IN SUPPORT OF THE PRIMACY OF SCIENCE

WHITE PAPER / FALL 2020

PHILIP MORRIS INTERNATIONAL

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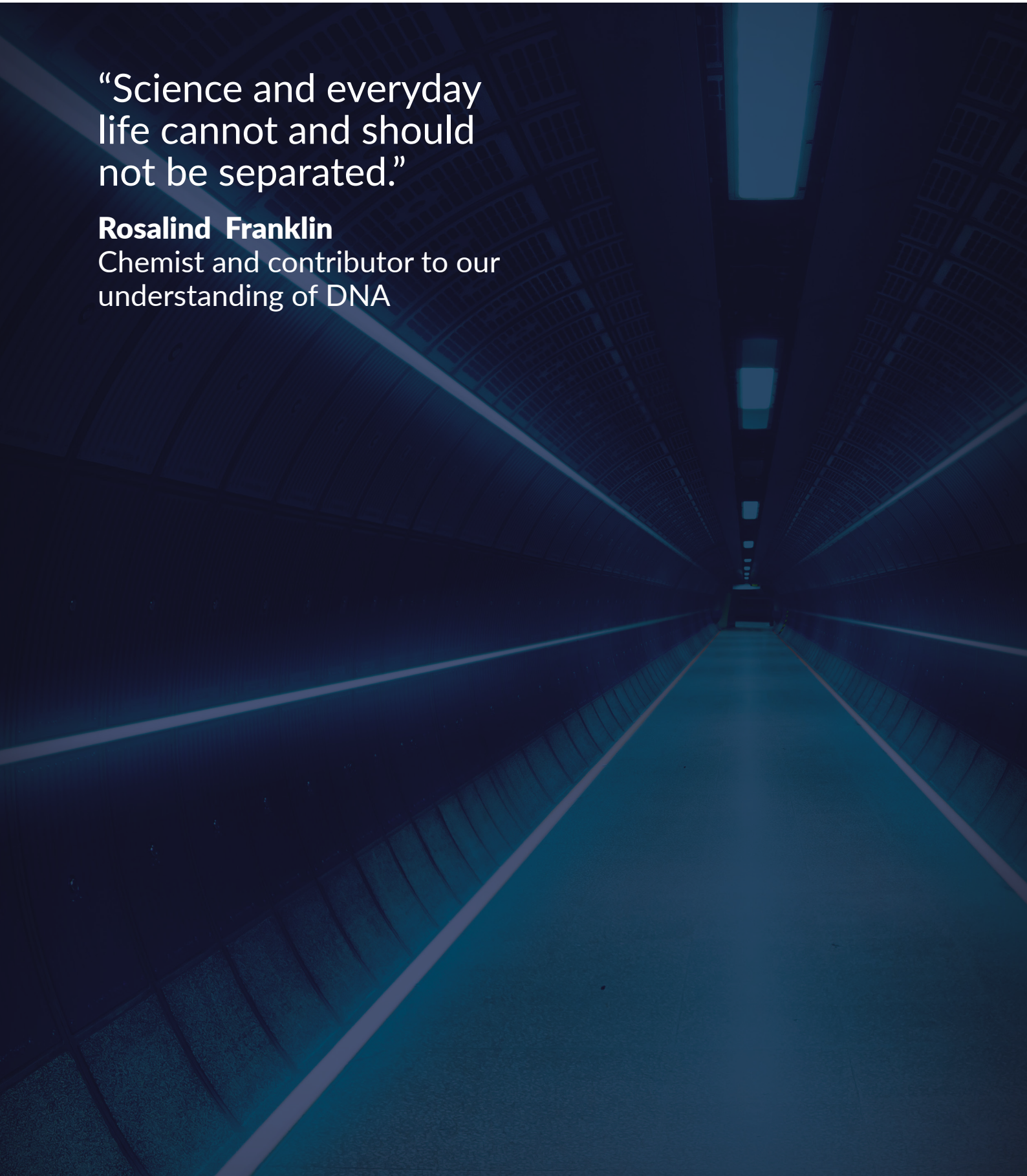

“Science and everyday life cannot and should not be separated.”

Rosalind Franklin
Chemist and contributor to our understanding of DNA

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WHITE PAPER

#01 INTRODUCTION

The modern world is underpinned—and made possible—by science. Science sits at the center of our technologies and gadgets, it fuels our power supplies, it makes the food we eat safe for consumption, and it treats and even cures a myriad of ailments and diseases that once were deadly. Virtually every modern amenity and convenience—from clean water and refrigeration to content streaming and GPS—is rooted in science.

And yet, how often do nonscientists think about science? How closely do we follow scientific news? And when we do hear about a breakthrough or discovery, how well do we understand it—and to what extent do we believe it?

Another question to ponder: Does the public's grasp of and respect for science matter? Philip Morris International (PMI) believes it does. In the United States, the National Science Education Standards established by the National Academies of Sciences, Engineering, and Medicine define science literacy as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity." In a television interview, astrophysicist Neil deGrasse Tyson, director of New York City's Hayden Planetarium, put it more simply: **"[Science] is a way of equipping yourself with the tools to interpret what happens in front of you."**

Societies with low rates of science literacy are ill-equipped to make informed decisions related to health, climate change, technology, advances in genetics, and more. Individuals are unable to make fully learned choices on matters that routinely affect us all: Should I get the flu vaccine? Is my tap water safe to drink? How much sun exposure is safe for me? This knowledge gap has the potential to adversely affect both their quality of life and their sense of security and confidence. A lack of scientific literacy also makes it easier for people to fall prey to misleading information, as we have seen during the COVID-19 pandemic. Moreover, on a policymaking level, inadequate scientific literacy—or the willful choice to ignore science—too often results in decisions and regulations based on ideology or political convenience rather than objective truth. In some circumstances, this poses a very real danger to the public health.

Society and science: Better understanding the relationship

Earlier this year, PMI commissioned an online survey* by independent research firm Povaddo. Fielded in June–July 2020, the survey was completed by 19,100 adults in 19 countries and territories across Europe, Asia, the Americas, and Africa. Our intent was to better understand people's interest in science, their access to and understanding of scientific information, and how they rate various sources of scientific knowledge.

This paper details these findings and explores the potential consequences of science not being leveraged to its full potential. The findings make clear that the world's citizens want governments and public authorities to prioritize science and fact over ideology, politics, and unsubstantiated beliefs. When authorities fail to do so, opportunities for progress are lost and potential solutions to critical global challenges—from climate change and COVID-19 to tobacco harm reduction—are hindered.

* See appendix for the complete survey methodology.

Our intention is for this white paper to spark a broader conversation about the role of science, the importance of science-based decisions, and opportunities for progress. When science is not leveraged to its full potential—when the public and government officials are denied access to accurate, easy-to-understand, and non-misleading scientific information—a gap is created that allows ideology, politics, and unsubstantiated beliefs to take precedence over facts. This impedes progress at a time when the world is facing multiple existential threats, most notably climate change and the novel coronavirus pandemic. As shown by the results of this study, the world's citizens want science to sit at the heart of decisions impacting them. Leaders in government and business should heed this call to action.

Among the key findings of the study:

Faith in science is high. Most people surveyed (77 percent) are hopeful that advances in science ultimately will solve many of the world's most pressing problems.

The vast majority of those surveyed (84 percent) want their governments to take the latest scientific evidence into account when making policy decisions, but governments are not meeting expectations. Just over half of the respondents believe their governments are doing a good job of ensuring that science informs their decision-making processes.

Most of those surveyed (79 percent) have a keen interest in science—as evidenced by their tendency to seek out additional information when scientific developments are announced—but nearly half (48 percent) find it difficult to access reliable scientific information. Here again, governments receive poor marks, with 41 percent of the sample indicating that their officials are doing a poor job of communicating unbiased and reliable information about the latest scientific developments and studies. (Only 10 percent of the sample feel strongly that governments are doing a good job of sharing such information.)

Views are split on whether society accords sufficient respect to science today. While 45 percent of the sample believe society places sufficiently strong importance on science, 47 percent disagree.

There also is strong interest in businesses prioritizing science, with 90 percent of respondents saying it is important to them that businesses invest continually in science to improve their products, and 87 percent indicating that they look more favorably upon those businesses whose products are supported by robust science.

