them will have the disease"). By this yardstick of understanding, the segment demonstrating a complete grasp of the concept of probability stands at around 80% in Denmark and the Netherlands, 60% in the United Kingdom and United States, 50% in France, Germany and Spain, and 40% in the Czech Republic and Italy, and attains its lowest level in Austria and Poland (around 30%).

Table 22: Percentage answering correctly with regard to the concept of probability (saying that the doctor means that "each child the couple has will have an equal chance of suffering the disease", and neither that "if their first three children are healthy, the fourth will inherit the disease" nor that "if the first child has the disease, the next three will not" nor that "if they only have three children, none of them will have the disease". Base: all cases

Total Europe	48.5
Denmark	81.4
Netherlands	79.3
United Kingdom	59.8
France	50.7
Germany	48.4
Spain	45.7
Czech Republic	41.9
Italy	39.8
Austria	33.5
Poland	32.7
United States	60.6

2.2.2. VALIDATION OF SCIENCE

Testing is seen as the main way to validate a scientific theory

Besides understanding key scientific concepts and principles, another essential dimension of scientific culture is knowing how knowledge is obtained and validated.

The majority of respondents in the survey affirm that for a scientific theory to be considered true, it is vital that the results should be **tested**, both by the researcher concerned and other scientists. Importance is accordingly attached to whether it has been tested through experiments and, also, whether other scientists have repeated the experiment with similar results (over 40% describe these two criteria as "very important"). Adding on those who define it as "fairly important", we find that over 85% of citizens in all societies believe that experimental testing or the possibility of repeating the experiment with similar results are key ways to validate scientific theories (see figure 23).

The publication of results is considered another factor of weight, albeit less so than testing. Between 20% and 30% in almost all countries say it is very important that the results are published in a scientific journal, and between 10% and 20% that they are reported in a mass communication medium like the newspapers or TV.

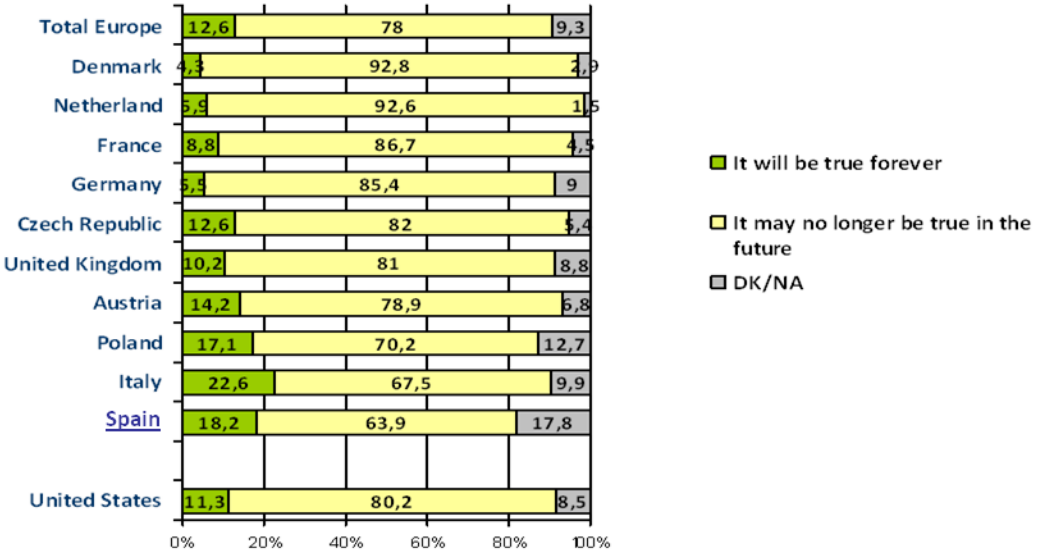
Citizens in the United States attach more importance to the testing and repetition of experiments than the European average. Within Europe, the Danes are the most inclined to see these two attributes as very important, but are also the least convinced, along with the Dutch, of the importance of results being published in a mass communication medium. Spaniards stand close to the European average in the importance assigned to all these aspects.

