Fundación BBVA
Department of Social Studies and Public Opinion

BBVA Foundation International Study on "Scientific Culture"

Understanding of Science

May, 2012

Surveys of scientific culture have a long tradition, dating back to the middle of the 1980s. Their purpose is to assess to what extent citizens in general (not only those at some stage of studying the subject matter) are familiarized with science.

It is widely believed that a public attuned to and familiar with science makes for more considered decision-making at an individual level and, also, a society that is more accepting of innovation and better equipped to negotiate change.

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.

- **Geographical scope of the study:** 10 European Union countries (Spain, Italy, France, Netherlands, Germany, Austria, Czech Republic, Poland, United Kingdom and Denmark) and the United States.
- **Size of random sample:** 1,500 face-to-face interviews in each country (approximate total of 16,500 interviewees) with the population aged 18 and over.
- **Fieldwork:** Conducted by TNS Opinion over October and November 2011.

Two main axes

- Interest and closeness to science
- Level of scientific knowledge

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Interest and degree of closeness to science

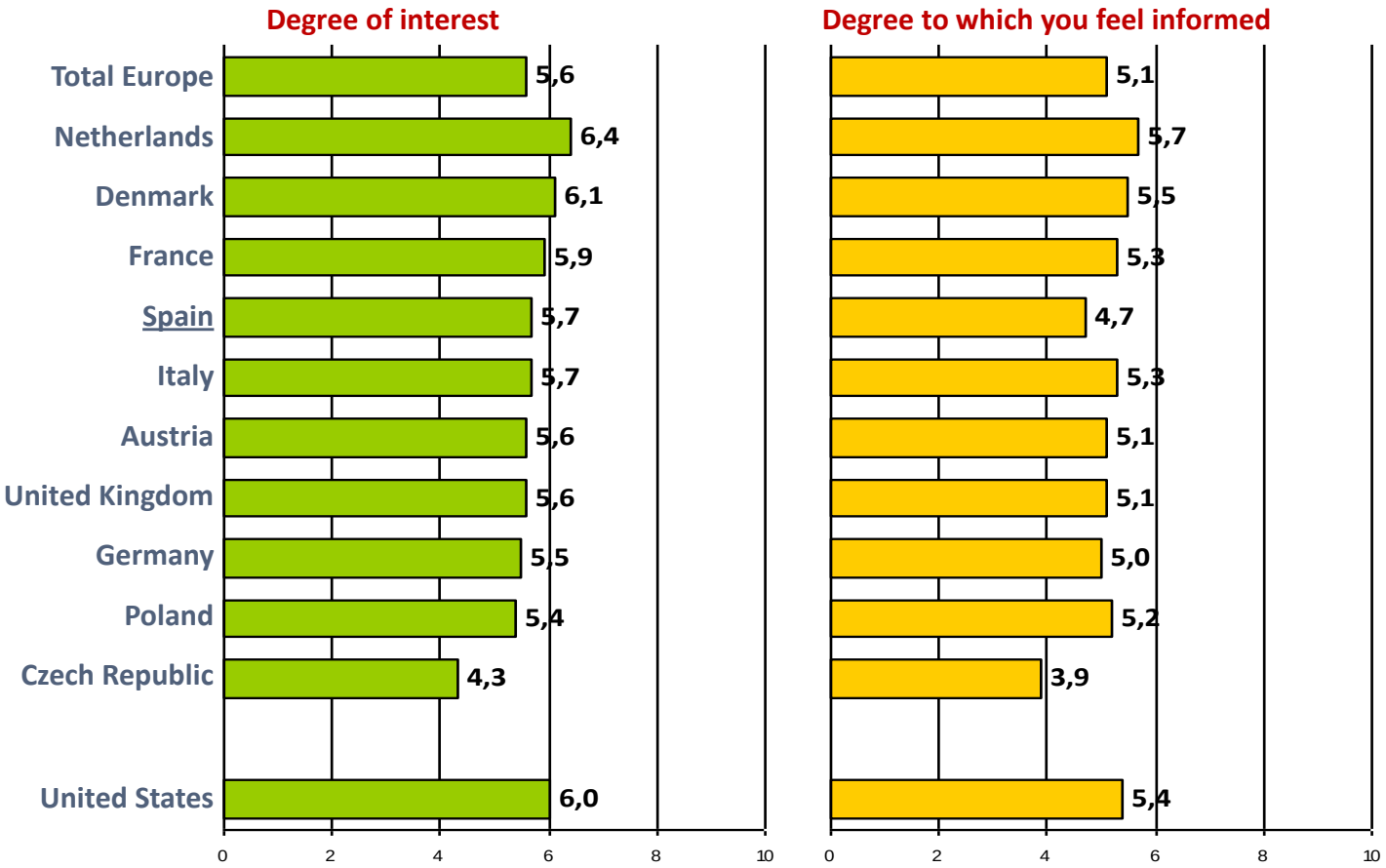
- Stated ‘interest' and ‘information’ about scientific issues
- Channels used to follow scientific information
- Other connections with science and scientific professionals

INTEREST AND INFORMATION ABOUT SCIENTIFIC ISSUES

- **Respondents express medium-to-high interest in news touching on scientific issues but tend to feel less well informed.**
- **Spain scores close to the European average by level of interest and lower by level of information.**

Stated 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

INTEREST AND INFORMATION ABOUT SCIENTIFIC ISSUES

Stated level of interest

Respondents feel more interested than informed about scientific issues

Stated level of information

Spain is the country with the widest gap between interest and information

Spaniards stand close to the European average by level of interest but lower by level of information

Map of countries

(+) Netherlands, Denmark , France and United States

Italy, Spain, Austria, United Kingdom, Germany, Poland

(-) Czech Republic

Map of countries

(+) Netherlands, Denmark and United States

France, Italy, Poland, Austria, United Kingdom, Germany

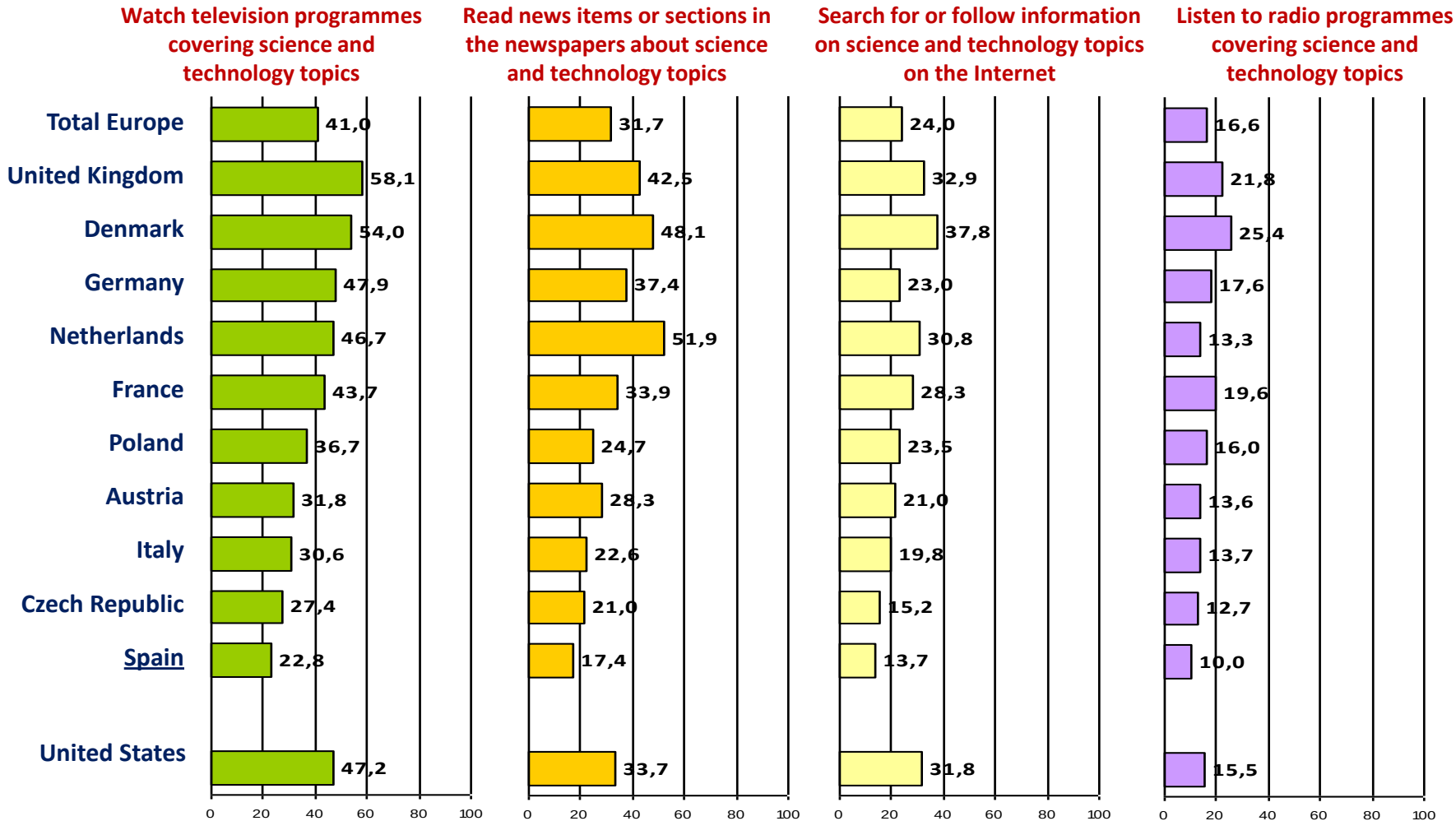
(-) Spain
Czech Republic

ATTENTIVENESS TO SCIENCE NEWS

- **TV is the most popular channel for following science and technology topics.**
- **Citizens in the United States are likelier to follow science and technology issues than their European peers. Within Europe, Denmark, the United Kingdom and the Netherlands are where citizens most closely follow science, with Spain, the Czech Republic and Italy, occupying the lowest positions by this measure.**