Why does a tobacco company care about scientific literacy and public interest in science?

PMI is undergoing a fundamental transformation into a science- and technology-powered company with the aim of delivering a smoke-free future—a future without cigarettes. With the right regulatory encouragement and support from civil society, we believe this goal can be achieved in many countries within 10–15 years.

The best choice for any smoker is to quit tobacco and nicotine use altogether. However, many will not quit. Our corporate mission is grounded in moving those adult smokers who would otherwise continue to smoke away from cigarettes to the scientifically substantiated better alternatives that are now available. We are proud to report that, as of June 30, 2020, an estimated 11.2 million smokers around the world have already changed to PMI's heat-not-burn product and stopped smoking. Our aspiration is that by 2025, at least 40 million adults who would otherwise have continued to smoke will have changed to PMI's smoke-free products.

Scientific literacy plays an important role in educating policymakers about these better alternatives and the role they can play in tobacco control and harm reduction.

Delivering a Smoke-Free Future

Since 2008, Philip Morris International has invested billions of dollars in developing, testing, and manufacturing better alternatives to cigarettes. These smoke-free products, which include heated tobacco and e-vapor products, are the result of nearly two decades of R&D work, underpinned by a rigorous scientific assessment program and led by a team that today includes more than 430 world-class scientists and other experts. We make our scientific findings and methods available for others to scrutinize, we invite independent research into our products, and we encourage a broad, science-based conversation with regulators, scientists, and the public health community about the best way to make these products available to adult smokers while minimizing unintended use. The best choice a person can make is never to start smoking or, if they do, to quit tobacco and nicotine use entirely. Our smoke-free products are intended for those existing adult smokers who would otherwise continue to smoke.

#02
WHY NOW? SCIENCE MOVES FRONT AND CENTER

Has there ever been a better time than 2020 to explore public interactions with science? Every day, science and scientists feature prominently in the news. As public authorities and news organizations scramble to deal with the novel coronavirus, they are relying more than ever on the expertise of specialists whose work normally takes place behind the scenes. During this pandemic, the activities and opinions of virologists, microbiologists, epidemiologists, pharmacologists, and data scientists have been thrust into the spotlight, as many governments have made a point of showing how their policies are being guided by science. Some of the specialists they consult have even become media phenomena. No wonder. It has been a long time since there has been a public health threat of such immediate concern to such a large swath of the world's population. It has been a long time since a public health threat has shut down entire countries and industries for months, with the prospect of many months more.

The hundreds of millions of people confined to their homes during lockdowns have had plenty of time to go online to check out the science of epidemics in general and COVID-19 in particular. There has been plenty to look up. A number of scientific journals and prominent news brands have made their COVID-19 stories accessible to nonsubscribers at no charge, and social media platforms have been full of links to media coverage. Online and offline, people have been discussing technical issues such as R0 numbers, case fatality rates, herd immunity, viral load, PCR and antibody testing, and the effectiveness of face masks. In the space of just a few months, many millions of nonscientists have learned more—or at least heard more—about these and other technicalities than they had previously in their entire lives.

With one eye to the present and the other to the future, we think it is an appropriate time to explore public attitudes toward science.

The pandemic has placed science front and center in policymaking, media discussions, and everyday life. It has reminded people of the role science can play in solving some of the world's most significant challenges. And it has brought forward pertinent questions around the evolution of scientific knowledge, the understanding of scientific facts, and how science can better inform our decisions. With one eye to the present and the other to the future, we think it is an appropriate time to explore public attitudes toward science and reflect on the opportunities that exist for our world to leverage the full potential of the discipline, as well as the speed bumps in the way.

#03 EXPECTING SCIENCE TO COME TO THE RESCUE

"Any sufficiently advanced technology is indistinguishable from magic."

Arthur C. Clarke,
author, inventor,
and futurist

We live in a world in which the miraculous is mundane, a world that to any time traveler from the past would seem to be full of magic. Thanks to the application of science through technology, we take for granted thousands of gadgets and services that once were the preserve of science fiction. Most of the time, we don't even notice them—at least until they don't work as expected.

In the personal domain, people enjoy many everyday marvels: hand-held computers thousands of times more powerful than those that enabled the Apollo 11 moon landing; high-speed wireless connections; global, multiparty video chats; instant language translation; satellite navigation; and the ability to watch virtually any movie or listen to any music from anywhere at any time. And in specialist domains, many can benefit from such wonders as rapid and affordable DNA sequencing, diagnostic imaging, and remote keyhole surgery.

In virtually all cases, most of us accept these marvels with barely a thought. Seeing something new, we may think, "That's ingenious," but then we quickly move on to the next thing. In virtually all cases, for most of us, the technology is not something we have actively wished for. It's not providing a solution to a serious everyday problem. It just appears, pushed forward by the rapid pace of innovation and expectations that the next thing will come soon. Technological advances have been happening so widely, so fast, and for so long that if a problem does arise, we now expect science and technology to have solutions at the ready, or to invent them quickly.

There is a big divide, however, between the little problems of everyday life and the massive challenges facing the world such as COVID-19, pollution, climate change, water shortages,

deforestation, and species loss. Although these are planet-sized challenges, the respondents to our survey are hopeful that science will provide solutions.

Without mentioning specific issues, the PMI survey asked: *Generally speaking, how hopeful are you that advances in science and scientific developments can deliver solutions to society's biggest problems?* The question was not specific to COVID-19, so these figures cannot be linked directly to thoughts about the pandemic. That said, the survey was fielded in summer 2020, following/during several months of lockdown in many places, with the media regularly speculating on how long it would take for a vaccine to be developed. Therefore, it is reasonable to assume that thoughts of the pandemic were present for respondents as they answered the question.

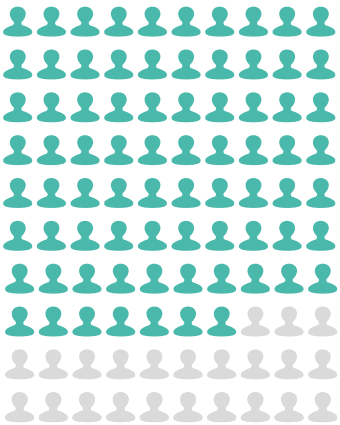
Across the sample, the balance of opinion shows clearly that there are a lot more people who are hopeful about science than there are unhopeful people:

- 77 percent said they are hopeful (including 26 percent who are very hopeful).
- 20 percent are not hopeful (including just 4 percent who are not at all hopeful).

We don't know whether many respondents have specific ideas about how science could be applied to society's biggest problems. What we do know is that they have faith that these problems will be addressed—and ultimately solved—by science and scientists.