Figure 23: How important do you think the following criteria are in deciding whether a scientific theory is valid? Base: all cases

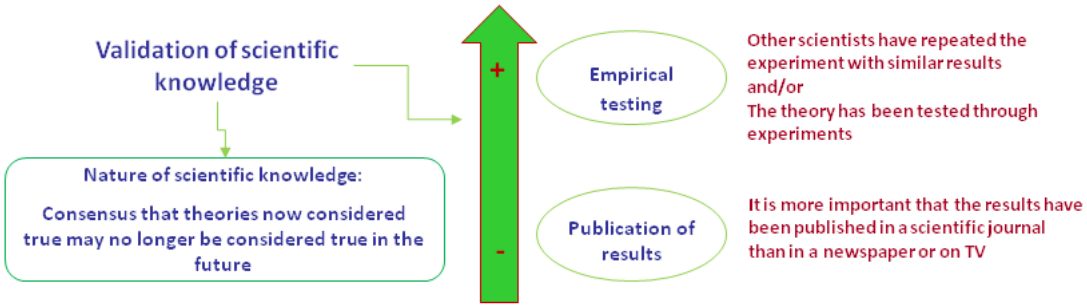
Questioned about the validity of scientific theories, an ample majority in all survey countries regard it as relative rather than absolute, i.e., they believe that a theory now considered true will not necessarily be considered true in future.

Those likeliest to perceive scientific knowledge as subject to change are the Danes and the Dutch, followed by French and Germans. Although only a minority in all countries respond that a scientific theory will be true forever, this view finds widest support in Italy (23%), Spain (18%) and Poland (17%). In Spain, specifically, although a majority believe that scientific theories now considered true may cease to be so in future, the percentage choosing this response is the lowest of any country in the survey. In effect, a significant percentage believe the theory will be true forever or feel unable to state an opinion (see figure 24).

Figure 24: If a scientific theory is now considered true, does that mean it will be true forever or do you think it may no longer be true in the future? Base: all cases



Synthesis: Nature and validation of scientific knowledge



2.3. FAMILIARITY WITH THE GREAT SCIENTISTS

Albert Einstein, the best known scientist

Another measure of citizens' familiarity with science is their ability to identify those who have made seminal contributions to science. They were accordingly asked to give the names of three scientists of any age or country.

The first thing that strikes us is the difference between countries in the percentage unable to name a single scientist; a fact presumably indicative of a weak scientific culture. Difficulties identifying even one scientist affect a similar percentage in Europe and the United States (27%), but rise significantly in Spain (46%), followed by Italy (31%), the United Kingdom (27%), Poland (26%) and France (25%). In remaining countries, around 20% could not name any scientists, and a smaller percentage in Denmark (15%) (see table 25).

Table 25: Percentage that cannot or prefer not to mention the name of any scientist. Base: all cases

Total EU	ES	IT	UK	PL	FR	CZ	AT	DE	NL	DK	US
27.1	45.9	30.5	26.8	26.0	24.5	23.4	20.2	19.4	18.8	14.7	27.4

Among those able to identify at least one scientist, Albert Einstein is the name mentioned most frequently by citizens in the 11 survey countries. His 42% of mentions in Europe and 50% in the United States place him far ahead of his nearest rivals. Within Europe, the percentages mentioning Einstein run from 54% in Germany and 51% in Denmark to 30% in Poland and 32% in Spain.

A long way behind, a consensus forms around the figures of Isaac Newton (13% in Europe as a whole with his highest share of mentions in the United Kingdom, 24%), Marie Curie (11% on average in Europe, 45% in Poland), Louis Pasteur (9% in Europe, 37% in France), and Galileo Galilei (8% in Europe, 18% en Italy).

Scientists known as physicists, like Galileo Galilei and Newton, tend to be well represented, while those whose names are associated with DNA or more recent discoveries receive far less recognition.

National scientists feature prominently in most countries

Aside from these names, we observe a wide dispersion and heterogeneity among the other scientists mentioned. Citizens in each country tend to include more national figures in their lists or mention them in a higher position. For instance, 44% of Danes mention Niels Bohr, 32% of Poles mention Nicolaus Copernicus, 15% of Americans mention Thomas Edison and 11% Ben Franklin, 13% of Italians mention Rita Levi Montacini and 10% Leonardo Da Vinci, 11% of Germans mention Robert Koch and 10% Wilhelm Conrad Röntgen, and 11% of the British mention Stephen Hawking. Spaniards however accord far less recognition to great national figures, and mention them less frequently than scientists from other countries. Hence Santiago Ramón y Cajal is mentioned by around 5% of Spaniards and Severo Ochoa, mentioned by 2.5%, does not even make into the top five.