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

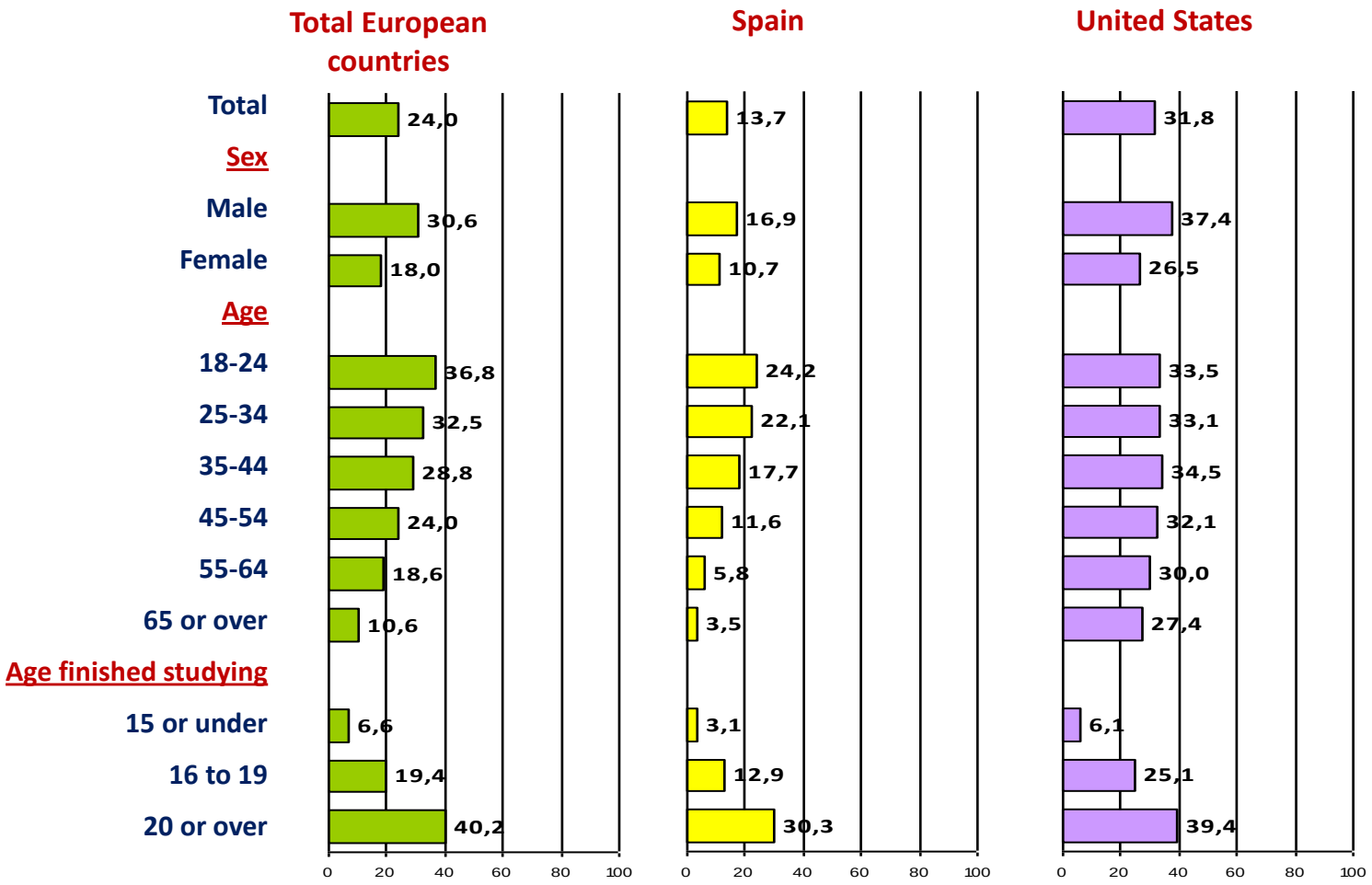
Base: all cases



ATTENTIVENESS TO SCIENCE NEWS

- **Sex, age (especially in Europe and Spain) and, most notably, educational level are all determinants of Internet use to search for information on science and technology topics, which is higher among men, young adults and the segment with most years of education.**

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

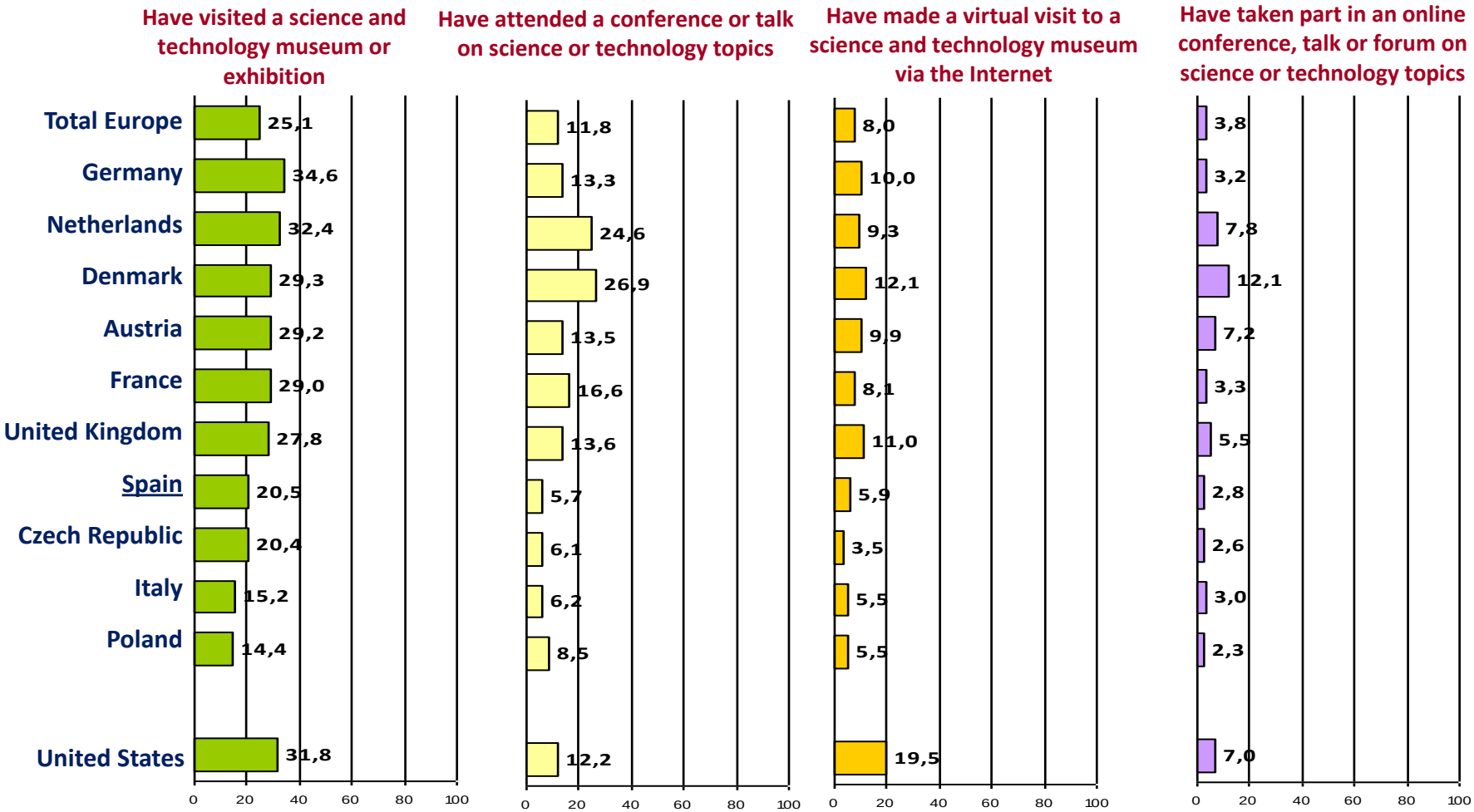


"EXPLORING SCIENCE" ACTIVITIES

- **Involvement in "exploring science" activities is very limited. A higher percentage have visited a science and technology museum than have attended a science conference. Involvement on the online version of these activities is lower still.**
- **The Danish, Dutch, Germans and Americans occupy the top places by this measure.**

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

"Percentage answering yes" Base: all cases

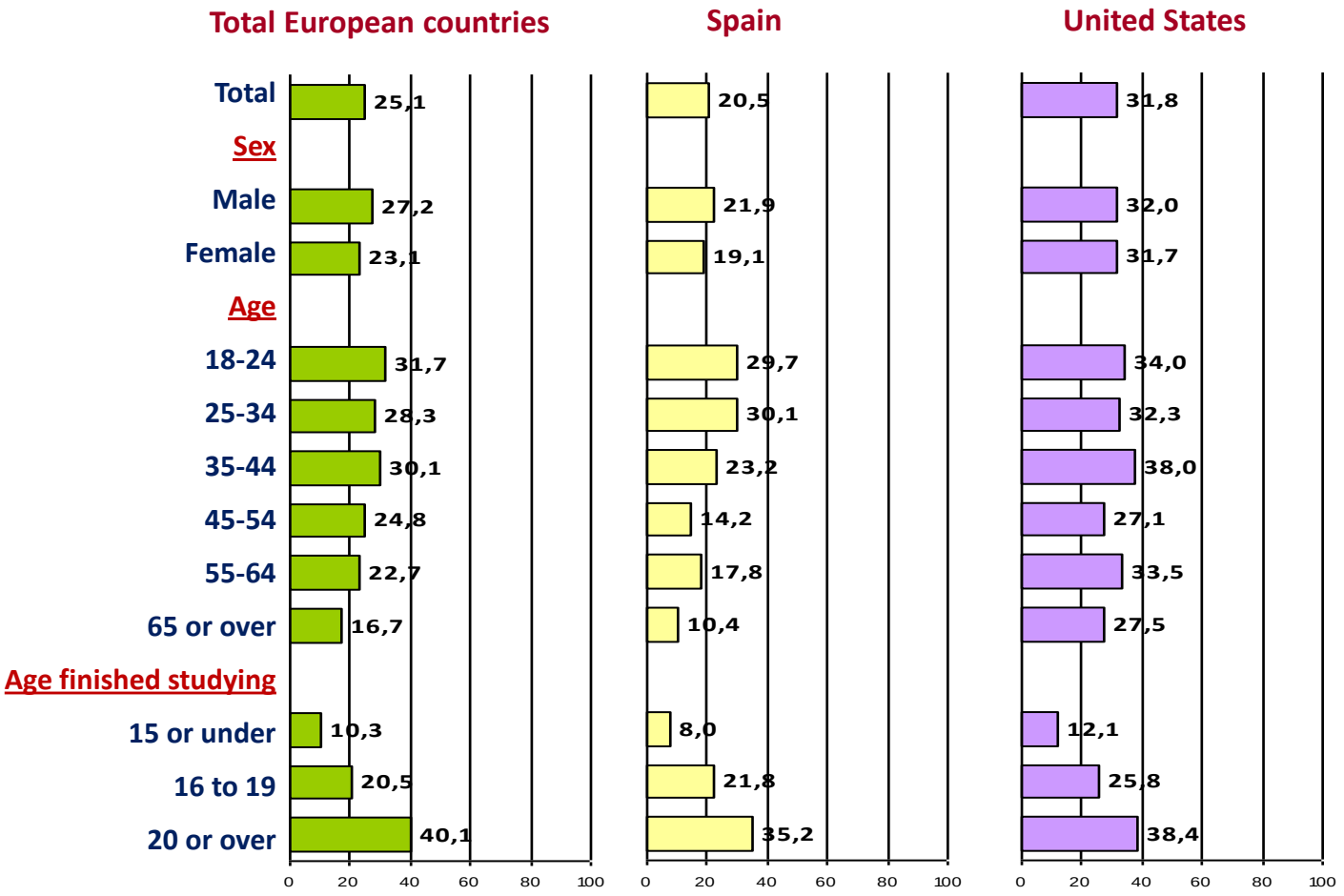


INVOLVEMENT IN SCIENCE-RELATED ACTIVITIES

- **Differences in museum visits by segment:**
  - **Considerably more frequent among those of a higher educational level.**
  - **More frequent among young people, with the gap wider in Europe and Spain than the United States.**