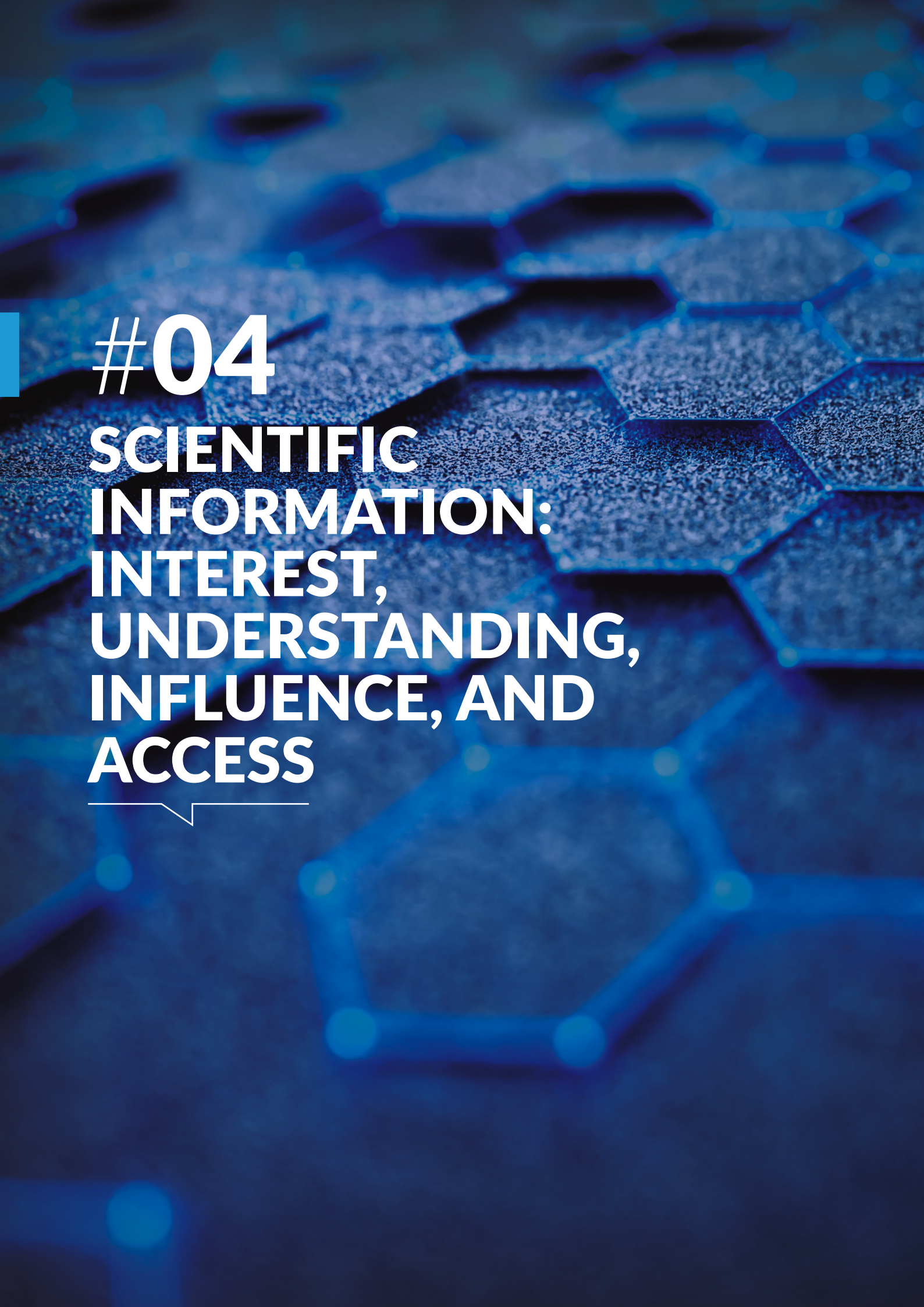
TAKEAWAYS

Most people have high expectations of science. They "believe" in science, just as most people in previous eras believed in higher powers. There is a widespread expectation that science will find a way.



77%

of people are hopeful that advances in science can deliver solutions to society's biggest problems



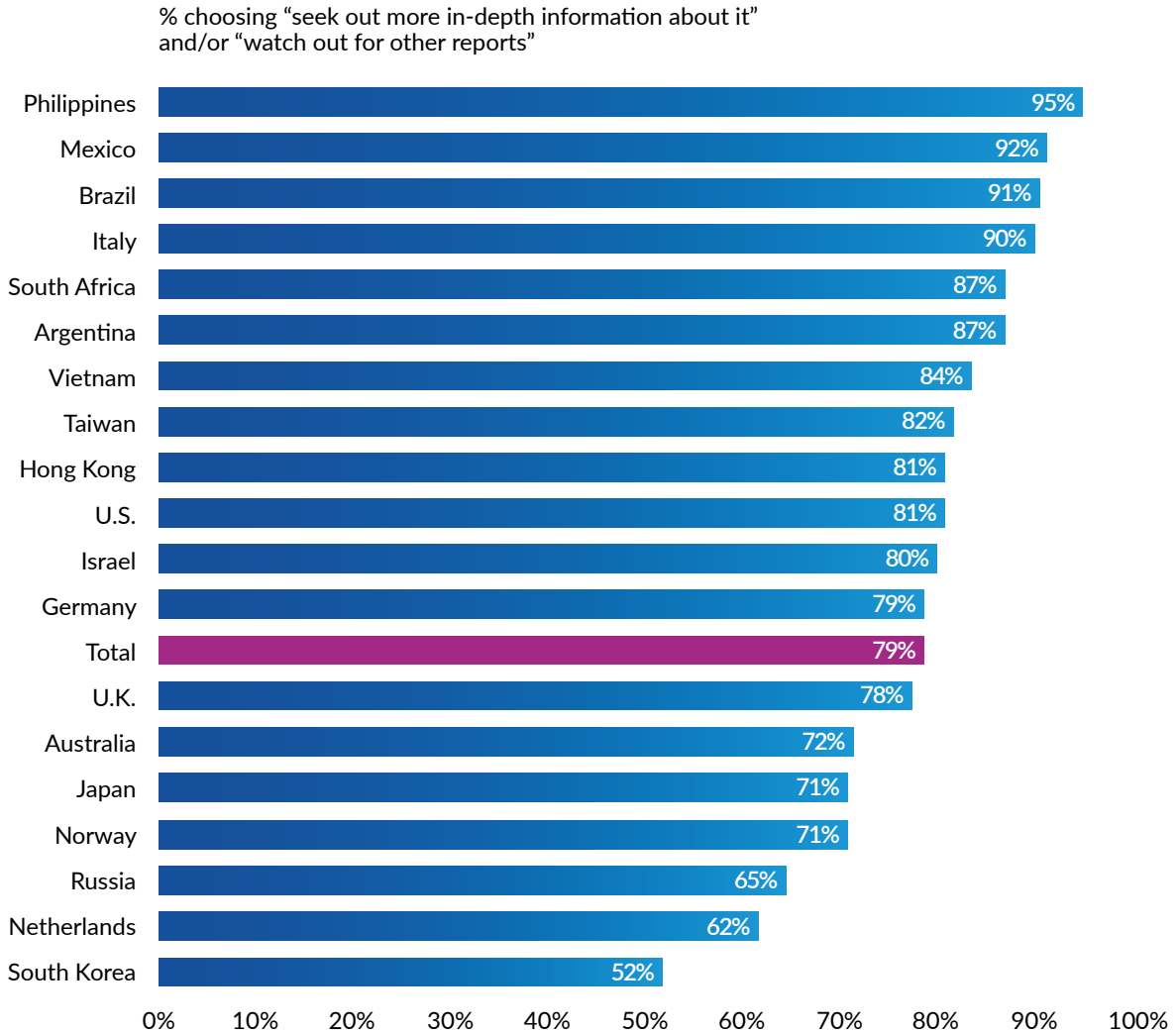
#04 SCIENTIFIC INFORMATION: INTEREST, UNDERSTANDING, INFLUENCE, AND ACCESS

Beyond their expectation that science will provide solutions for the world, respondents expressed strong interest in scientific information—be it scientific developments or new studies. A substantial majority also agree that science influences their personal decisions. Yet, despite this clear desire to look to science for answers, most respondents find it difficult to access scientific information they consider reliable.

Interest in scientific information

To ascertain respondents' level of interest in scientific information, we asked: *When you hear*

When you hear about a new scientific development or study, which of the following do you typically do?



about a new scientific development or study, which of the following do you typically do?

- *Not pay much attention*
- *Watch out for other reports*
- *Seek out more in-depth information about it*
- *Unsure*

As the chart above shows, 79 percent of respondents stated that they typically "seek out more in-depth information about it" or "watch out for other reports." This indicates an appetite for scientific learning.