Table 26 on the next page shows the top ten names mentioned in each of the survey countries.

Table 26: Could you give me the names of the 3 scientists who you think have been the most important in all of history? All mentions.

Germany	
Albert Einstein	53.9
Robert Koch	11.2
Galileo Galilei	9.8
Wilhelm Conrad Röntgen	9.7
Isaac Newton	9.7
Marie Curie	9.9
Thomas Alva Edison	6.1
Wernher von Braun	5.8
Alfred Nobel	5.0
Albert Schweitzer	4.8

Austria	
Albert Einstein	47.6
Isaac Newton	14.1
Thomas Alva Edison	11.2
Galileo Galilei	10.4
Marie Curie	9.4
Sigmund Freud	9.1
Wilhelm Conrad Röntgen	6.1
Charles Darwin	5.1
Leonardo Da Vinci	4.8
Alfred Nobel	4.4

Denmark	
Albert Einstein	51
Niels Bohr	43.5
Isaac Newton	14.5
Thomas Alva Edison	12.6
Tycho Brahe	8.9
Charles Darwin	8.9
Alexander Graham Bell	7.1
Hans Christian Ørsted	5.8
Sigmund Freud	4.6
Marie Curie	4.2

Spain	
Albert Einstein	31.6
Isaac Newton	15.2
Alexander Fleming	6.4
Thomas Alva Edison	5.8
Marie Curie	5.5
Santiago Ramón y Cajal	4.8
Steven Hawkins	4.4
Galileo Galilei	4.0
Louis Pasteur	4.0
Charles Darwin	3.9

France	
Albert Einstein	41.2
Louis Pasteur	37.1
Marie Curie	26.2
Pierre & Marie Curie	9.4
Isaac Newton	7.9
Galileo Galilei	6.5
Leonardo Da Vinci	4.5
Alexander Fleming	2.6
Christiaan Barnard	2.6
Thomas Alva Edison	2.5

Italy	
Albert Einstein	37.3
Galileo Galilei	18.4
Rita Levi Montalcini	12.7
Isaac Newton	12.4
Leonardo Da Vinci	10.3
Alessandro Volta	6.8
Enrico Fermi	6.1
Margherita Hack	6.0
Guglielmo Marconi	5.9
Antonino Zichichi	5.2

Netherlands	
Albert Einstein	57.8
Isaac Newton	15.8
Alexander Graham Bell	12.6
Charles Darwin	8.8
Thomas Alva Edison	8.3
James Watt	6.9
Marie Curie	6.2
Louis Pasteur	5.8
Leonardo Da Vinci	5.5
Sigmund Freud	4

Poland	
Marie Curie	45.3
Nicolaus Copernicus	32
Albert Einstein	30
Isaac Newton	11.3
Thomas Alva Edison	8.3
Alfred Nobel	7.3
Louis Pasteur	2.6
Pythagoras	2.6
Charles Darwin	2.3
Alexander Graham Bell	2

United Kingdom	
Albert Einstein	43.2
Isaac Newton	23.9
Steven Hawkins	10.5
Marie Curie	9.3
Charles Darwin	8.7
Louis Pasteur	8.3
Alexander Graham Bell	7.5
Alexander Fleming	7.0
Thomas Alva Edison	5.3
Galileo Galilei	4.0

Czech Republic	
Albert Einstein	37.1
Thomas Alva Edison	24.9
Isaac Newton	11.5
Alfred Nobel	10.1
Marie Curie	8.6
Alexander Fleming	7.0
Jan Jánský	4.5
Alexander Graham Bell	4.2
Charles Darwin	4.1
Jaroslav Heyrovský	3.9

United States	
Albert Einstein	49.8
Isaac Newton	15.7
Thomas Edison	15.3
Ben Franklin	10.9
Jonas Salk	8.1
Charles Darwin	6.8
Marie Curie	6.5
Alexander Graham Bell	6.4
Galileo	6.2
Louis Pasteur	4.6

MAP OF COUNTRIES BY CLOSENESS TO SCIENCE AND SCIENTIFIC KNOWLEDGE

Scientific knowledge is increasing with degree of closeness to science

Our final map of countries combines an essentially attitudinal dimension with another cognitive in nature, consisting of: a) A summated scale of closeness to science, which, as explained earlier, comprises indicators of attentiveness to scientific information, involvement in science-related activities and connection with the scientific career (scale ranging from 0 to 20) and b) A summated scale of level of objective scientific knowledge (ranging from 0 to 22) (see figure 27).