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

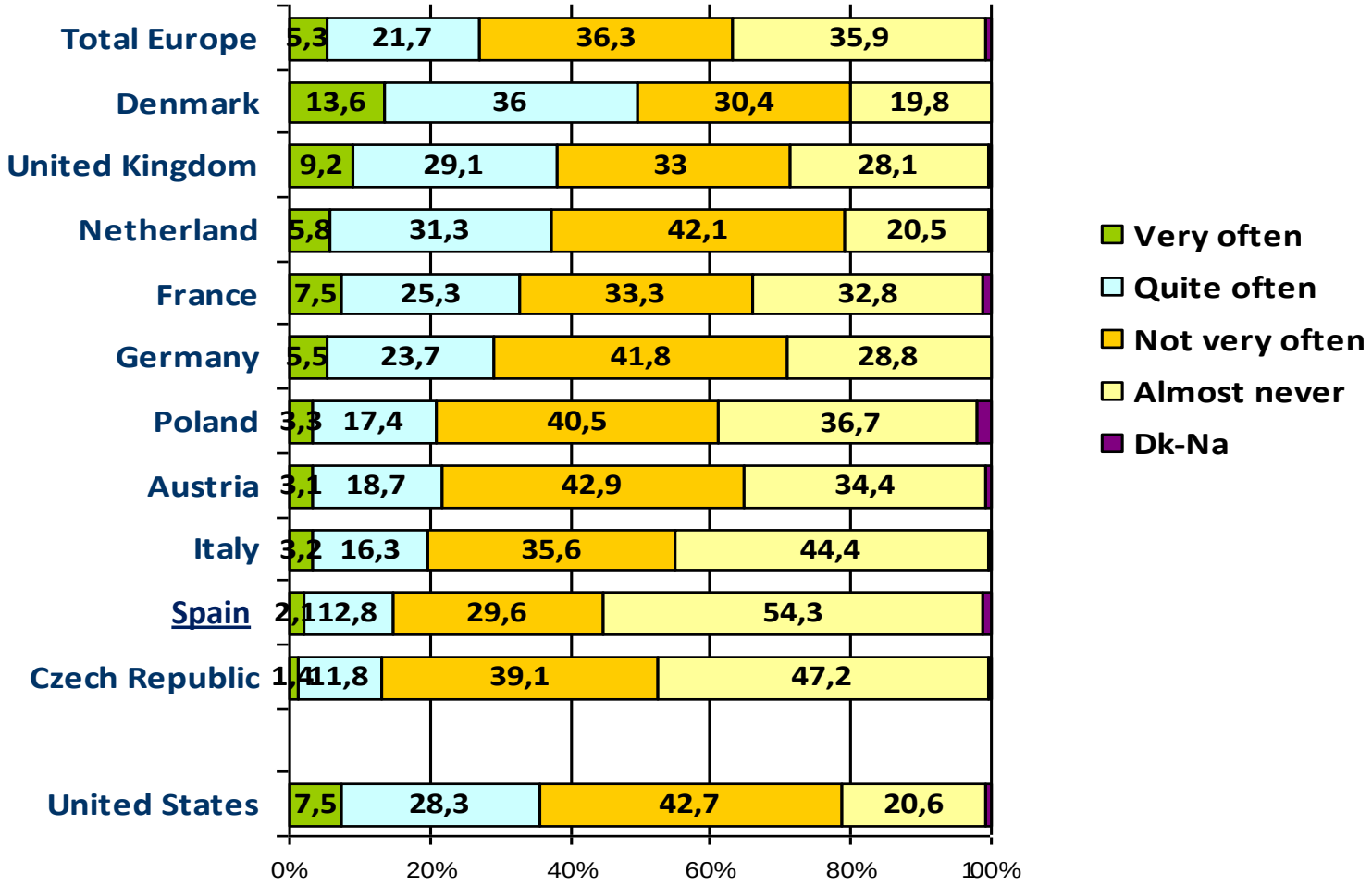
"Percentage answering yes". Base: all cases



SCIENCE TOPICS IN EVERYDAY CONVERSATION

- **Science topics receive scant attention in citizens' day-to-day contacts: a majority in all countries converse with friends and relatives about scientific topics "not very often" or "almost never".**
- **The frequency is highest among the Danes followed by the British, Dutch and Americans. Spaniards stand at the lower end of the scale.**

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

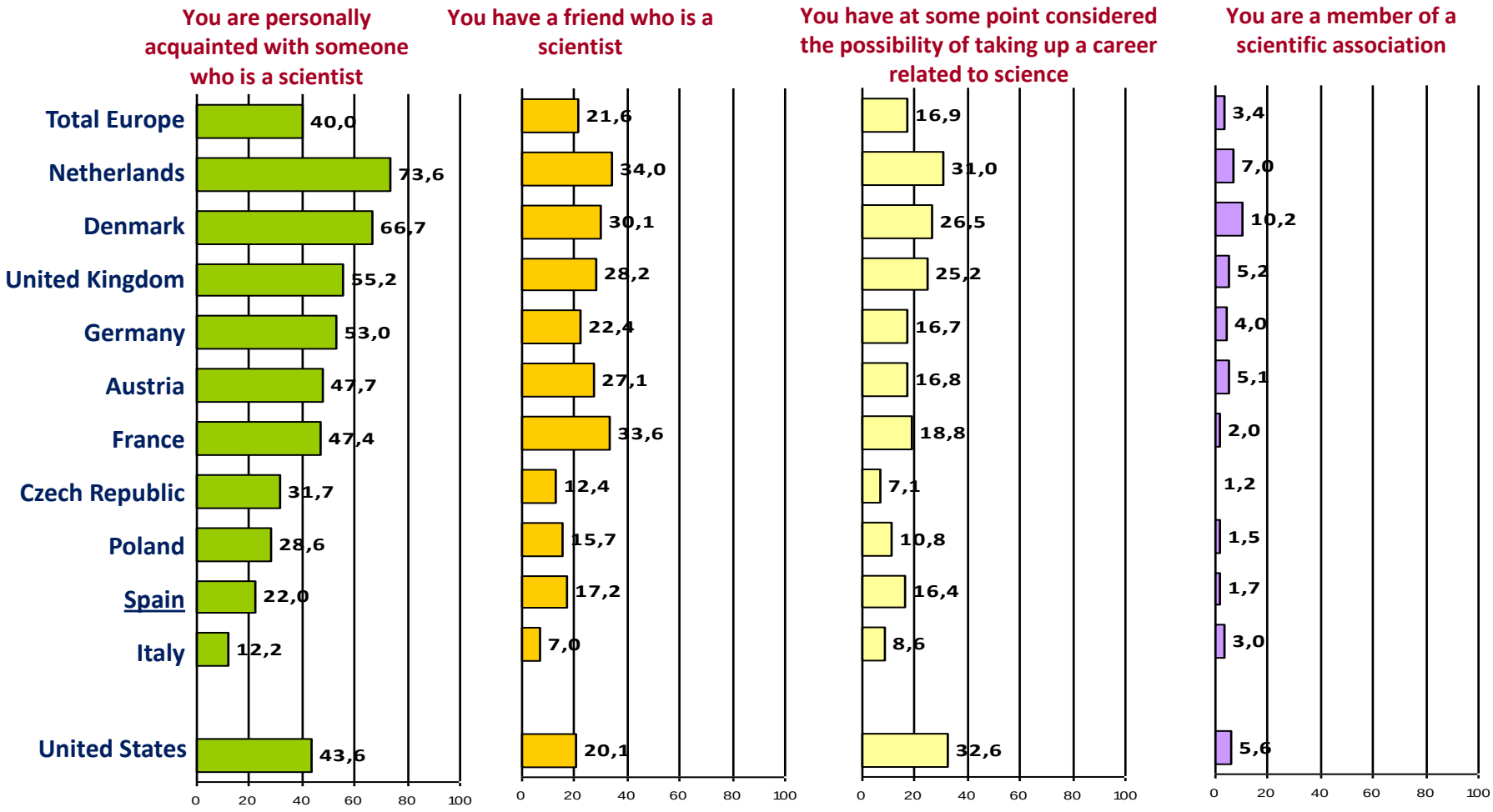


CONNECTION WITH THE SCIENTIFIC CAREER

- Scant connection with the "scientific career" through direct personal experience or that of friends or acquaintances working in science.
- The closest connection is among the Danish and the Dutch.

Could you tell me which of the following situations apply to your personal situation? "Percentage answering yes"

Base: all cases



INVOLVEMENT IN SCIENCE-RELATED ACTIVITIES AND CONNECTION WITH THE SCIENTIFIC CAREER

Scant involvement in science-related activities

- (-) Poland, Italy, Czech Republic, Spain
- (+) Denmark, Netherlands, Germany, United States

→ **Slightly higher in the United States than Europe[1]**

Little connection with the "scientific career"

- (-) Italy, followed by Spain, Poland and the Czech Republic
- (+) Denmark and the Netherlands

→ **Similar in the United States and Europe**

Compared to the rest of Europe, Spaniards figure among those least involved in science-related activities and those evidencing least connection with the scientific career.

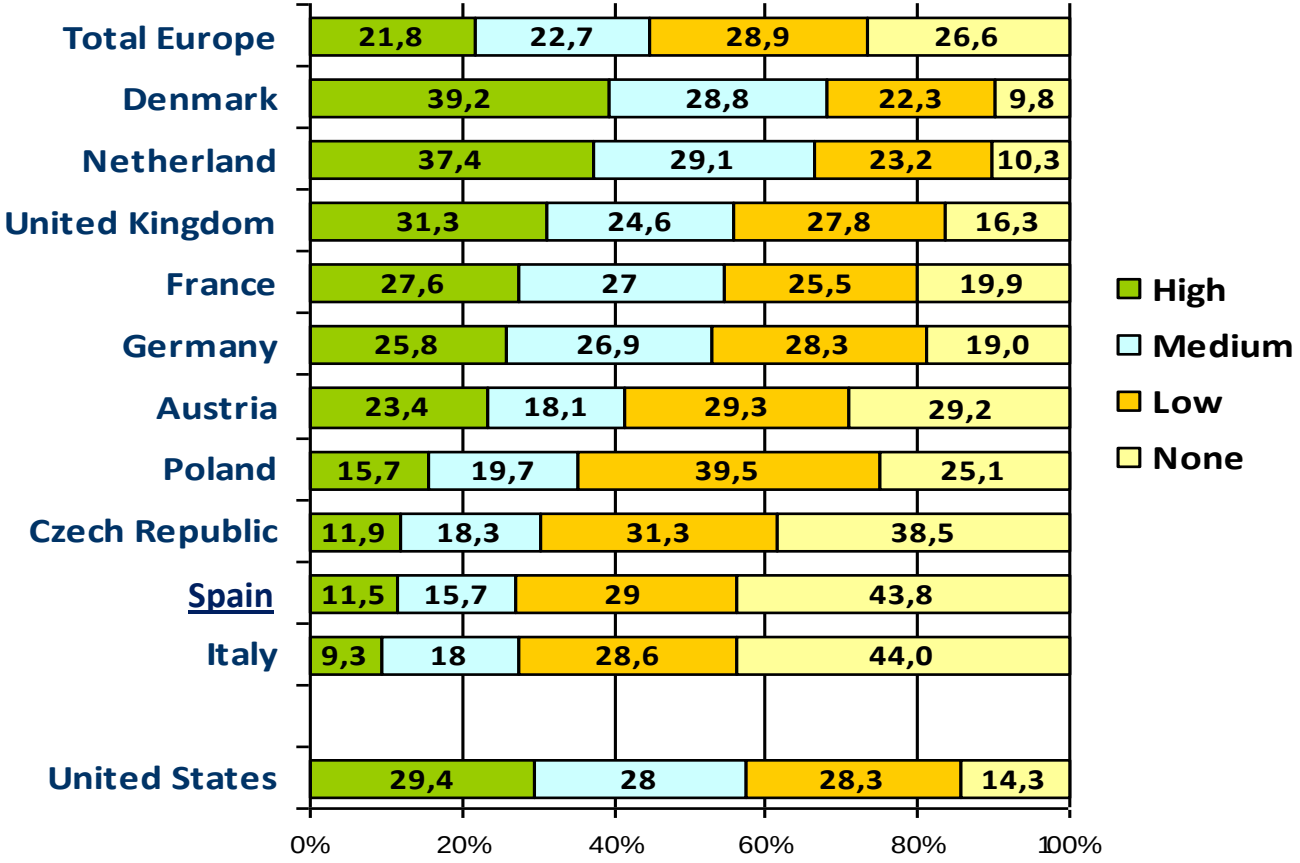
However younger Spaniards are catching up significantly with their age group elsewhere in Europe.

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

A GENERAL MEASURE OF CLOSENESS TO SCIENCE

- In order to obtain a single measure of closeness and connection to science, we constructed an aggregate indicator spanning 1) attentiveness to scientific information, 2) involvement in other "exploring science" activities and 3) connection with the "scientific career". This indicator comprises 20 separate measures (range 0 to 20) divided into four closeness brackets: 'none', 'low', 'medium' and 'high'.
- Level of closeness to science is low and also varies between countries. The segment with a high level of closeness is largest in Denmark and Netherlands and smallest in Italy, Spain and the Czech Republic. In these three countries, around 4 out of every 10 citizens evidences no connection with science.