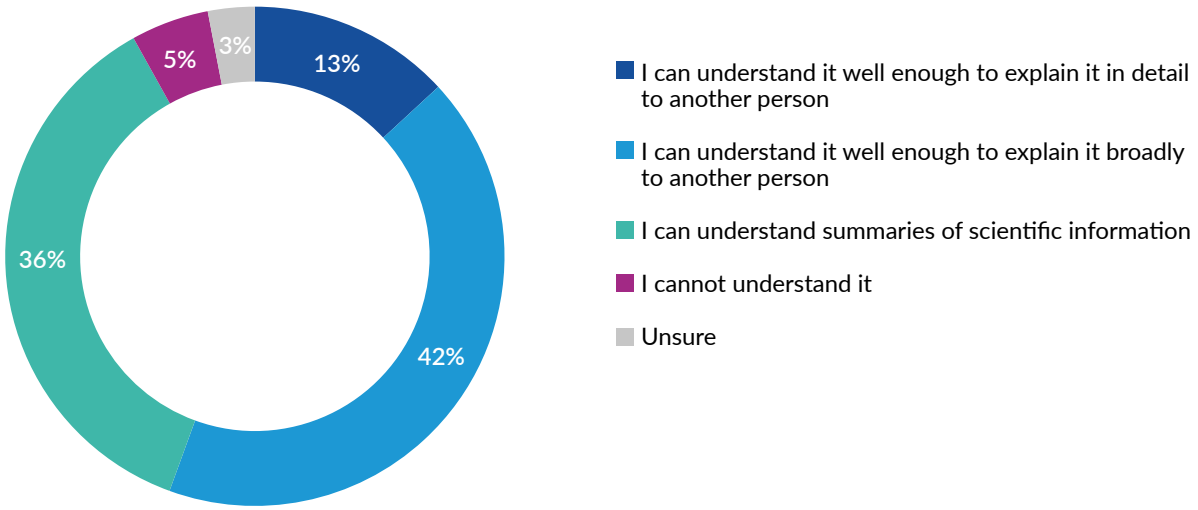
This paper does not delve into detailed analysis of each of the 19 geographic samples covered in the survey. It is potentially illuminating of the bigger picture, however, to compare and contrast the responses of different countries and territories on some issues. For example, while it is striking enough that 79 percent of respondents overall feel this actively engaged, it is even more striking to see that figure exceed 90 percent in the Philippines, Mexico, and Brazil.

Understanding of scientific information

Being interested in scientific information is one thing. Understanding it—especially well enough to explain it to others—is an altogether different matter.

One of the big challenges of presenting scientific information to the general public is determining how to communicate it in an engaging way without "dumbing" it down to the point at which essential nuances are lost. If the communication goes into too much detail, it risks overwhelming people who don't have sufficient knowledge of the field. If, on the other hand, the account is too "big picture," too general, that risks oversimplifying the issue and giving the false impression that the science is complete and

Which of the following best describes your general attitude to scientific information?



unchallenged. As the pandemic has shown, issues of science are far from simple. Even basic recommendations (e.g., use a face mask, maintain social distancing) can cause confusion and, in the current climate, may even be politicized.

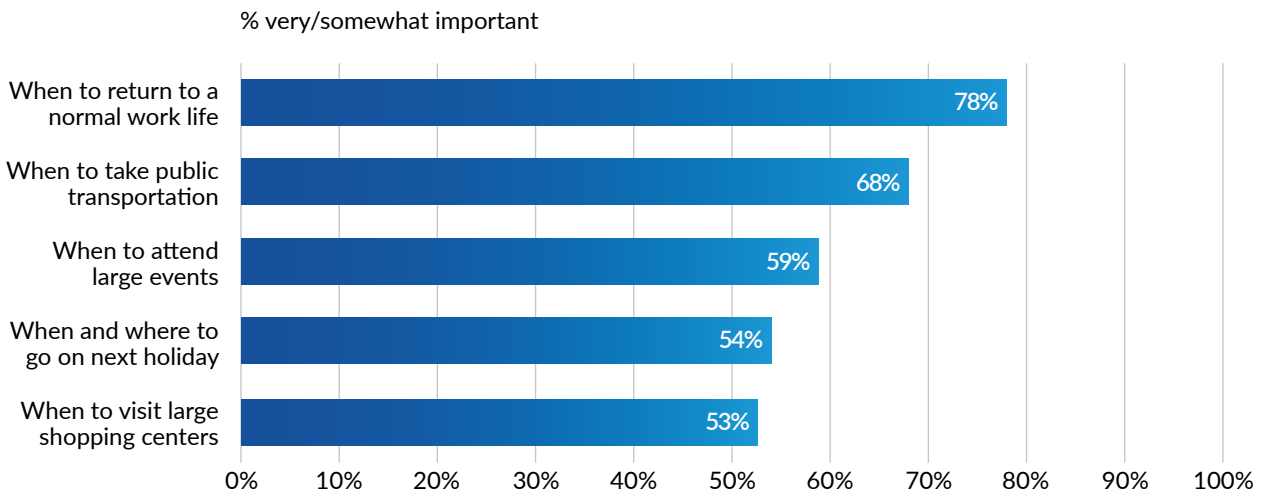
In the PMI survey, we asked respondents to rate their understanding of scientific information. One acid test of understanding a piece of content is being able to communicate essential points of it to someone else. Around one in eight respondents to the survey (13 percent) agreed, *"I can understand it well enough to explain it in detail to another person."* For them to answer in this way indicates a high level of understanding—or at least a high degree of confidence. Over three times as many (42 percent) chose, *"I can understand it well enough to explain it broadly to another person."* Just over one-third (36 percent) were more cautious, choosing, *"I can understand summaries of scientific information."* A small minority either claimed they could not understand it (5 percent) or were unsure (3 percent).

Influence of science on personal decisions

The numbers we have presented so far indicate that majorities in most geographies are interested in scientific information and feel confident that they can understand it well enough to explain it to others. In view of these attitudes, what influence does science have on their personal lives? In particular, we wanted to know how important science would be in influencing people's decisions regarding five actions that may carry risks during the coronavirus pandemic.

A majority of respondents said that science would be important in influencing all five of these decisions. They gave the highest scores to the activities that are the most prevalent in most lives: work and transit.

Please indicate the importance of science in influencing the following personal decisions:

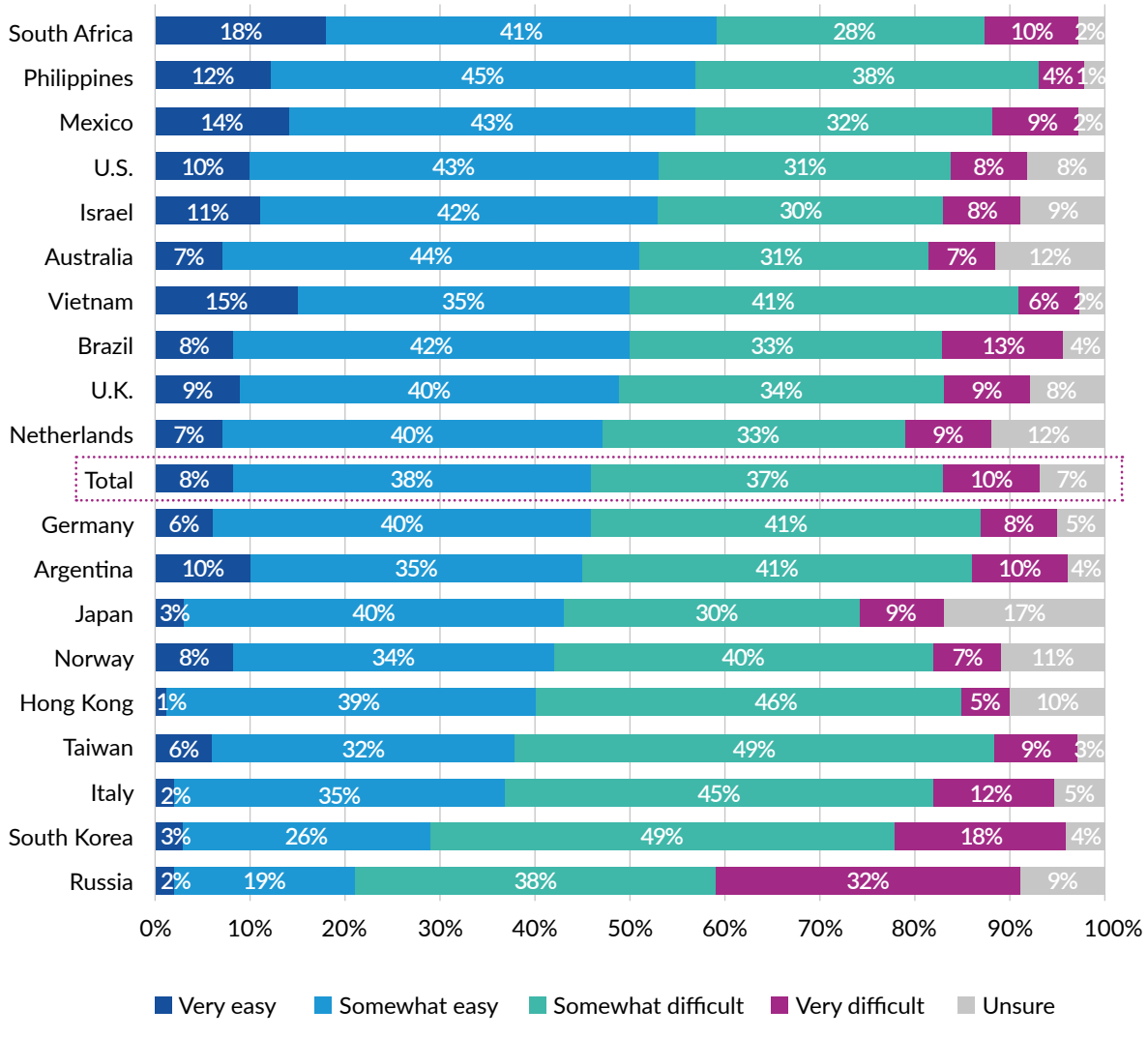


Access to scientific information

It's concerning that, despite significant interest in scientific information, most respondents said they do not have easy access to it. We asked: *Generally speaking, do you find it easy or difficult to access reliable information about the latest scientific developments and studies?* Almost half the sample (48 percent) said they find it difficult, including 10 percent who find it very difficult.

It could be tempting to gloss over this finding, but a closer look at what is at stake when people have to make decisions in the absence of reliable

Generally speaking, do you find it easy or difficult to access reliable information about the latest scientific developments and studies?



information allows us to evaluate this shortcoming in a more comprehensive way.

According to the significant body of research exploring human decision-making—and in particular the roles of cognition, emotion, and intuition in this process—human thinking is shaped both by gut feelings and logical analysis. The former is quick, while the latter requires time and thinking based on the facts and evidence at hand.

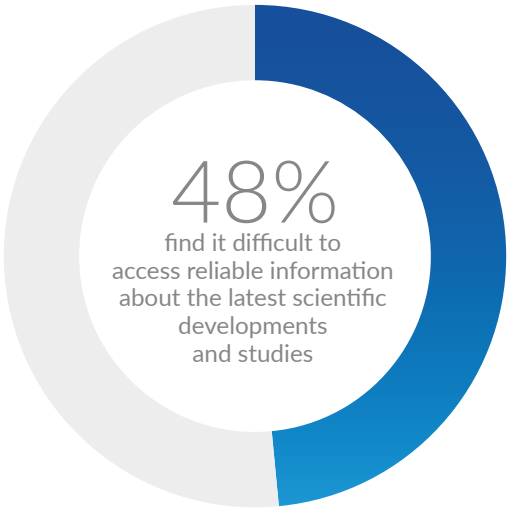
Naturally, in situations where reliable information is scant, we have to rely more on our gut and use mental shortcuts, also known as *heuristics*, to reduce complexity and assist our decision-making. We routinely take an "educated guess" or apply the "rule of thumb" to make decisions that range from figuring out the quickest route to the office during rush hour to selecting a gift for a friend.

Mental shortcuts help us go about our everyday lives. But what happens when we need to make a decision on complex matters for which we lack knowledge, experience, and expertise? Take, for example, decisions around protection during the coronavirus pandemic. If people are not able to access reliable information on the latest scientific developments and data, they will be less capable of analyzing the situation and understanding their options. What's worse, they may resort to unreliable shortcuts to make decisions—potentially including following what the neighbors are doing, what they feel good about doing, or accepting advice from a random Facebook group.

In short, when access to reliable scientific information is limited, people may be more susceptible to misinformation, wild guesses, and hearsay, hindering their ability to make informed choices.

TAKEAWAYS

Most people have an appetite for scientific information, most feel confident in their ability to understand it, and most allow science to influence important decisions in their personal lives. Despite these overwhelmingly positive attitudes toward science, the majority of respondents indicated that they don't have easy access to reliable information about scientific developments and relevant studies—a concerning finding given that, in the absence of such information, biased assumptions or even life-endangering falsehoods may be more likely to influence their decisions.



#05 SCIENCE, SOCIETY, AND INSTITUTIONS

"There are in fact two things, science and opinion; the former begets knowledge, the latter ignorance."

Hippocrates

Over centuries, scientists have played an increasingly central role in everyday life, helping us uncover truths about the world and accumulating knowledge that is fueling progress in every aspect of life—from medicine and environmental management to the food we consume and the textiles we use to make our clothes. Galileo Galilei, Isaac Newton, Charles Darwin, Louis Pasteur, Marie Curie, Albert Einstein, and Nikola Tesla are just a few of the many scientists who have come to figure in popular culture. Their names and their discoveries are part of the story of the modern world.

The scientific approach to understanding the world, with its methodical questioning, empirical observations, experimentation, and testing of hypotheses, has gradually eclipsed unquestioning belief-based approaches of religion and tradition. Some religious leaders assert that science and faith are not incompatible; for example, Pope Francis and his statements concerning the theory of evolution and the Big Bang or the Dalai Lama calling for collaboration between science and religion.

On the other hand, a growing anti-science mindset is contesting the findings of science and even its legitimacy. The anti-vaccine and, more recently, the anti-mask movement are telling examples of how personal beliefs or ideologies can shape people's decisions, even in the face of scientific evidence to the contrary.

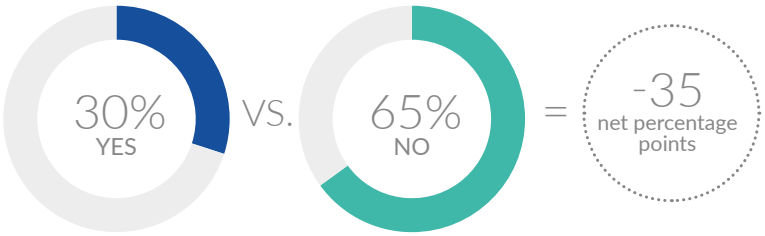
Nevertheless, it is clear from our survey that majorities in these 19 countries and territories align themselves with science. They are interested in it, they are confident they understand it, and they say their decisions are influenced by it. But do they think others in their societies have similarly respectful views of science?

The importance accorded to science

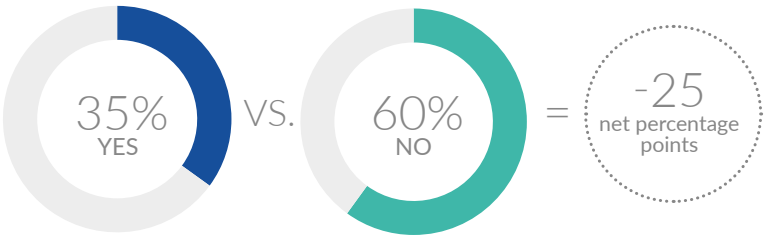
In our survey, we asked respondents: *Generally speaking, do you feel like society places a strong enough importance on science?* The global sample was almost evenly split, with 45 percent answering "yes," 47 percent answering "no," and 8 percent unsure. The fact that a majority of respondents don't think society appropriately respects science or are unsure indicates a significant gap between the importance they ascribe to science and how it is perceived by the broader society.

The patterns of response varied widely between and within countries. The only discernable regional pattern is in Latin America, where the perception that society does not place a strong enough importance on science is especially pronounced.

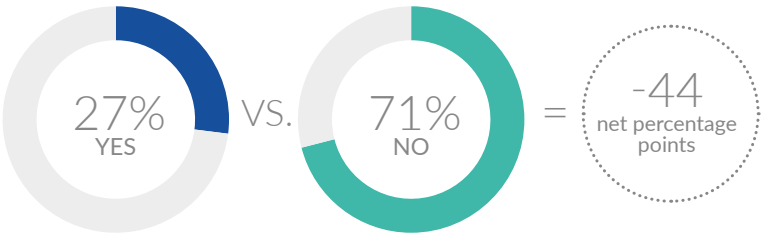
Argentina



Brazil



Mexico



Trust in sources of scientific information

The great majority of people are not scientists. They don't have the training and may not have the time to search out original scientific research and determine its value. And so they rely on third parties for information. But which sources do they trust?