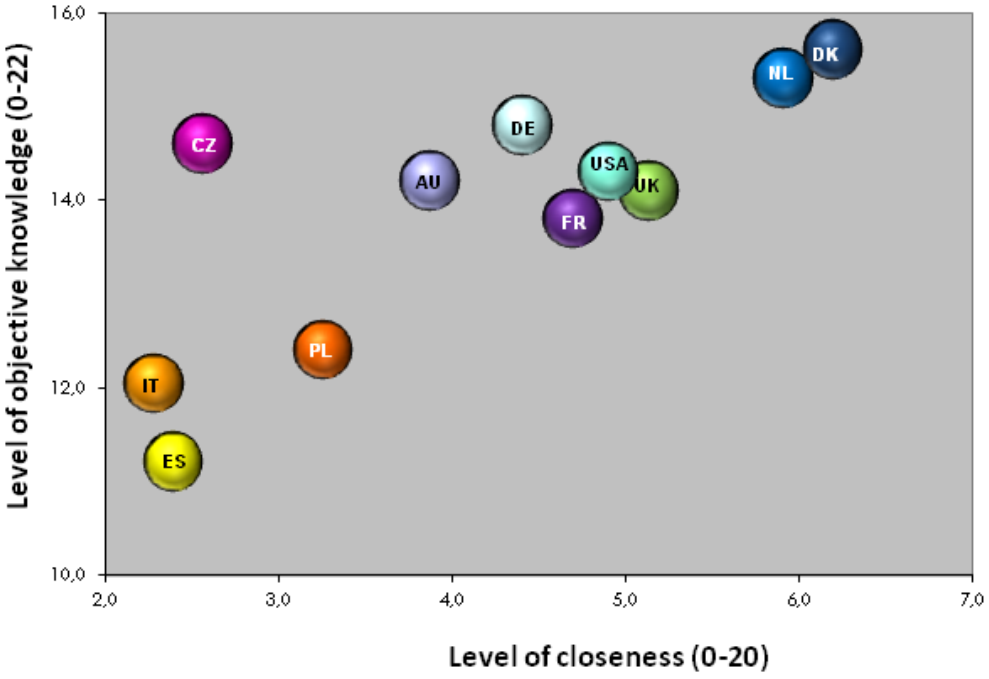
These two dimensions are related in such a way that the greater the closeness the higher the level of scientific knowledge. The correlation between the two scales stands between a Pearson's r[5] of 0.4 and 0.5 depending on the country. Thus:

- Countries with a higher degree of closeness also tend to be those evidencing a higher level of scientific knowledge: Denmark and the Netherlands.

[5] The Pearson's r correlation coefficient provides an indication of the strength of the association between two quantitative variables. The resulting correlation index moves in the interval [-1,1]

- Around the middle of the map come countries with a medium level of closeness and scientific knowledge: Germany, the United States, Austria, France and the United Kingdom.
- The lower part of the map is occupied by countries with a lower level of closeness and scientific knowledge: Poland, Italy, Spain. The Czech Republic shares a low level of closeness with this group but deviates in its higher level of objective scientific knowledge.

Figure 27: Positioning of countries by level of knowledge and closeness. Base: all cases



TECHNICAL NOTES

Universe: in each country, the general population aged 18 or over.

Method: administered face-to-face interview in respondents' homes via CAPI (Computer-assisted Personal Interviewing).

Sample size and distribution: 1,500 cases in each of the 11 countries. Multistage sample distribution stratified by region (NUTS classification or equivalent)/size of habitat, with primary units selected at random. Selection of individual respondents by the last birthday rule.

Sampling error: the estimated sampling error is +/- 2.6% in each country for a confidence level of 95.5% and in the worst-case scenario (p=q=0.5).

Survey period: October-November 2011.

Weighting: Results for Europe as a whole are arrived at by weighting each country's data according to its population weight in the sample of European countries surveyed.

Fieldwork: Fieldwork coordinated by TNS Opinion.

Study design and analysis: BBVA Foundation Department of Social Studies and Public Opinion.