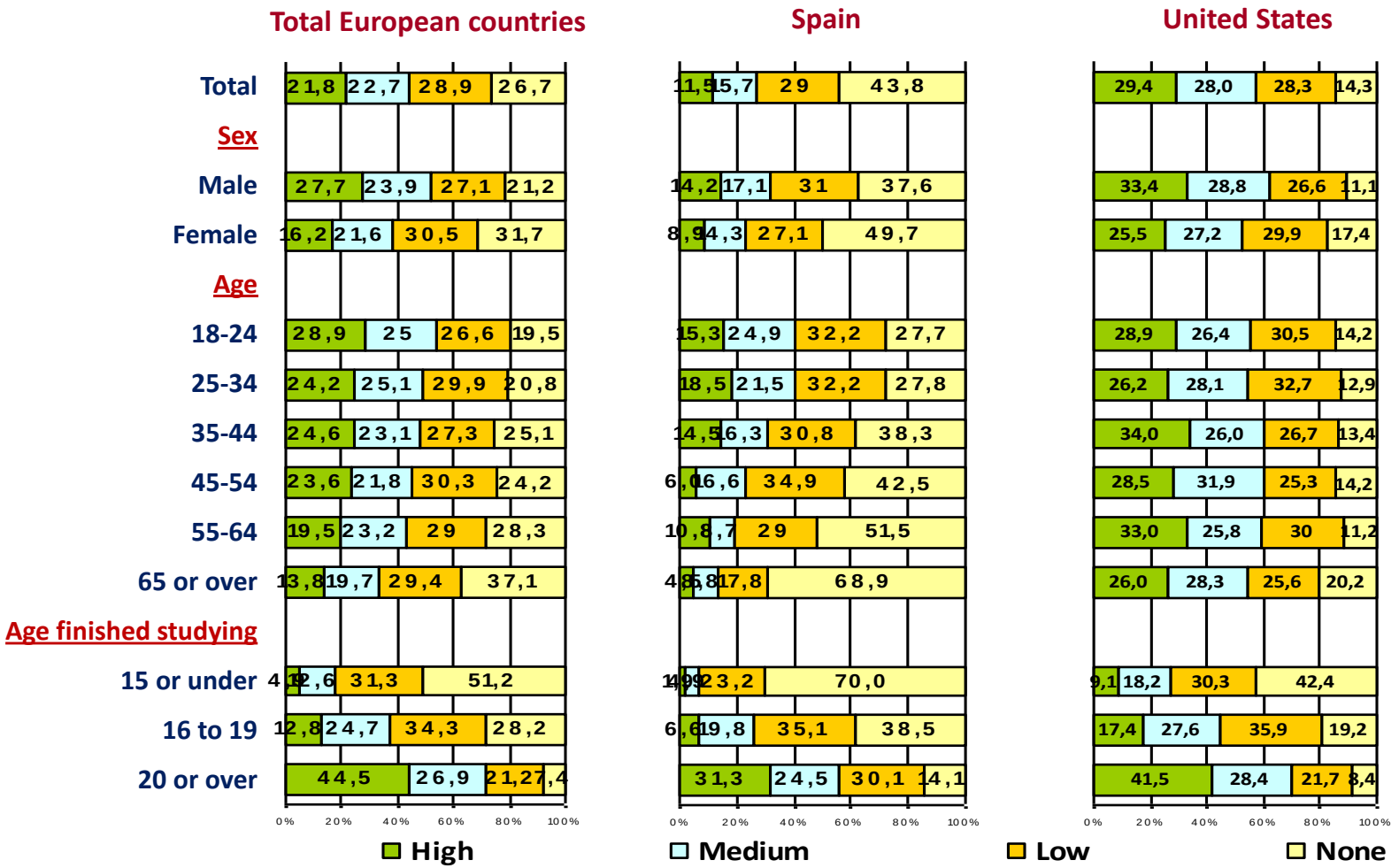
Distribution of level of closeness to science (0-20). Base: all cases



A GENERAL MEASURE OF CLOSENESS TO SCIENCE

- **Men, young adults and, most notably, those with a higher educational level evidence the closest connection to science.**
- **Differences in closeness by age are plainer in Europe, and Spain particularly, than in the United States. Educational level also differentiates more strongly for closeness to science in Spain than in Europe or the United States.**

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



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Level of scientific knowledge

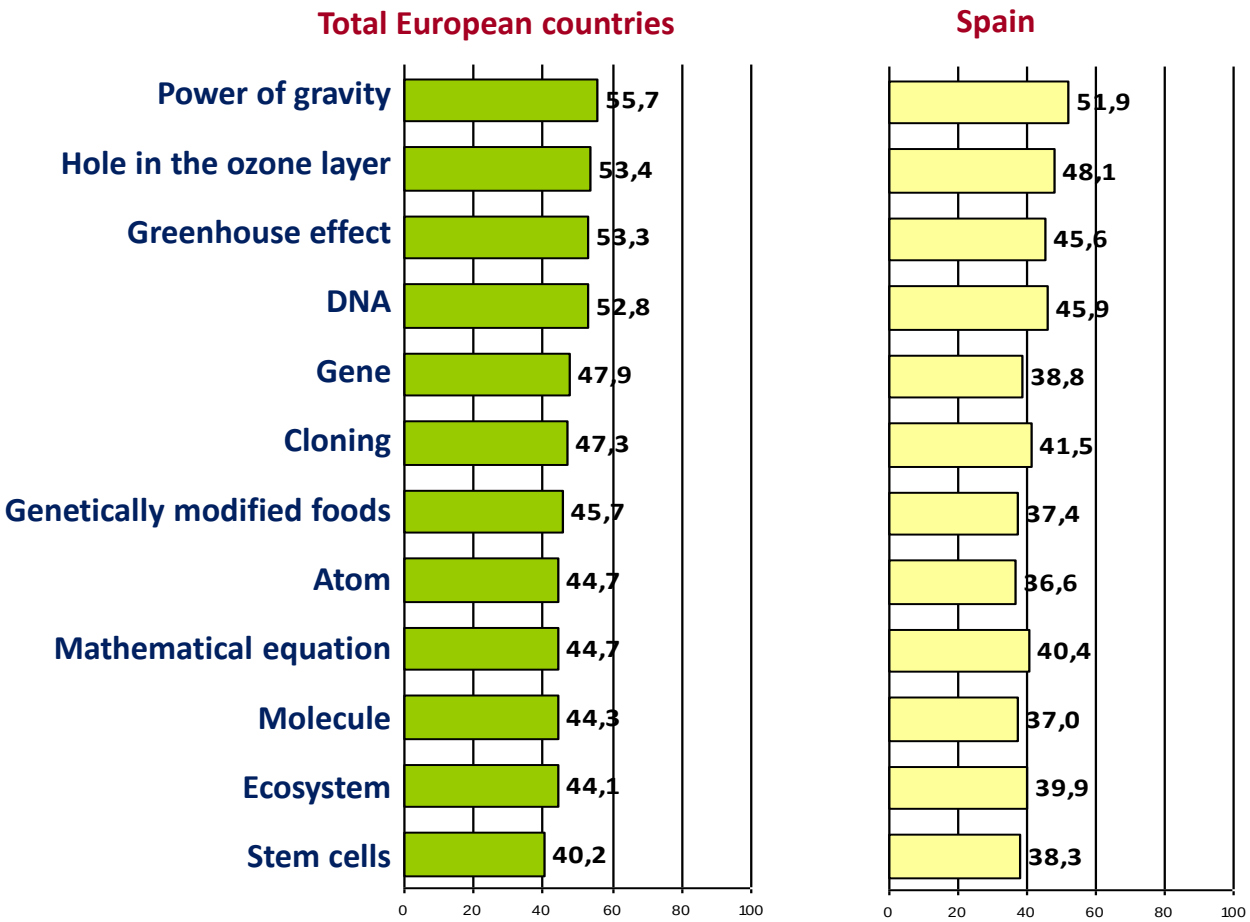
- Subjective (perceived) and objective knowledge of scientific concepts and theories
- How scientific knowledge is generated
- Familiarity with the great scientists of all times and places.

SUBJECTIVE KNOWLEDGE

- **A first measure of people's scientific knowledge is their declared understanding of a sample of key scientific concepts.**
- **Of this sample, those meeting with the highest level of declared understanding are 'the power of gravity', the 'hole in the ozone layer', the 'greenhouse effect' and 'DNA'.**

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.

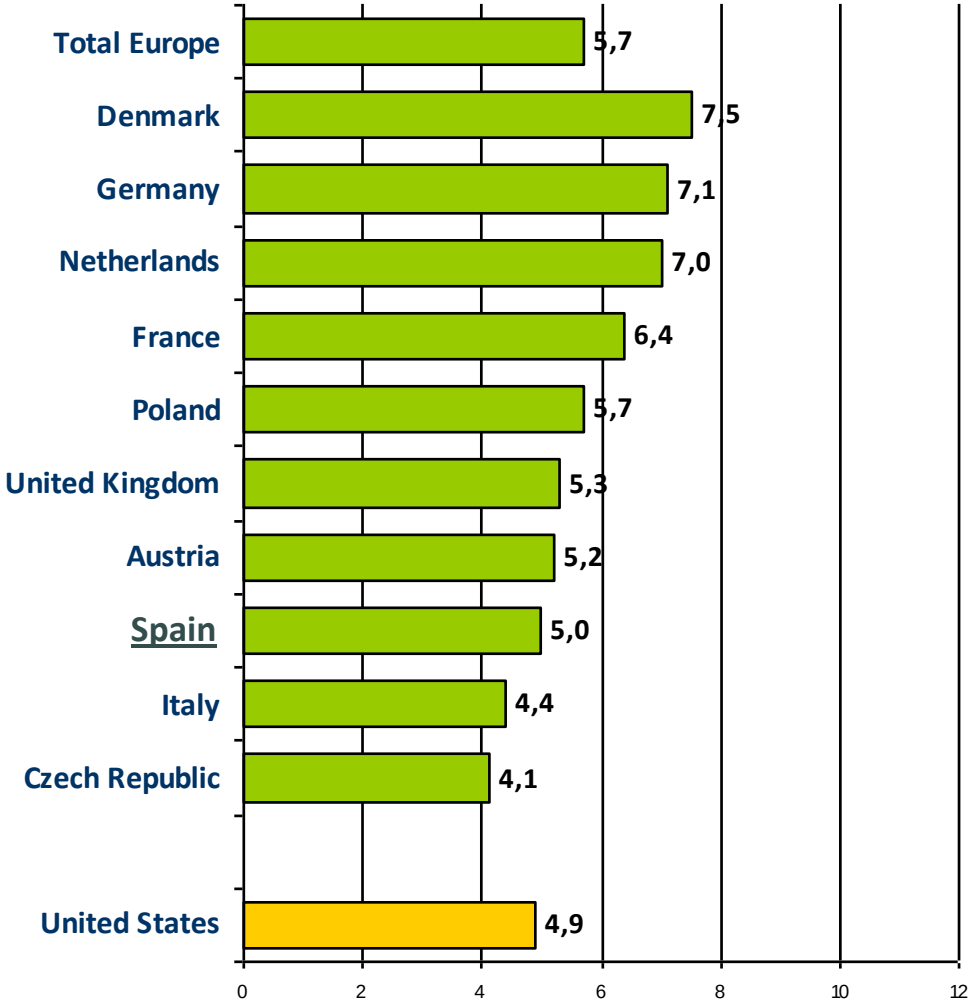
"Percentage saying they understand completely"



PERCEIVED KNOWLEDGE

- **Summing the concepts they claim to understand completely, we find that perceived knowledge stands higher on average among Europeans than in the United States.**
- **Within Europe, Denmark, Germany and the Netherlands are the countries with the highest levels of perceived knowledge, with Spain at the lower end.**