We asked respondents how much they trust each of 10 individuals and institutions to provide unbiased and reliable information about the latest scientific findings.

Ministries or departments of health came out on top as most trusted, with around two-thirds of respondents trusting them completely or somewhat to provide unbiased and reliable scientific information. Fewer respondents gave high marks to the person in charge: the minister of health (59 percent). Perhaps this reflects the fact that the ministry/department is an institution composed of many people who between them have a lot of experience. The minister, by contrast, typically is a political appointee and may or may not have much relevant health and/or scientific expertise.

Similarly, trust in the World Health Organization (WHO) is higher (63 percent) than in the WHO leadership (58 percent). The same pattern pertained to the lowest scoring of the 10 sources: Just 42 percent trust the media to convey accurate scientific information, and slightly fewer (39 percent) trust journalists.

Science in policymaking

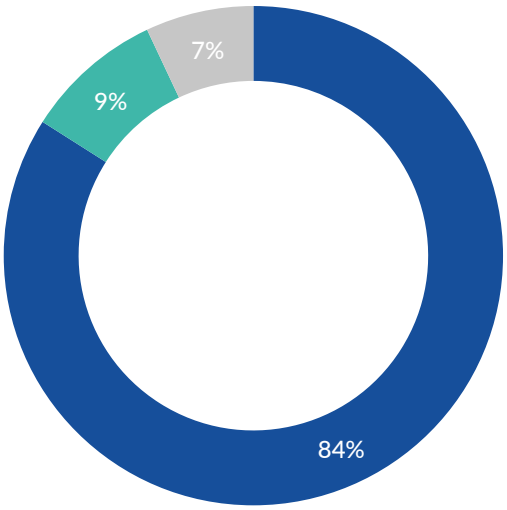
The principle of science-based policymaking seems straightforward—after all, why wouldn't officials apply available scientific evidence to policy decisions? In most cases, they do, as we have seen in the formulation of policies to mitigate climate change (e.g., Paris Agreement, science-based targets to cut greenhouse emissions). In other instances, such as tobacco harm reduction, science may be eclipsed by politics or dogma in some quarters.

The COVID-19 crisis has given even greater prominence to the crucial role that science can and should have in informing policy decisions. Unsurprisingly, many governments have been keen to show that they are formulating policy in close consultation with scientists.

The PMI survey included this request: *Please indicate whether you support or oppose the government ensuring the latest scientific developments and studies are taken into account when making policy.* Overall, 84 percent support it (including 39 percent strongly), while just 9 percent oppose it—an emphatic show of support. This question did not refer explicitly to COVID-19, although respondents may well have had the novel coronavirus in mind.

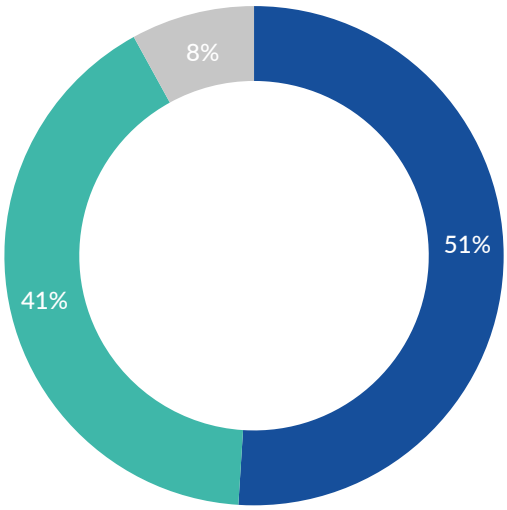
Yet despite this widespread support for bringing science into policymaking, only 51 percent rated their government as doing a good job of ensuring that science and scientific evidence are included in decision-making processes. Meanwhile, around four in 10 respondents (41 percent) think their governments are doing a poor job of it. They're not alone: In 2018, 180 science organizations came together to form the International Science Council with the intent of increasing the role of scientific evidence in public policymaking and "advanc[ing] science as a global public good."

Do you support or oppose the government ensuring the latest scientific developments and studies are taken into account when making policy?



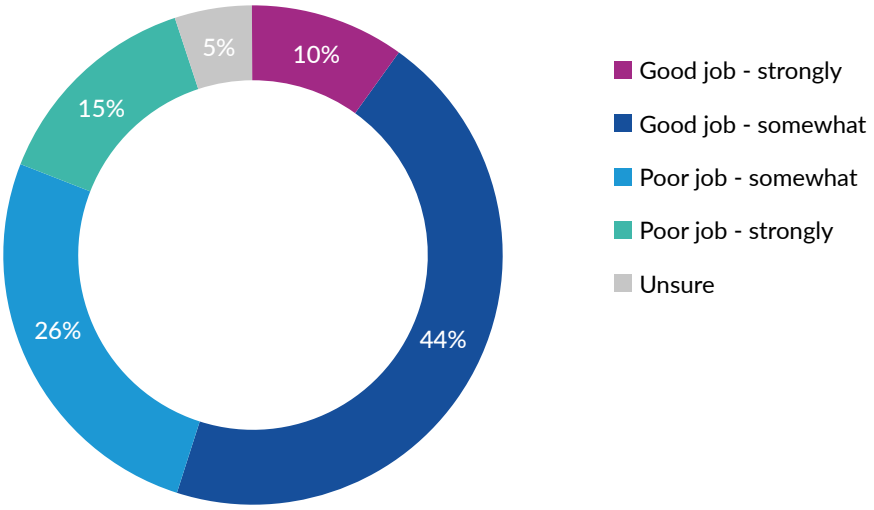
VS.

Do you believe your government does a good job or a poor job ensuring science and evidence are included in the decision-making process?



Similarly, only a slight majority (54 percent) of respondents indicated they think their governments are doing a good job when asked: *Do you believe your government does a good job or a poor job communicating unbiased and reliable information about the latest scientific developments and studies?* A hefty minority of 41 percent rated their governments poorly on this measure.

Do you believe your government does a good job or a poor job communicating unbiased and reliable information about the latest scientific developments and studies?



These findings show that policymakers and regulators have more work to do if they want to meet society's expectations of how science should be leveraged to shape policies and decisions.

Beyond looking for objective facts and assessing the totality of available evidence to inform their decisions, it is equally important for policymakers to debate the data openly and transparently, and to do so while being clear about both implicit and explicit biases. Moreover, when policymakers are guided by robust science, it is in their interests to provide access to science content that explains and justifies their policy decisions. It's comparable to math exams, where it is not enough for the student to simply give the final answer. Examiners want to see the workings—the process whereby the student came to the answer. Only then can they properly judge the value of the result.

In addition to the inherent benefits of transparency and productive debate, such an open approach to science and evidence allows stakeholders to follow along throughout the process and to be better positioned to both provide input and understand the logic of the resultant policy decisions.

Science and business

Given the value most respondents accord to science, it comes as no surprise that clear majorities are keen for businesses to prioritize the discipline. The survey asked respondents to rate their agreement with several statements relating to this topic.

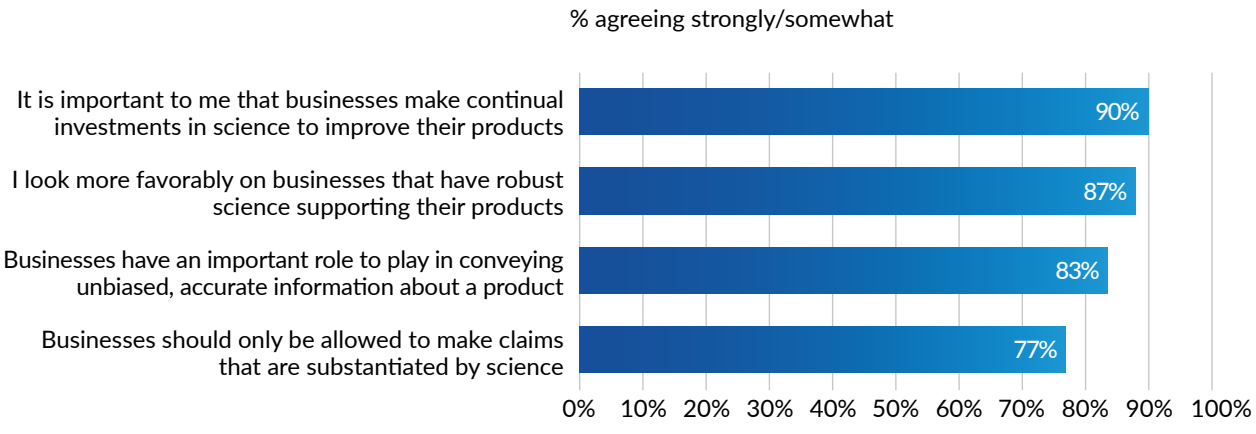
They were almost unanimous (90 percent) in agreeing: *It is important to me that businesses make continual investments in science to improve their products.*

Almost as many (87 percent) agreed: *I look more favorably on businesses that have robust science supporting their products.*

A similarly high majority (83 percent) agreed: *Businesses have an important role to play in conveying unbiased, accurate information about a product.*

A clear but smaller majority (77 percent) agreed with a stricter statement: *Businesses should only be allowed to make claims that are substantiated by science.*

The survey responses make it clear that today's consumers want businesses to invest in science and rely on it in manufacturing and promoting their products. In a portion of the survey not directly pertaining to science, we presented respondents with a set of issues related to the economy, the environment, public health, and income inequity. In addition to addressing these issues directly, 68 percent of the sample would like to see governments encourage private businesses to develop their own solutions to these global issues. This is yet more evidence of the heightened role business is expected to play. And with 85 percent of respondents stating that businesses should develop science-based solutions to some of the biggest problems facing society today, the expectations are clear for science to sit at the center of many of these efforts.



TAKEAWAYS

Most people feel positively about science and would like society to accord greater importance to it. In particular, they want businesses to be more engaged in developing, communicating, and respecting science. A large majority support governments taking the latest science into account in policymaking, but barely more than half think their government is doing that.

#06
THE ROLE OF SCIENCE CONTENT IN SHAPING INFORMED DECISIONS

In pre-pandemic times, rarely a day went by without media flagging some kind of science-related news ("New research shows …"). Sometimes this news is about obscure subjects such as black holes in deep space, ancient fossils, and nanotechnology. However, much of the time, science is shared via stories that are immediately relevant to virtually everybody.

While our survey shows that public interest in science is strong, there has been a trend away from "serious" science journals toward more general-interest scientific news, which offers more scope for pseudoscience and hype.

Given the importance of science in modern life, it is worthwhile to dig a bit deeper into the coverage and communication of science and to ask some questions.

There has been a trend away from "serious" science journals toward more general-interest scientific news.

What motivates people to follow science content?

The survey confirms that people take a strong interest in science. But what motivates them to follow scientific news and developments in an era in which one's choice of media content is virtually unlimited? It comes down to a mix of interest and self-interest.

Science related to health is of near-universal interest because it affects everyone. If we don't have a particular ailment now, most of us are at least curious about how to avoid developing it. Now, in the era of COVID-19, interest in health information has escalated, as people look for information on mitigation tactics and potential breakthroughs that offer hope of beating the virus and making it possible to get back to something resembling "normal" life.

Public interest in the environment also has grown as the topic has become more relevant to our everyday lives. Air pollution, for instance, has become a big worry for people all over the world. Throughout 2019, global action kept the environment in the headlines, abetted by regular occurrences of "extreme weather," with its too-often-devastating impacts. In 2020, coverage of the lockdowns has included stories on how the natural world seems to have benefited from the break in human activity—the so-called "anthropause."

Technology, too, is of widespread interest. People often want to know not just about the latest tech gadgets, but also about their social implications and potential health risks.

One would hope that the consumption of scientific information (when accurate) would help people to make better choices. And sometimes it does. For example, increased awareness of the health and environmental benefits of organic food and beverages

arguably is among the reasons for the sharp growth in global sales in this category, from less than $116 billion in 2015 to an anticipated nearly $328 billion by 2022, according to Allied Market Research. However, we know all too well that poor dietary choices continue to contribute to rising rates of obesity and cardiovascular disease, among other afflictions, demonstrating that scientific knowledge may not necessarily translate into meaningful action.

Science content can and should aim to help achieve better outcomes, including in the realm of public health.

What is needed from providers of science content to enable people to make better-informed decisions?

From the media side, at an absolute minimum, science coverage needs to contain sound information that is grounded in robust empirical work conducted rigorously in accordance with established scientific principles. This means, among other things, that it should not mislead people—for example, by using headlines created to grab attention while misrepresenting the details of the work being reported. Research from Cardiff University in the U.K. reveals that exaggerations in news coverage on topics related to public health tend to stem not from the research itself but from the press releases the scientists or organizations crafted or approved. The authors assert that the cumulative effect of such exaggerations can damage the reader's understanding of the health matter being reported.

Alongside the ethical dimension comes quality of content. Some science content is brief and simple. Some is long and detailed. Either way, at whatever degree of complexity it is communicated, it should present the most reliable knowledge available on the subject. The deeper the level of complexity, the more it should reflect the nuances that are the mark of honest and balanced scientific reporting (e.g., sample size, margins of error, limitations of current knowledge and applied methodologies, acknowledgment of different opinions). The lower the level of complexity, the more it should guard against the risk of people coming away with overly simplified or misleading interpretations.

Moreover, science content should make clear what the implications of the content are for the reader/viewer in concrete terms, as well as what actions they might consider taking and choices they could make in light of these implications.

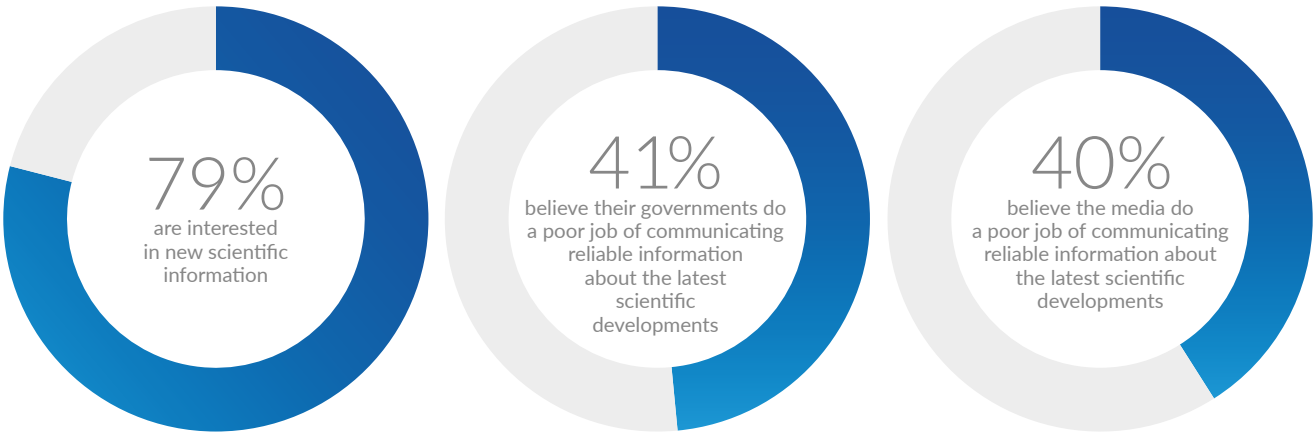
Content providers should also be cognizant that some scientific terms have a completely different meaning when used by nonscientists. For example, the word *theory*. In science, it's "a well-substantiated explanation of an aspect of the natural world that can incorporate laws, hypotheses, and facts." For nonscientists, a theory is merely a hunch or a guess without a solid body of supporting evidence. Similarly, the concept of "uncertainty" can also express different meanings. In science, almost nothing is regarded as absolutely certain in all conditions. When scientists talk about uncertainty, they are referring to "the range of how confident they are in their findings or their measurements." When nonscientists use the word, it means they don't know something or doubt it.

What conditions will give science content the best chance of positively influencing behavior change?

For consumers of science content to achieve better outcomes, they must not only have easy access to quality information but reason to trust it. It is critical, therefore—especially in the health space—that public authorities and media platforms work to expose and, to the extent they can, eliminate fraudulent and unfounded assertions. At the same time, people need to be educated on how to assess the veracity of scientific information. This must include the ability (and desire) to differentiate between science content promoted by a celebrity or activist and science reports based on empirical, peer-reviewed work.