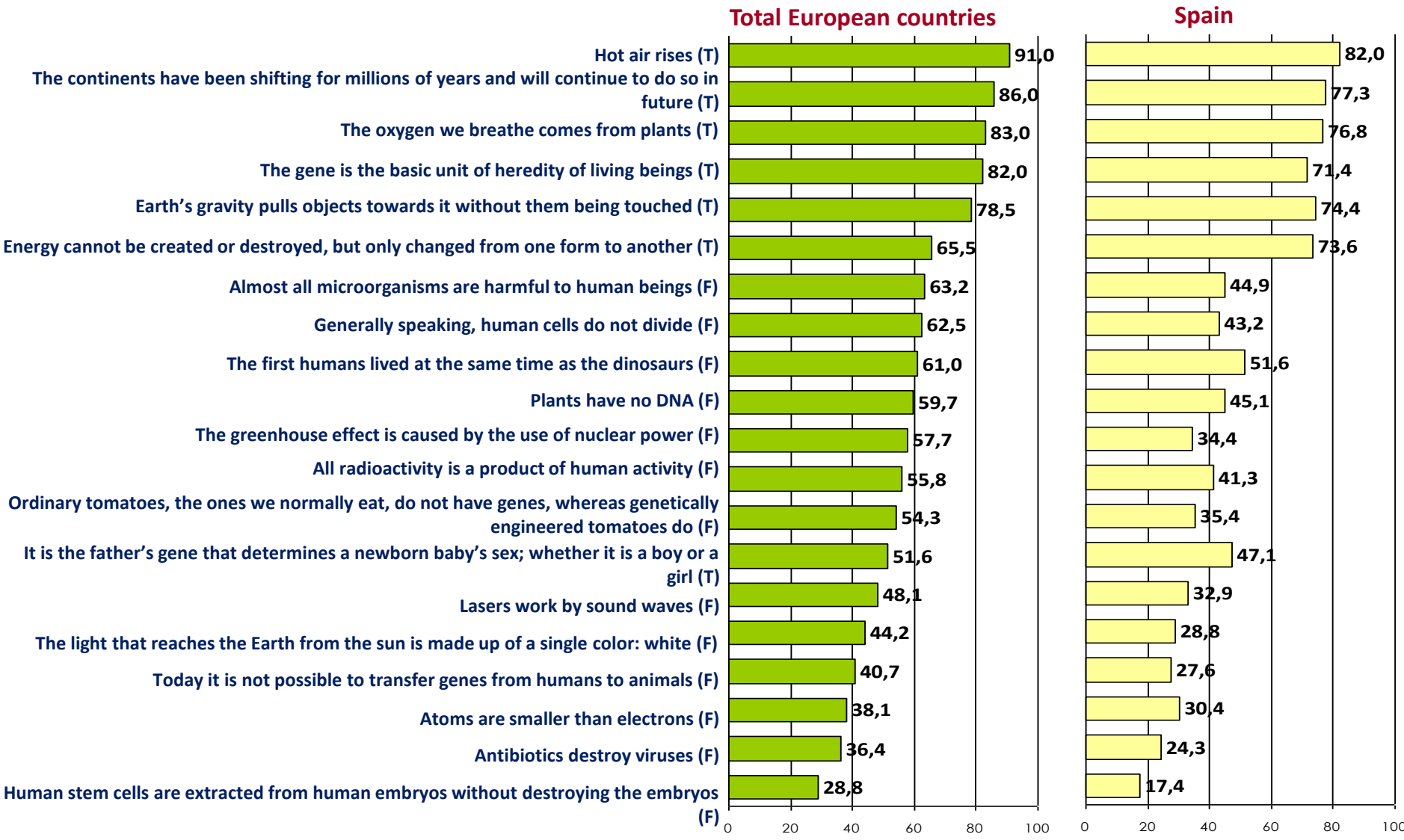
Average of concepts reportedly understood completely (0-12). Base: all cases



OBJECTIVE KNOWLEDGE

- **A second measure of the public's scientific knowledge was obtained through a kind of objective "test" covering a long list of scientific concepts and principles.**

Please tell me, for each of the following sentences, the extent to which you believe they are true or false?
"Percentage answering correctly" (totally true or probably true – totally false or probably false as appropriate). Base: all cases

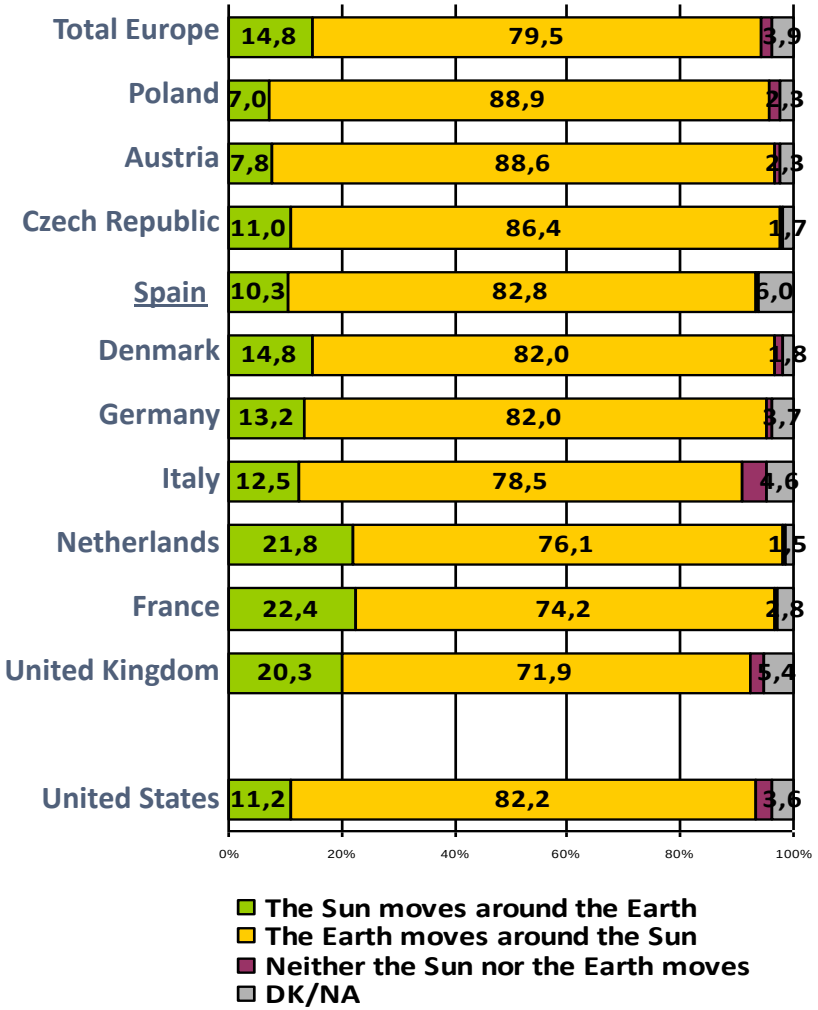


OBJECTIVE KNOWLEDGE

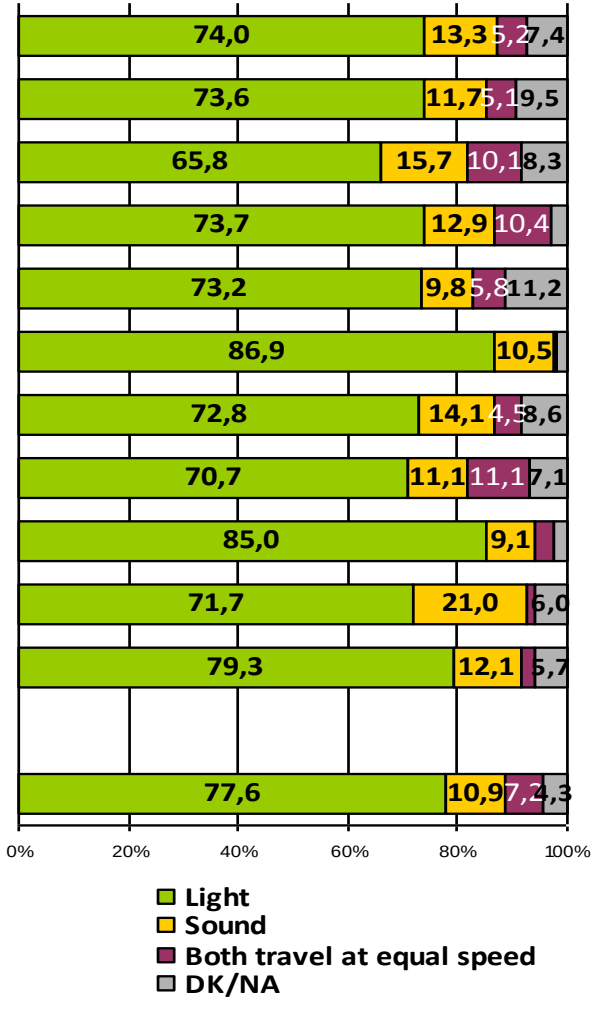
- **A large majority in every country knows that the Earth moves around the Sun, and that light travels faster than sound, though in some the segment answering wrongly exceeded 20%.**

Level of scientific knowledge. Base: all cases

Which of the following statements do you think is true?



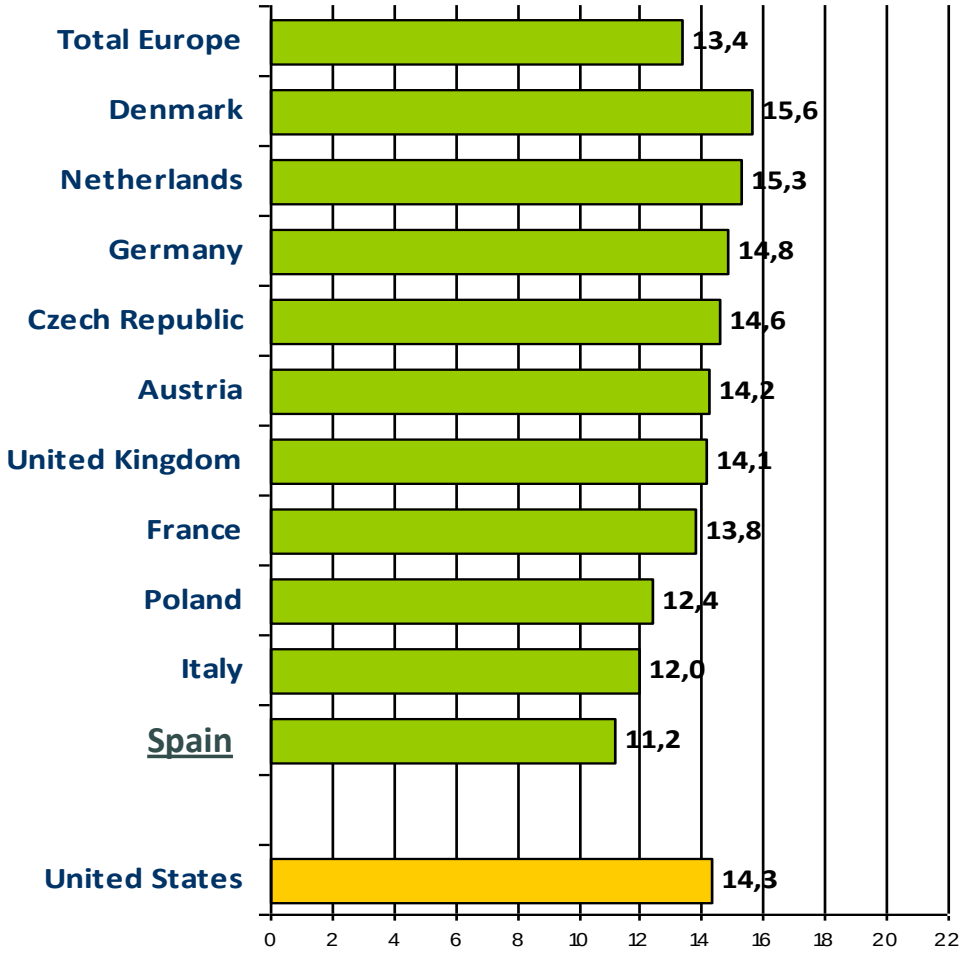
Which travels faster, light or sound?



OBJECTIVE KNOWLEDGE

- According to the aggregate results of the knowledge test (comprising 22 items), the Danish and the Dutch are the most knowledgable citizens ahead of the Germans and the Czechs.
- Spain obtains the worst result, followed by Italy and Poland.

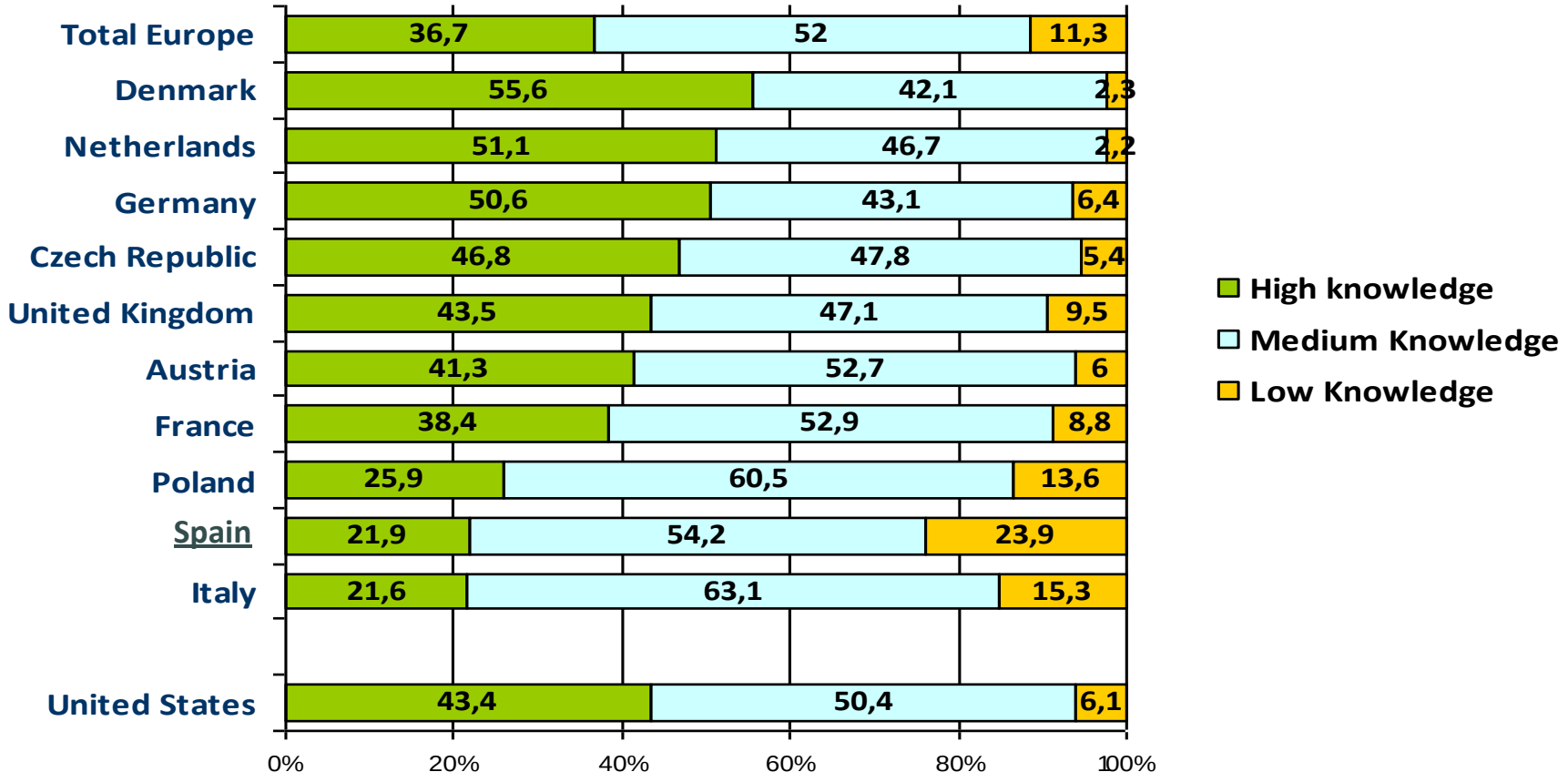
Average objective scientific knowledge (0-22). Base: all cases



OBJECTIVE KNOWLEDGE

- Grouping test answers into three segments (high knowledge: 16 to 22 right answers; medium knowledge: 8 to 15; low knowledge: 0 to 7) throws inter-country differences into greater relief.
- A majority of respondents in all countries fall within the medium knowledge segment. However major differences emerge when we look at the high knowledge segment, which extends to over 50% in Denmark, the Netherlands and Germany, compared to 25% approximately in Poland, Italy and Spain.

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

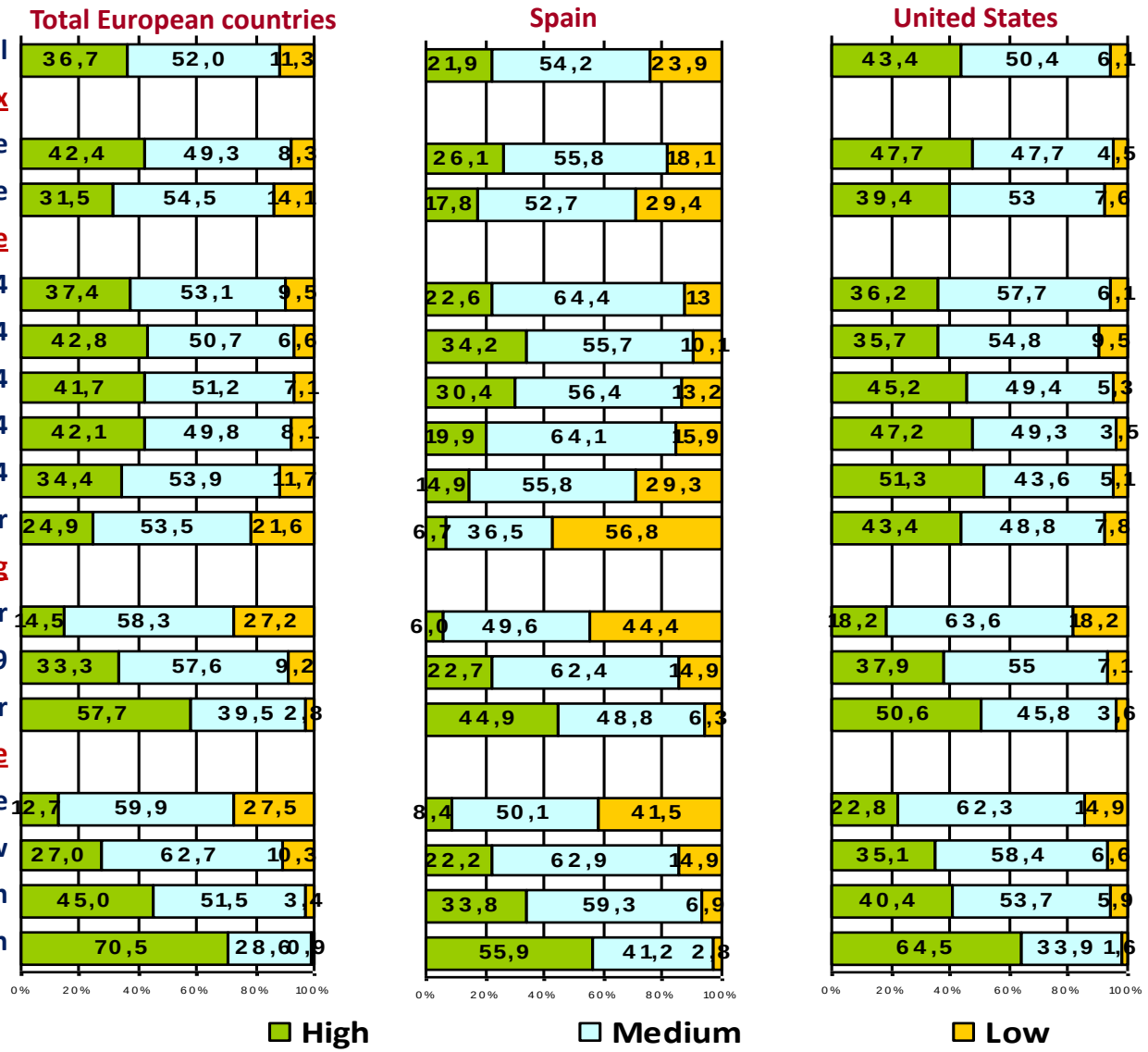


OBJECTIVE KNOWLEDGE

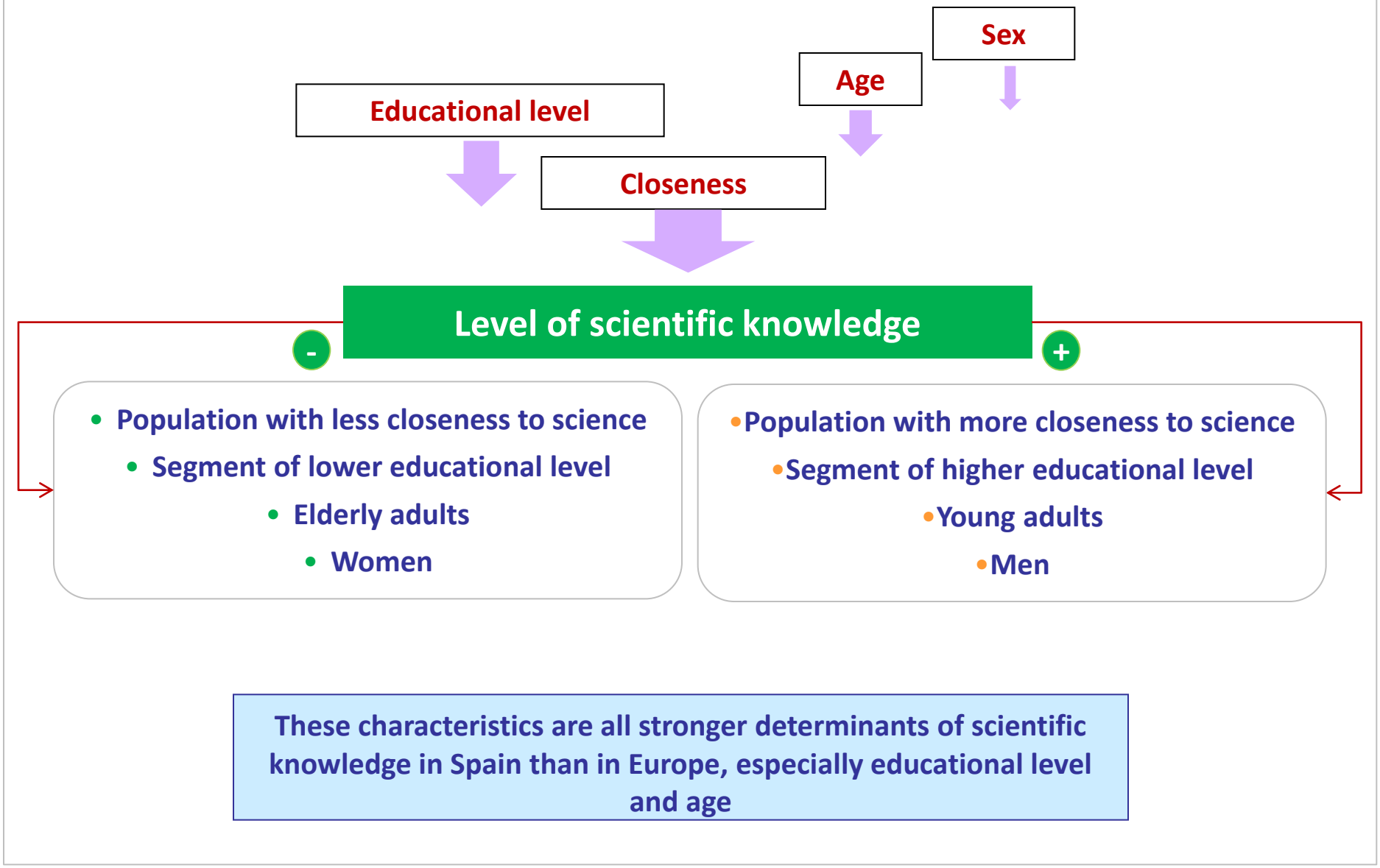
- **Men, young adults and, most notably, citizens with a higher educational level and more connection with science are also those displaying the highest level of scientific knowledge.**
- **The distance between Spaniards' scientific knowledge and the European average is wider among older adults, and tends to shorten (though not disappear) among younger ages and those with more years of education.**