TAKEAWAYS

Science content can aim to do more than keep people informed. It can aim to provide more robust information so that people can make better-informed decisions.



#07
THE DANGERS OF BAD SCIENCE

What are the practical consequences of people being unable to differentiate between solid information and misinformation? What dangers lie in the public being denied access to unbiased and up-to-date scientific findings?

When interest in science goes wrong

The anti-vax movement provides a sobering case history of how the public interest in science can lead to negative outcomes. Although opposition to vaccination goes back to the 19th century, it is the anti-MMR (measles, mumps, rubella) version that has been having a big impact in recent decades.

In 1998, the British medical publication *The Lancet* published a paper linking the MMR vaccine to autism. The story ran for five years, garnering widespread coverage until an investigative journalist published an exposé in 2004. The paper was retracted by the coauthors and the publication 12 years after its initial appearance, but by then vaccination rates had dropped significantly. Even today, rates in some countries are still below those needed to prevent group infections, as some people reject vaccinations outright and others hesitate too long. Now measles is resurgent.

The anti-vax movement may turn out to be still more impactful as governments attempt to deal with COVID-19. According to media reports, even as researchers are racing to develop vital vaccines, some conspiracy theorists are alleging that a vaccine against COVID-19 fits into an Orwellian government masterplan.

Importance for public policy

The COVID-19 crisis illustrates why public interest in science matters. People's interest and understanding of why policies are proposed affects their willingness to support the policies politically and adhere to them in practice.

In most instances, the effects of public policy take years or even decades to become evident. For example, the mandatory use of seat belts—a standard feature in cars today and probably one of the most common safety devices in modern history—was at first fiercely contested by segments of the population in the U.S. and elsewhere. But as research and data on road fatalities accumulated over the decades that followed, the initial claims that seat belts were ineffective, inconvenient, and uncomfortable have been dismissed for good.

On the other end of the spectrum, bad science—intentional or not—can limit opportunity for progress. In the U.S., an August 2020 Gallup poll showed that one in three Americans would not get the COVID vaccine if available today. Among the naysayers are anti-vaxxers, those who refuse vaccinations, but also a growing number of citizens who have lost trust because of perceived politicization of the science.

The real risk—similar to what we see in the field of better alternatives to cigarette smoking—is that, without thorough research and review, "junk science" is being used to set political agendas. In the field of tobacco and health, poor-quality science is being used to sway the public against alternatives to cigarettes despite good-quality science showing that such products are a far better choice for adult smokers than continuing to smoke. Because of this interference, policymakers in many countries are opting to stick with the status quo. They are still allowing the sale of cigarettes—the most dangerous form of nicotine consumption—while banning or restricting the sale of scientifically substantiated better alternatives. Good policymaking requires that ideology and personal beliefs be set aside and that all of the evidence be dispassionately evaluated.

#08
CLOSING THOUGHTS: TURNING INTEREST INTO PROGRESS

"While we will not all become scientists, we can certainly learn to think like them."

Jacek Olczak,
Chief Operating Officer,
Philip Morris International

At first blush, it is encouraging that so many people identify themselves as interested in scientific information, as keen to find out more, and as able to understand and explain it. However, displaying this apparently pro-science attitude does not necessarily mean that they are "thinking like scientists"—methodically gathering a range of evidence and evaluating it critically. They may equally—or more probably—be looking for information that confirms what they already think or wish to believe.

In an ideal world, people with an appetite for scientific information will identify which media outlets rely on trustworthy sources to create solid stories. They will take the time to follow up references in the stories. They will take advantage of the wealth of sober, high-quality scientific content available, and they will dig into it in a spirit of open but critical curiosity. In a less-than-ideal world of widespread doubt and mistrust, unfortunately, many people with an appetite for scientific information will be led astray. Sensationalist pseudo-scientific content abounds online—"alternative" views that make a virtue of running counter to "mainstream" science.

Content providers intent on ensuring that accurate information reaches its intended audiences face a daunting challenge: They must square the joint needs for both scientific rigor and broad comprehensibility. "Upstream," the information is likely to involve complex calculations and technical nuances that must satisfy peer review. "Downstream," the information must be presented in a way that enables end users to draw accurate and actionable conclusions from it. It must also make clear that scientific opinions in complex areas are often provisional. They are based on the best information available at the time and may change in the light of new findings.

For nonscientists who think that science is "supposed to" offer proof and definitive answers, it may be hard to understand and accept that "the science" is likely to change. This leads to another challenge: being transparent and earning trust.

Unless they are willing to dig very deep, most people must be able to trust that the scientific information being presented to them has been generated using rigorous methods. They must be confident that the information is being presented in good faith, with the intention to inform, not confuse or deceive. Any faltering in their trust makes people more vulnerable to the risks of competing information.

Exacerbating the problem: Some search and recommendation algorithms rank information sources online by popularity rather than integrity. This means that peripheral and even discredited scientific information can gain currency among people who are suspicious of established science. As growth in the number of anti-vaxxers and other conspiracy-minded citizens has shown, misinformation and disinformation masquerading as science may be harnessed for ideological purposes—especially when it is promoted by influential groups. This raises the risk of people making choices that are objectively, measurably detrimental to their own interests and/or to the wider society.

Reinforcing public trust in science

At PMI, we believe that public access to good-quality scientific information is critical. Only through unfettered access to such information can people make informed choices based on facts rather than gut feeling or ideology. At the same time, we must recognize that such access is not sufficient on its own. Many people reject mainstream scientific information even if it's accessible, not because it is of poor quality, but because it goes against what they are committed to believing. Addressing the problem of "society rejecting facts," *Science Daily* advocated: "Our common goal should be to return public trust in our research enterprise, which has done so much good for so many. [...] The more we can do as scientists to promote our guiding principles of rigor, transparency, honesty and reproducibility and to provide the best evidence possible and get people to understand [it], the greater the likelihood that they will listen to the message and follow it."

It is entirely possible that two people will systematically examine the same robust scientific information and come to different conclusions. In the scientific world, it is expected that thinking will evolve, that consensus will change as new information and evidence emerge. After all, science often advances when a prevailing point of view is challenged and shown to be wrong. And no matter how difficult it may be to let go of long-held beliefs, the scientific mindset shows us the way. Consider Albert Einstein's "cosmological constant"—his belief that the universe was static, based on the prevailing wisdom and knowledge at the time. Some claim that he later called this view the "greatest blunder" of his career. For Einstein, the idea of an expanding universe didn't fit with his view of how the universe acted, but after listening to evidence from astronomers such as Edwin Hubble, he eventually admitted his error.

Food for thought

For scientists and others interested in science, this is a golden age. Never before in human history has so much information been so widely available. This poses immense opportunities, daunting challenges, and some risks.

Our survey results show that people all over the world value scientific information and want public authorities to do a better job of incorporating science into policymaking. They also would like to see governments better communicate unbiased and non-misleading scientific information. Transparency and open debate are vital.

Governments, policymakers, business leaders, and citizens alike have a unique opportunity today to elevate science and scientific knowledge as a reliable force for good. Progress will depend on our collective ability to objectively examine the facts, move past our biases, and open ourselves to new ways of thinking. We must all work together to ensure that the policies our governments are instituting do not run counter to objective truths.

"The greatest obstacle to discovery is not ignorance—it is the illusion of knowledge."

Daniel J. Boorstin,
Historian and Librarian
of the U.S. Congress

APPENDIX

Survey details

Povaddo conducted this study on behalf of PMI between June 25 and July 8, 2020. The survey was fielded among general population adults ages 21 and older in 19 countries and territories: Argentina, Australia, Brazil, Germany, Hong Kong, Israel, Italy, Japan, Mexico, the Netherlands, Norway, the Philippines, Russia, South Africa, South Korea, Taiwan, the United Kingdom, the United States, and Vietnam. For the overall sample, there is a margin of error of +/- 0.72% at the 95% confidence interval.

Various safety restrictions to stop the spread of COVID-19 were in place around the world at the time of fieldwork; for this reason and in an effort to ensure the safety of all participants, all fieldwork for this project was conducted online. Therefore, these results are representative of the online adult population in each country, meaning the portion of the adult population in a given country that has personal and routine access to the internet.

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