Distribution on the scientific knowledge scale (0-22)

Base: all cases



INFLUENCE OF SOCIODEMOGRAPHIC AND ATTITUDINAL CHARACTERISTICS ON SCIENTIFIC KNOWLEDGE



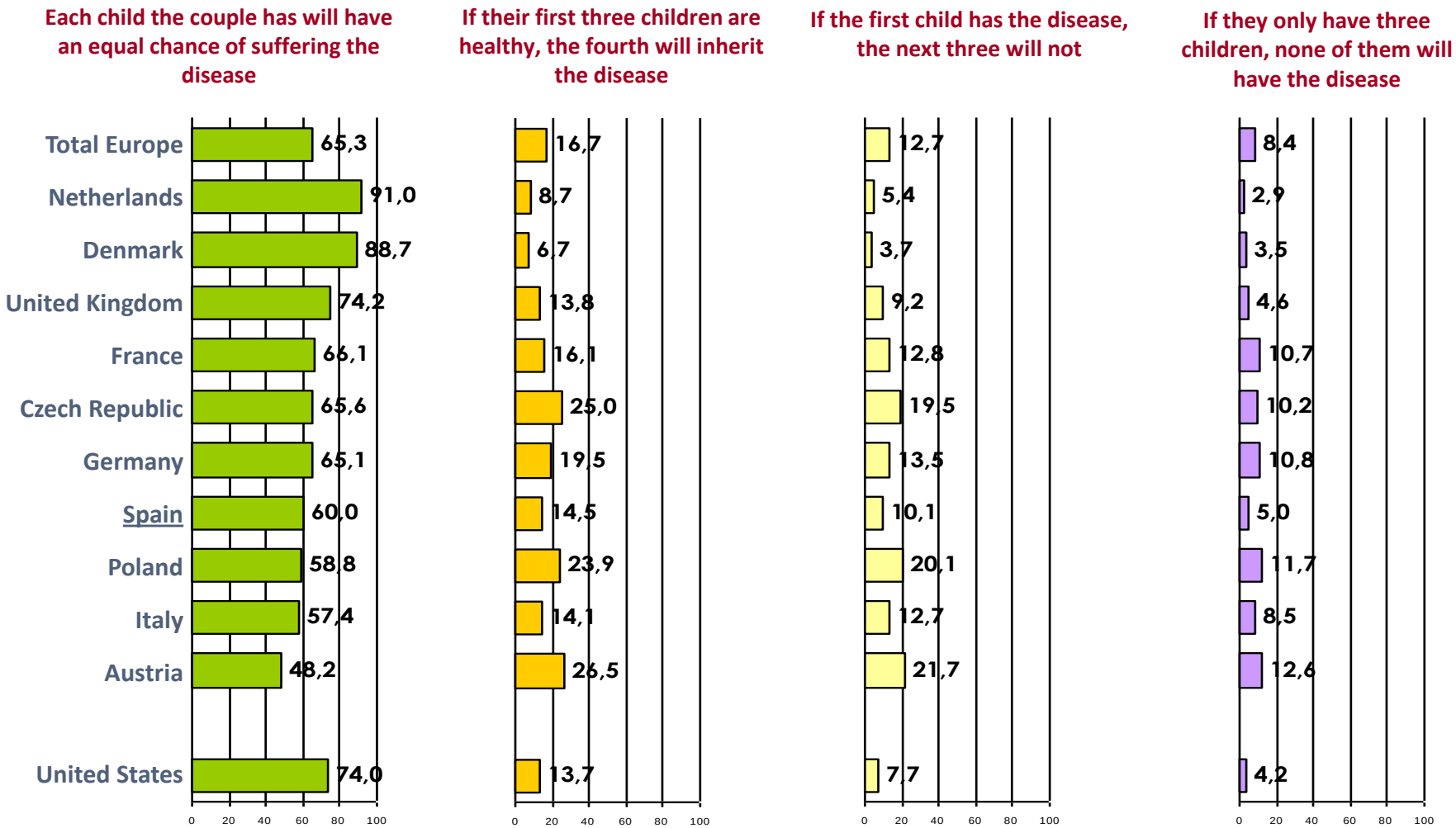
These characteristics are all stronger determinants of scientific knowledge in Spain than in Europe, especially educational level and age

GRASP OF THE CONCEPT OF PROBABILITY

- As well as knowledge of scientific concepts, the study examined respondents' grasp of "probability", a notion that is important for decision-making in a number of domains.
- Their grasp of this notion was assessed by reference to a concrete case.

A doctor tells a couple that according to their genetic tests, they have a one on four chance of having a child with a hereditary disease. Do you think what the doctor means by this is ...?

"Percentage answering yes" Base: all cases

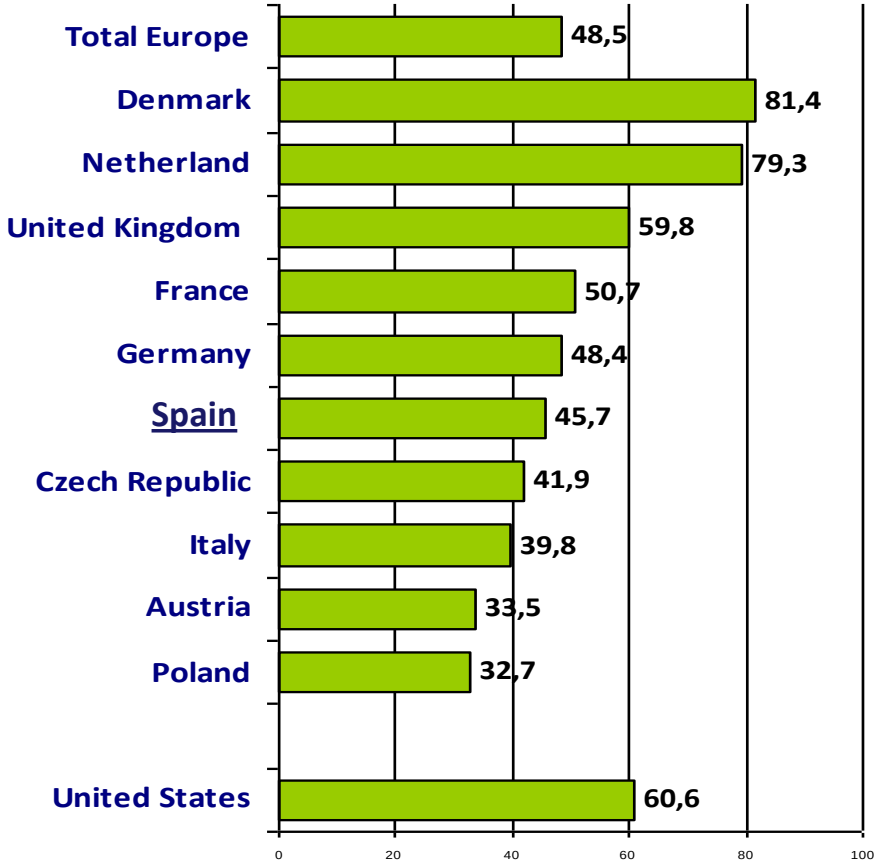


GRASP OF THE CONCEPT OF PROBABILITY

- **The percentage answering correctly, i.e., that understand the notion of probability, differs sharply between countries: high in Denmark and the Netherlands, followed by the United Kingdom and France, and significantly lower in Austria and Poland.**
- **Spaniards occupy an intermediate position (close to the European average) in their intuitive grasp of the concept of probability.**

A doctor tells a couple that according to their genetic tests, they have a one on four chance of having a child with a hereditary disease. Do you think what the doctor means by this is ...?

Percentage answering correctly Base: all cases



Percentage answering correctly:

Answering true that the doctor meant:

- **"each child the couple has will have an equal chance of suffering the disease"**

and answering false that the doctor meant:

- **"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"**
- **"if they only have three children, none of them will have the disease"**

VALIDATION OF SCIENTIFIC KNOWLEDGE

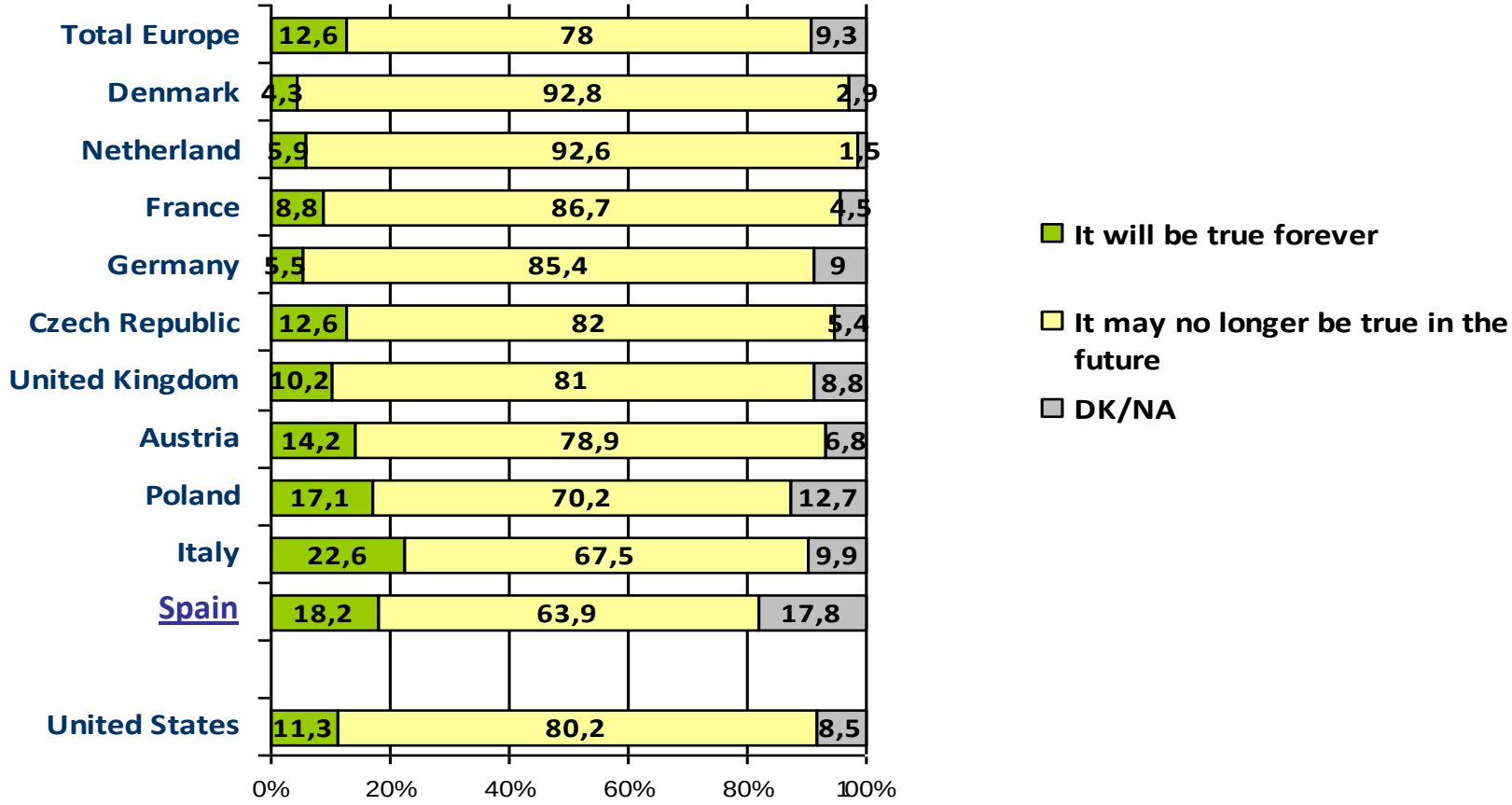
- **Besides understanding scientific concepts, the other essential dimension of scientific culture is understanding how knowledge is obtained and validated. Here a majority affirm that it is very important that the results are tested, by both the researcher and other scientists.**

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

VALIDATION OF SCIENTIFIC KNOWLEDGE

- **Questioned about the validity of scientific theories, a large majority regard it as relative, i.e., they believe that a theory now considered true will not necessarily be considered true in future.**
- **Although this view also predominates in Spain, a higher percentage believe it will be true forever, or feel unable to state an opinion.**

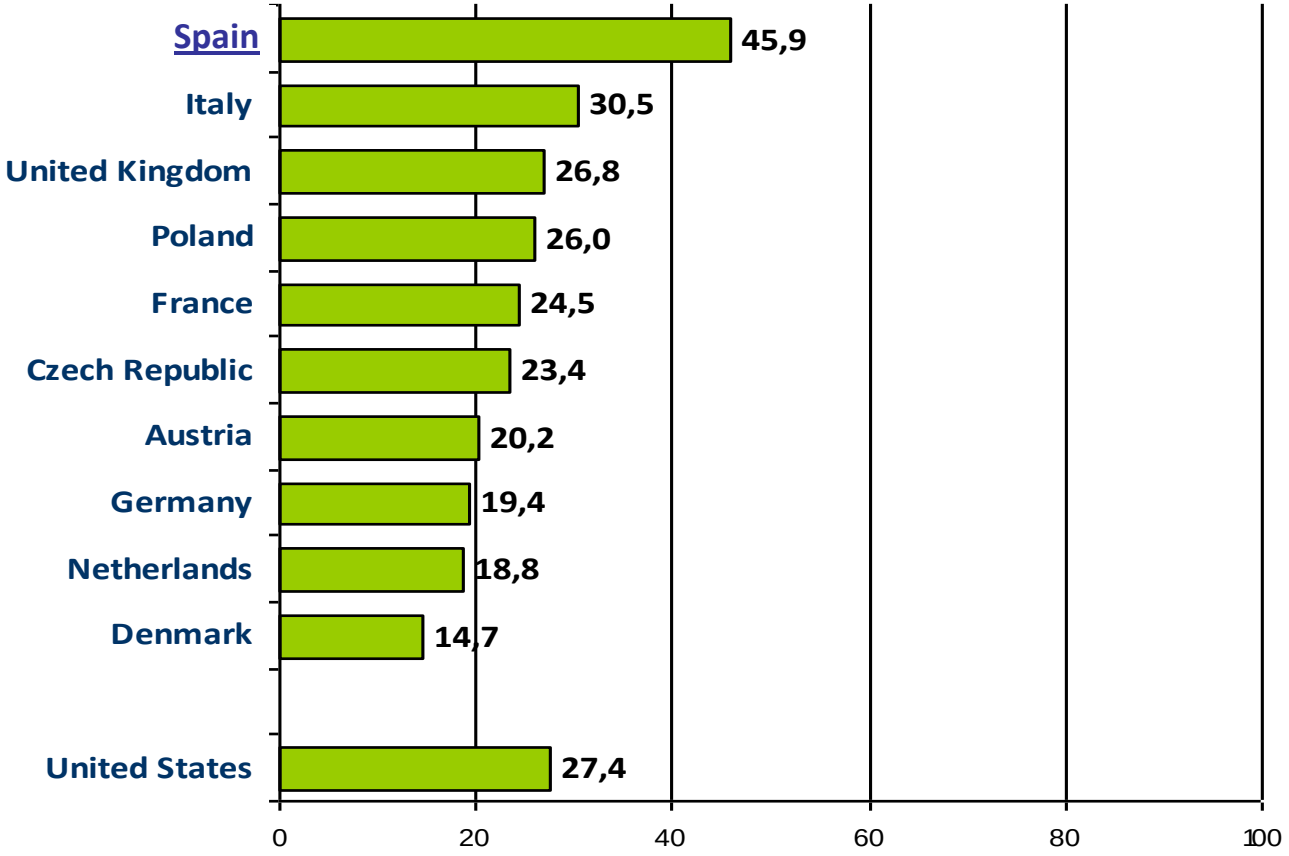
If a scientific theory is now considered true, does that mean it will be true forever or do you think it may no longer be true in the future? Base: all cases



CITIZENS' FAMILIARITY WITH GREAT SCIENTISTS

- **Finally, the study measured citizens' familiarity with the names of some of the great scientists of every age and country.**
- **The percentage unable to give the name of even one scientist varied between countries. Its high level in Spain may be indicative of a weak scientific culture.**

Could you give me the names of the 3 scientists who you think have been the most important in all of history? Percentage that cannot or prefer not to mention the name of any scientist. Base: all cases



CITIZENS' FAMILIARITY WITH GREAT SCIENTISTS

Spontaneous mention of scientists important in history

- *Scientists known as physicists attract a relatively high number of mentions, while those whose names are associated with recent discoveries tend to represent a smaller percentage*
- *National scientists feature prominently in a majority of countries*
- *Spaniards, however, accord little recognition to great national scientists, who are mentioned far less often than those of other countries.*

Santiago Ramón y Cajal is mentioned by almost 5% of Spaniards and Severo Ochoa by 2.5%.

1st Albert Einstein (42% average in Europe)

The next mentioned, at a distance, in almost all countries are names like:

Isaac Newton

Marie Curie

Louis Pasteur

Galileo Galilei

In Spain	
Albert Einstein	31.6
Isaac Newton	15.2
Alexander Fleming	6.4
Thomas Alva Edison	5.8
Santiago Ramón y Cajal	4.8
Marie Curie	4.6
Steven Hawkins	4.4
Galileo Galilei	4.0
Louis Pasteur	4.0
Charles Darwin	3.9
Severo Ochoa	2.5

CITIZENS' FAMILIARITY WITH GREAT SCIENTISTS

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
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

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	10
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	11
Thomas Alva Edison	5.3
Galileo Galilei	4

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
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 Alva 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

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Conclusions

SYNTHESIS

Low level of closeness to science in a majority of countries

- *Low attentiveness to scientific information*
- *Scant involvement in science-related activities*
- *Weak connection with the "scientific career"*

Levels of closeness and knowledge are positively correlated

Medium level of understanding of science

- *Split response on perceived knowledge of key scientific concepts*
- *Objective knowledge of scientific concepts in the medium range*
- *Understanding that science is experimentally tested and published knowledge subject to change*

(+)

- **Higher level of closeness and scientific knowledge: Denmark and the Netherlands**
- **Medium level of closeness and scientific knowledge: Germany, United States, Austria, France and United Kingdom**
- **Low closeness combined with medium knowledge: Czech Republic**
- **Lower level of closeness and scientific knowledge: Poland, Italy, Spain**

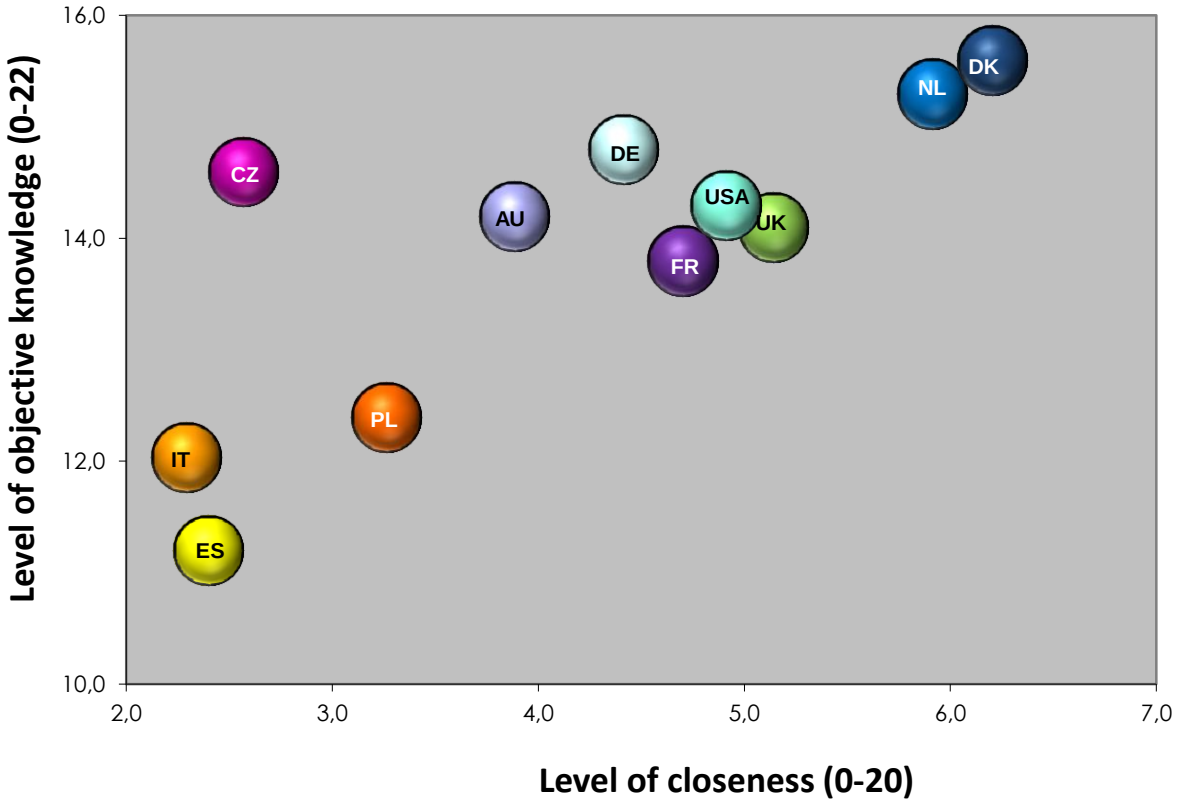
(-)

In each country, men, young adults and, particularly, the more educated public have a higher level of both closeness to science and scientific knowledge

MAP OF COUNTRIES BY LEVEL OF CLOSENESS TO SCIENCE AND OBJECTIVE SCIENTIFIC KNOWLEDGE

- High level of closeness and scientific knowledge: Denmark and the Netherlands.
- Medium level of closeness and scientific knowledge: Germany, United States, Austria, France and United Kingdom.
- Low level of closeness and scientific knowledge: Poland, Italy, Spain.
- An atypical case: low level of closeness and medium level of knowledge: Czech Republic.

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



Spaniards vs. Europe

- Spaniards stand close to the European average by declared level of interest in scientific issues, but feel informed to a lesser extent.
- They are the least likely to all to follow science news and information through either print or audiovidual media.
- A very small percentage of Spaniards have personal acquaintance with a scientist. Likewise, only a very small percentage have thought at some point of pursuing a scientific career.
- Using an aggregate indicator, we find that Spaniards are the European citizens evidencing least closeness to science, along with the Italians and the Czechs.
- Spaniards score lowest on average in the objective knowledge test of scientific concepts and theories out of the 11 nationalities in the survey.
- In Spain, age and educational level are strong determinants of scientific knowledge and connection with science, with young adults and the more educated public scoring far hgiher on both these counts than older adults and those with fewer years of studies.
- Younger age groups are catching up with their peers elsewhere in Europe, and the survey shows a process of convergence in scientific knowledge and interest in science. Conversely, older Spaniards stand at a considerable distance from the European average by the measures of connection to science and scientific knowledge.

TECHNICAL NOTES

Geographical scope of the study: 10 European Union countries (Germany, Austria, Denmark, Spain, France, Italy, Netherlands, Poland, United Kingdom and Czech Republic) and the United States

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.